



TIGER CONSERVATION PLAN

MANAS TIGER RESERVE (2014 to 2024)

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Submitted by

Field Directorate, Manas Tiger Project
GOVERNMENT OF ASSAM

Barpeta Road, Assam

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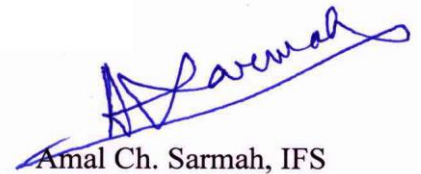
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Amal Ch. Sarmah, IFS

Field Director,

Manas Tiger Project

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EXECUTIVE SUMMARY

Manas with its spectacular landscape, is one among most stunning pristine wildlife habitats in the world. The area has a unique distinction of being Natural World heritage site, a Tiger Reserve, an Elephant Reserve and Important Bird Area.

Manas Tiger Reserve, one of the first batch of nine Tiger Reserves declared on 1st April, 1973 under the aegis of “Project Tiger” had a core area of 391 sq. km. with legal status as sanctuary declared in 1928. The erstwhile Manas Wildlife Sanctuary encompassed part of Monas RF (120.00 sq. km.) and North Kamrup RF including 1st addition to NKRF (271.02 sq. km.). Subsequently the area was extended to 500.00 sq km by inclusion of three more Reserved Forests contiguous to the core area and declared as Manas National Park vide Govt. notification no. FRW.55/86/64, dated 7th September, 1990.

The current Tiger Conservation Plan has been designed for the next ten years (2014-2024) and consists of three major parts – Core, Buffer and Corridor Area, and is organised under Part 1 & Part II and Part III.

Within each part, the initial chapters (Part A) describe the existing situation and the past history of management, whereas the later chapters (Part B) pertain to the proposed management.

Manas Tiger Reserve is biologically very rich. It is located in the confluence of 3 major Bio-geographic Zones viz. Lower Gangetic plains (7B), Central Himalayas (2C), and Brahmaputra valley (8A). The core area of MTR being a World Heritage Site, has been providing the universal conservation value towards nature and human being. Besides, Royal Manas National Park of Bhutan is situated in the northern boundary of MTR. This is an international corridor for migration of wildlife between Manas National Park and Royal Manas National Park in Bhutan. The geology of Manas consists of Bhabar tract zone with sandy loam soil with granite and igneous as bed rocks. The ‘Terai’ tract in the south consists of fine alluvial deposits with underlying pans.

The reserve features a mosaic of habitats and represents diverse ecosystems. The Forests of Manas National Park are classified into 6 types in accordance with the classification system of Champion and Seth. Manas National Park harbours 61 species of mammals, 477 species of birds, 42 species of reptiles, 9 species of amphibians, 79 species of fishes and more than 200 species of butterfly and 100 species of invertebrates. Manas NP supports one critically endangered, seven endangered, ten vulnerable mammals; five critically endangered, two endangered, eighteen vulnerable birds and four endangered and nine vulnerable reptiles. Distribution of tiger in the core area of the Manas Tiger Reserve is not uniform in any part of the habitation. The distribution of tiger in the core area i.e. Manas National Park is mainly dependent on the availability of prey species in a particular area.

Camera-trapping has been regularly conducted in Manas since 2006. The systematic sampling to arrive at tiger numbers have been carried out since 2010-11 and the results have been briefly discussed below:

- a) 2010-11: 9 unique individually identified tigers comprising of 5 females and 4 males were photo-captured, during the 4389 camera trap night survey period, resulting in population estimate of 11 (SE 4.91).
- b) 2011-12: 18 individually identified tigers comprising of 6 males and 9 females (3 unidentified) were photo captured, during the 6480 camera-trap night survey period. A total of 184 pictures of tigers were collected during the survey. The exercise also photo captured 4 cubs during the sampling period.
- c) 2012-13: 11 individually identified tigers comprising of 8 females and 3 males (1 unidentified) were photo captured during the 4920 camera trap night survey period. 3 new

individuals were photo-captured which were not captured during 2011-12 sampling. Besides tiger, the camera traps were also able to photo capture all the major predator and prey species present in Manas, which indicates the healthy ecosystem of the area. Other species photo captured includes leopard, clouded leopard, dhole, leopard cat, jungle cat, sloth bear, Asiatic black bear, elephant, sambar, gaur, water buffalo, wild pig, barking deer and rhino.

- d) 2013-14: 11 individuals (10 adults and 1 cub) (9 having both flanks, 9 having left flanks and 11 having right flanks) were captured. Right flank photographs were considered for interim Individual ID. Among the 11 adult individuals, 4 males and 7 females were identified. In addition, a cub was also photo-captured during the study. Along with the tigers, photographs of Clouded leopard and Common Leopard as well as several other species of animals of the park were also recorded.
- e) 2014-15: 15 individuals (14 adults and 1 cub) were photo-captured. Among the 14 adult individuals, 8 males and 7 females were identified. In addition, a cub was also photo-captured during the study.
- f) 2015-16: 11 individuals were photo-captured, out of which 4 males and 7 females were identified.
- g) 2016-17: A total of 25 individuals were identified from the camera trap photo-captures. Among the 25 adult individuals, 12 males and 12 females were identified, while one individual was unknown.
- h) 2017-18: A total of 29 individuals were identified from the camera trap photo-captures. Among the 29 adult individuals, 10 males and 19 females were identified. In addition, a cub was also photo-captured during the study.

The habitat management in the core area of the Manas Tiger Reserve includes the grassland management, artificial management of saltlicks and water hole management prevailed from the past. The management of the grassland is done mainly to create habitat for wildlife and to prevent the occupation of the grassland areas by faster advancing woodland species like *Bombax ceiba*, *Dillenia pentagyna*, *Leea crispa* which may otherwise reduce the grassland areas, the main habitat for the prey species of tiger.

The biodiversity and the outstanding scenic beauty of the Manas National Park, attracts people from far and wide. Annually 5000 – 6000 tourists visit core of Manas TR. Based on current estimates, the total ecotourism zone in the core shall be restricted to constitute around 20% of the core/ critical tiger habitat area, and shall encompass a total road length of approximately 100 km.

There are 62 thickly populated villages on the southern boundary of Manas National Park. The inhabitants of fringe villages belong to different ethnic composition including: Bodo (70%), Bengali (7%), Assamese (5%), Adivasi (5%), and others (13%) includes Muslim, Rabha, Garo, Nepali, Rasbongsi. The native communities of the reserve are socially, culturally and emotionally attached to the area. The livelihoods of the people of these villages are mainly of agriculture based and cattle rearing. Development programmes are not directly focusing on individuals or communities but are benefiting indirectly by providing employment, developing infrastructure, improving agriculture production etc.

The “zone” and “theme” approaches have been adopted in the proposed management strategies of MTR. Various managerial situations and needs shall be taken care of by an effective combination of the “zone” and “theme” plans. Under this approach, several specific objectives and problems relevant to an identified part of the PA shall be recognized as a “management zone”.

Manas Tiger Reserve is developing into an excellent research place due to its rich flora and fauna, and diverse habitat. Wildlife management is a mix of field craft and science based on field

research. Research will be handled by consultants, research Organizations/Institutes, Universities, individual researchers and competent NGOs. Day to day monitoring of wild life is one of the most important task of the camping staff. All the information is recorded in Camp register daily by patrolling party.

Any plan that is not monitored properly loses focus and fails to meet its desired goals and objectives. A mechanism needs to be developed for time bound evaluation and stock taking of the progress of implementation of the plan as well as for making necessary changes in the plan if required based on ground realities, with proper authorization.

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TIGER CONSERVATION PLAN – CORE AREA

PART A: THE EXISTING SITUATION

CHAPTER ONE

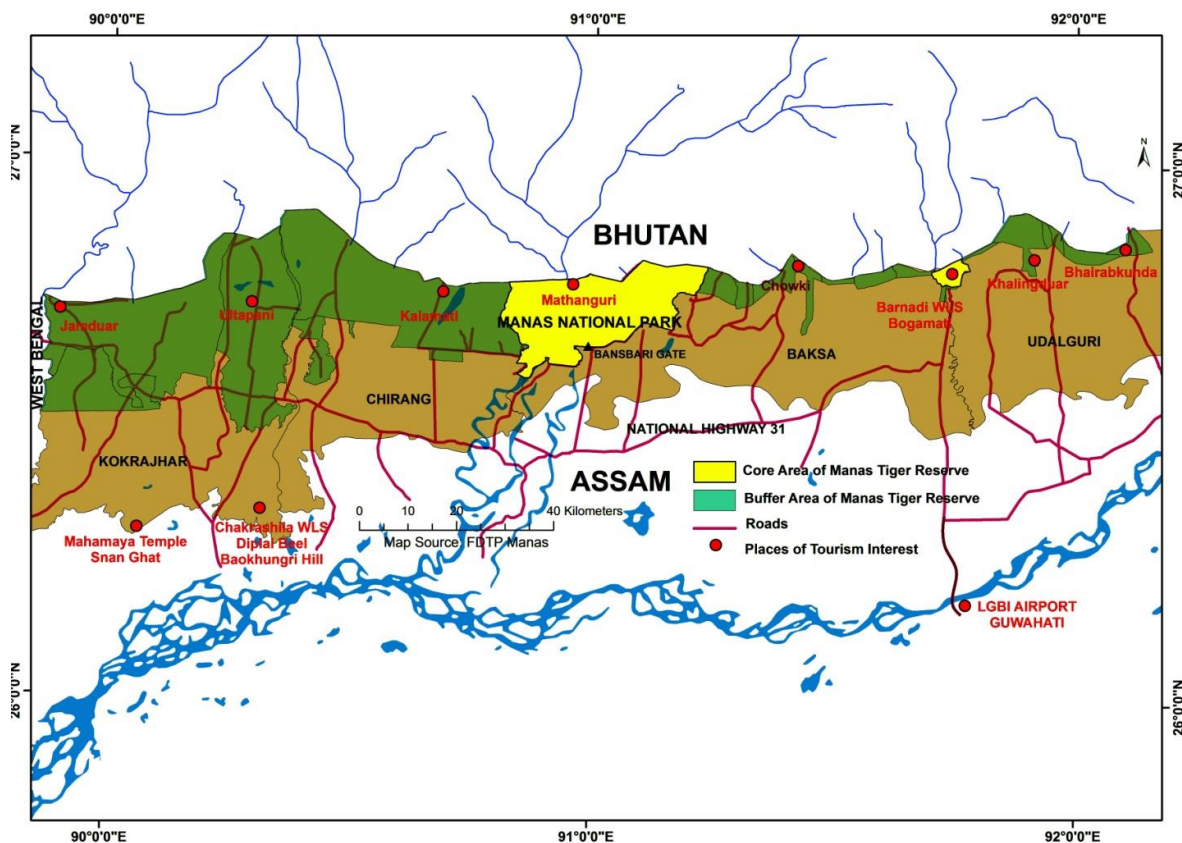
INTRODUCTION OF THE AREA

1.1. Name, Location, Constitution and Extent

The Manas Tiger Reserve is located in the foothills of the Bhutan Himalayas in four districts of Bodoland Territorial Council, Assam, India.

As per Govt. Notification No. FRW. 25/2008/36 dated 30.05.2008, the boundary description of Manas Tiger Reserve extends from the point where the Sankosh river cuts the Indo-Bhutan International Boundary, eastwards to the point where the tri radiate pillar indicates the Assam, Bhutan and the Arunachal Boundaries and from that point eastward and then westwards along the southern boundaries.

Fig 1.1: Location map of Manas Tiger Reserve (core and buffer area) in Assam, India



The core and buffer area of the MTR are as follows:-

Area of the Forest Block	: Manas National Park	= 500.00 Sq. km.
	: Manas National Park (1 st Addition)	= 350.00 Sq. km.
	: Barnadi Wildlife Sanctuary	= 26.22 Sq. km.
	: Reserved Forests	= 1960.88 Sq. km.
		Total areas = 2837.10 Sq. km.

Core Area	: 526.22 Sq. km.
Buffer Area	: 2310.88 Sq. km.
Total = 2837.10 Sq. km.	

The details on the various forest blocks and administrative details are as below: -

Table 1.1: Details of Forest blocks under Manas Tiger Reserve

Sl. No.	Forest Division	Forest Block	Area (Km ²)
1	FDTP, Manas	Manas National Park	500.00
2	Dhansiri Division	Barnadi WLS	26.22
3	Kachugaon Division	Ripu RF	605.27
4	Kachugaon Division	Kachugaon RF	214.45
5	Kachugaon Division	Chirang RF	592.54
6	Haltugaon Division	Bengtoll RF (Part 1)	10.71
7	Haltugaon Division	Bengtoll RF (Part 2)	60.92
8	Chirang Division	Manas RF	530.45
9	Chirang Division	Kuklung RF	14.69
10	Baksa Division	Daodhara RF	17.48
11	Baksa Division	Batabari RF	21.63
12	Baksa Division	Subankhata RF	23.37
13	Baksa Division	Morapagladia RF	21.05
14	Baksa Division	Darranga RF	23.58
15	Baksa Division	Sukanjuli RF	13.15
16	Baksa Division	Lebra PRF	3.65
17	Baksa Division	Dihira PRF	6.16
18	Dhansiri Division	Khalingduar RF	70.33
19	Dhansiri Division	Kherkhari PRF	6.00
20	Dhansiri Division	Kundar beel PRF	9.93
21	Dhansiri Division	Bhairabkunda PRF	35.43
22	Dhansiri Division	Bhairabkunda RF	24.41
23	Dhansiri Division	Newlee PRF	5.68
TOTAL AREA =			2837.10

In the following pages, the core area of Manas National Park and Barnadi wildlife sanctuary has been described.

Boundaries of the Core Zone:-

The existing boundaries of the Core Zone within the Manas National Park and Barnadi Wildlife Sanctuary are described briefly as under:-

a) Manas National Park:-

- North:- North- from the point where the Sukanjan River crosses Indo-Bhutan Boundary at B. P. No. 192/3 the Northern Boundary runs along the Indo-Bhutan Boundary eastwards upto the point where the Potanadi (Agarbari) river crosses the Indo-Bhutan Boundary at B. P. N. No. 220.

- East:- from the point of Indo-Bhutan Boundary Pillar No. 220 along the left bank of Potanadi (Agarbari) river towards South to a point where it meets the Southern Boundary of the Koklabari R. F. (Addition). Thence along the Southern Boundary road of Koklabari R. F. (Addition) Westwards to a point where it meets Randhani Bandhani stream (about 0.8 km.) below Koklabari camp and thence along the old Boundary of N. K. R. F. (Addition) at bearing of 267° For a distance of 1320.00 m. to B. P. No. 1.

Thence from:-

B. P. No.	To B. P. No.	At a bearing	To a distance
1	2	267°	340.00 meters
2	3	15°	180.00 meters
3	4	277°	3160.00 meters

Thence the Boundary line runs the left bank of Anglichinga river in a southerly direction from B. P. No. 4 to B. No. 23.

From B. P. No.	To B. P. N.	At a bearing	To a point
4	5	189°	140.00 meters
5	6	237°	220.00 meters
6	7	092°	560.00 meters
7	8	245°	200.00 meters
8	9	236°	320.00 meters
9	10	180°	400.00 meters
10	11	180°	400.00 meters
11	12	182°	360.00 meters
12	13	221°	380.00 meters
13	14	164°	345.00 meters
14	15	150°	240.00 meters
15	16	096°	200.00 meters
16	17	217°	180.00 meters
17	18	180°	220.00 meters
18	19	88°	110.00 meters
19	20	174°	160.00 meters
20	21	125°	720.00 meters
21	22	225°	920.00 meters
22	23	161°	460.00 meters

From B. P. No. 23 the Boundary line runs in the Western direction to B. P. No. 24 at a bearing of 2742 for a distance of 1540.00 M. along the Northern Boundary of Agrong Forest Village in a close proximity of Betbari Camp. Thence to B. P. No.-25 at a bearing of 1668 for a distance of 2400.00 M. where meets the old Southern Boundary road of N. K. R. F. (Addition) near Khoirabari Forest Camp.

- West: Thence along the left bank of Burisuta river and thence along the right bank of Sukanjan river to the starting point on the Indo-Bhutan B. P. No. 192/3.
- South: From the terminating point of the Eastern Boundary it runs along the old Agrong Bhuyanpara road South Boundary road of N. K. R. F. (Addition) to Bhuyanpara Range office. Thence along the old Southern Boundary road of N. K. R. F. touching at Katajhar Beat and Bhatgali Beat office and going further West upto the Eastern Boundary of Kahitama R.F. Thence along the left bank of Mora Manas where it meets the Southern Boundary of Kahitama R.F. and crosses Mora Manas. Thence along the old Southern Boundary road of Kahitama R.F. Thence it crosses the Jia Manas (Hakua) and runs along the Eastern Boundary of Panbari R.F. where it meets the Southern Boundary of Panbari R. F. Thence along the South Boundary of Panbari R. F. and thence along the Western Boundary of Panbari R. F. to a point on the left bank of Burisuta river.

Barnadi Wildlife Sanctuary:-

- North:- From the point where the Barnadi crosses the Bhutan boundary between pillars 98 and 99 eastwards along this line to the point where it is crossed by Nalapara nadi between pillars 99 and 100.
- East:- Thence along the right bank of the Nalapara nadi for about 155 chains the boundary pillar No.1 at northeast corner of Block 11 of the Bhadlapara Tea Estate thence along the northern boundary of this Block for about 52 chains to boundary pillar No.2 at its northwest corner, thence along the western boundaries of Block 11,8 and 7A of the said Tea Estate for about 154 chains through boundary pillars 3,4,5,6,7,8 and 9 to boundary pillar 10.
- South:- Thence a demarcated line at a bearing of 240° for about 28 chains to boundary pillar 11, on the track to Dharamjuli, thence at 270° for 77 chains to boundary pillar 12, thence at 292° for about 40 chains to boundary pillar 13, thence along the northern boundary of grant 300 of the Atharikhat Tea Estate for about 39 chains to boundary pillar 14, thence at 286° for 41 chains to boundary pillar 15, thence along the northern boundary of grant No. 119 N.R. of the same Estate for about 60 chains to boundary pillar 17, thence along the western boundary of grant NO.3/4N.R. Through boundary pillars 18,19,20,21 and 22 for about 115 chains to boundary pillar 23. Thence along a demarcated line at a bearing of 249° for about 7 chains to boundary pillar 24, thence at 247° for about 6 chains to boundary pillar 25, thence at 250° for about 15 chains to boundary pillar 26, thence at 251° for about 40 chains to boundary pillar 27, thence at 252 1/2° for about 28 chains through boundary pillar 28 ending on the left bank of the Bornadi.
- West:- Thence up the left bank of the Bornadi for about 340 chains to the starting point.

Boundaries of the Critical Tiger Habitat (CTH) & Inviolate Areas:- The floral, faunal and conservational significance of the Core Zone has already been discussed in the preceding chapters. Similarly, a total of 840.04 sq. km. area was declared critical tiger habitat as Govt. of Assam Forest Department's Notification No.FRW.2/2007/17, dated Guwahati the 20th December, 2007. For a viable Tiger Reserve at least an area of 800 to 1200 km² of inviolate space is a necessity. In this way, the identification and notification of the Critical Tiger Habitat in the Tiger Reserve is amply justified. The Critical Tiger Habitats of MTR includes-

- Manas National Park (500 sq. km.) Boundary Description :: As notified vide Govt. Notification No. FRW.55/86/64, dt.7/9/1990.
- Bornadi Wildlife Sanctuary (22.21 sq. km.) Boundary Description: As notified vide Govt. Notification No. GFR.145/42, dt. 25/4/1942.
- Daodhara Reserved Forests: (17.49 Sq. km.) Boundary Description :: As notified vide Govt. Notification No. AFR.45/52/59, dt. 27/7/1959.
- Manas Reserved Forests (Part) (300.34 sq. km.) Boundary Description :: As notified vide Govt. Notification No. FRW. 1886R, dt. 11/07/1927.

Boundary : 1st Addition Manas National Park - Area 350.00 Sq. km.

North : Indo-Bhutan International Boundary

East : Sukanjani river

South : Civil areas of Chirang district.

West : Sukan Tekklai river

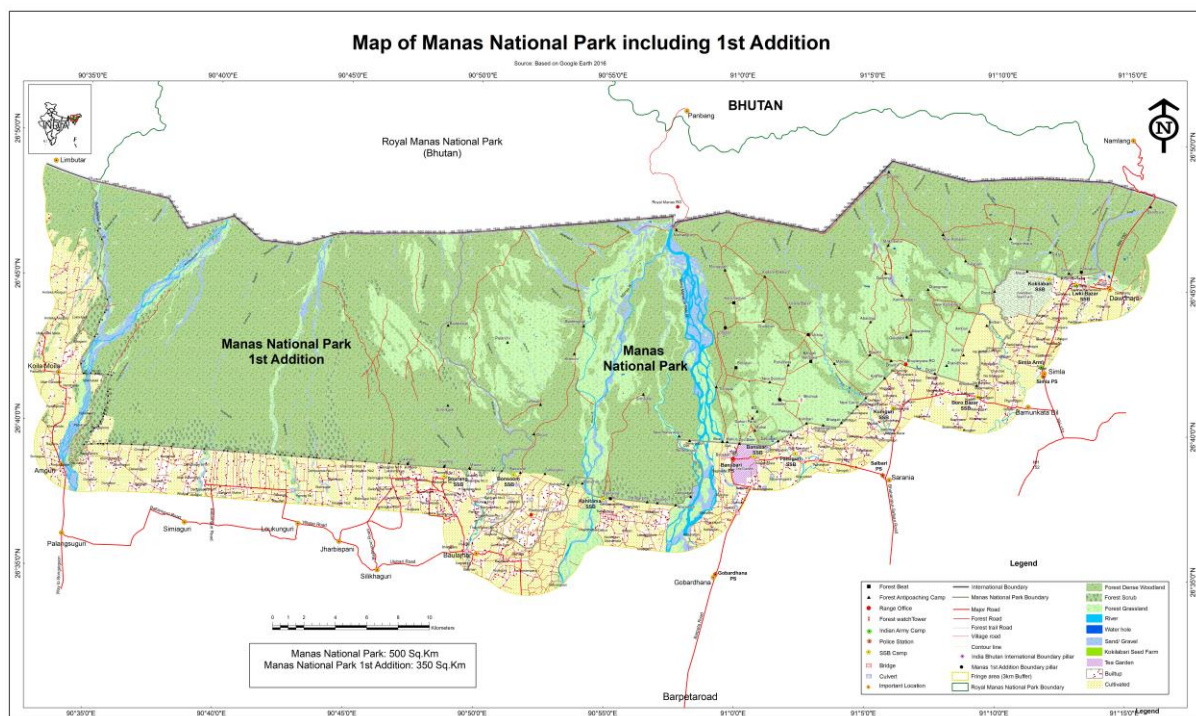


Figure 1.2: Manas National Park with 1st Addition area

1.1.1. Constitution of Manas National Park:-

The Manas National Park is part of the core area of the Manas Tiger Reserve (1973), Manas Biosphere Reserve (1989) and the Chirang-Ripu Elephant Reserve (2003). The chronicle of conservation history dates back to 1905 with the creation of a Proposed Reserve Forest called the North Kamrup Reserve Forest. Thereafter Manas Reserve Forest came into being in 1907, which was declared a protected area closed to hunting and killing of wildlife in 1908. Further in 1917 the North Kamrup and eastern part of Manas Reserve Forest were notified as a “Protected Region” and hunting, shooting and trapping of animals were prohibited, except fishing for sport. In 1924 the area of the Protected Region was increased to 360 sq. kms. and subsequently this area was declared as “Manas Wildlife Sanctuary” in 1928.

Through further additions to its area in 1951 and 1955 the geographical area of the Manas Wildlife Sanctuary (Manas Game Sanctuary) became 391 sq. kms.

Manas Tiger Reserve, one of the first batch of nine Tiger Reserves declared on 1st April, 1973 under the aegis of “Project Tiger” had a core area of 391 sq. km. with legal status as sanctuary declared in 1928. The erstwhile Manas Wildlife Sanctuary encompassed part of Manas RF (120.00 sq. km.) and North Kamrup RF including 1st addition to NKRF (271.02 sq. km). Subsequently the area was extended to 500.00 sq. km. by inclusion of three more Reserved Forests contiguous to the core area and declared as Manas National Park vide Govt. notification no. FRW.55/86/64, dated 7th September, 1990.

In 1985, Manas Wildlife Sanctuary (391 sq. kms.) was inscribed in the list of World Heritage Site (UNESCO), a site of outstanding universal value, under the criteria: N (ii), (iii) and (iv). In 1992 the UNESCO-IUCN reviews the status of the Site and decides to tag “in danger”, that is the “World Heritage Site in Danger” due to damages occurred to Park infrastructure and other properties during Bodo agitation since 1988. However, in June, 2011, Manas regained its original status of “World Heritage Site” as result of collective efforts of state government, the Bodoland Territorial Council, Park authorities, NGOs and local communities.



Manas (2837.10 sq. km.) was the 6th Biosphere Reserve to be declared by Govt. of India in 1989 (first in Assam). Manas Wildlife Sanctuary was subsequently upgraded to National Park status with an area of 500 sq. kms. on 7th September, 1990, by inclusion of Panbari RF (16.30 sq. kms.), Kokilabari RF (15.11 sq. kms.) and Kahitama RF (77.59 sq. kms.) in the eastern sector. In 2003, the Manas National Park became a part of Chirang–Ripu Elephant Reserve (2600 sq. km.) under the umbrella of ‘Project Elephant’.

1.1.2. Extent and notification of Manas National Park:-

The Manas National Park which is the core area of Manas Tiger Reserve stretches over a length of 43 kms from west to east and 13 kms (on average) from north to south. The total area of the core area is 500 km².

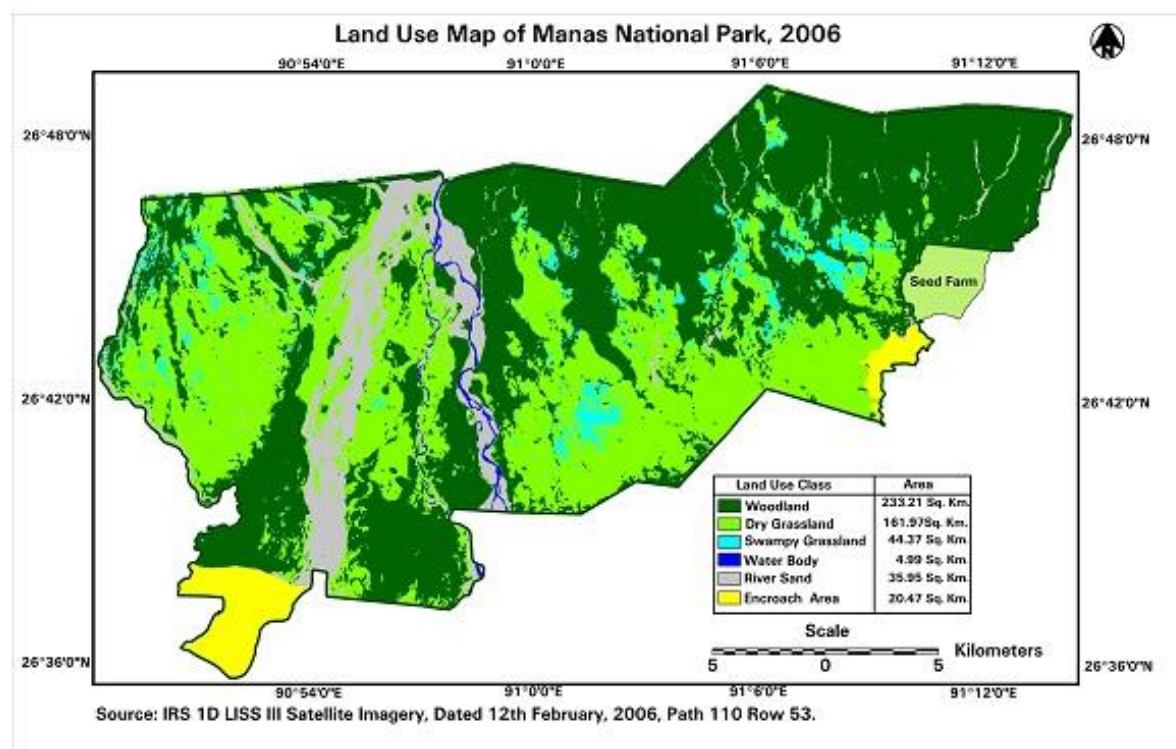
The total area of Manas National Park is of 500 sq. km. The break up of area is given below:

Table 1.2: Area of Manas National Park:-

Sl. No.	Status	Area in sq. km.
1	Manas Wildlife Sanctuary	391.00
2	Panbari RF	16.30
3	Kokilabari RF	15.11
4	Kahitama RF	77.59
Total =		500.00

All of the above Wildlife Sanctuary & Reserve forests areas are declared as Manas National Park vide Govt. notification no. FRW.55/86/64, dated 7th September, 1990. The boundary of Manas NP is clearly distinguishing with the Manas River to the north demarcate the international border with Bhutan, to the south by thickly populated villages and to the east and west by the forest reserves.

Fig 1.2: Land use and land cover map of Manas National Park:-



1.2. Approach & Access:-

Manas National Park (MNP) is accessible by roads, railways and airways. The main entry point to the MNP is through the Bansbari Range, which is 21 km away from the office of the Field Director at Barpeta Road. The nearest railway station is Barpeta Road. State transport Corporation Buses as well as private buses and taxis ply regularly to and fro in between Guwahati and Barpeta Road Town by N.H. 31. The nearest airport is Gopinath Bordoloi International Airport, Guwahati. The other facilities such as lodging, telephones and local transport services are available at Barpeta Road at reasonable rate.

Road Distances to the Park are as follows:-

1. From Guwahati	-158 km.
2. From Airport, Guwahati	-178 km.
3. From Bongaigaon	- 60 km.
4. From Kokrajhar	- 96 km.

1.3. Statement of significance (Manas NP and Barnadi WLS): -

Manas Tiger Reserve is biologically very rich. It is located in the confluence of 3 major Bio-geographic Zones viz. Lower Gangetic plains (7B), Central Himalayas (2C), and Brahmaputra valley (8A). The project site supports vital population of tiger (*Panthera tigris*). Similarly, Bengal Florican (*Houbaropsis bengalensis*) is a critically endangered bird that has a resident population within the fringe of Manas National Park.

Significance of Manas National Park in the International context lies in the fact that it provides shelter and protection to various species of Wildlife included in the Red Data Book (RDB) of the IUCN (International Union for Conservation of Nature and Natural Resources) and the appendices of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora).

The core area of MTR being a World Heritage Site, has been providing the universal conservation value towards nature and human being.

Similarly, Barnadi Wildlife Sanctuary is an important habitat of Pygmy hog (*Porcula salvania*). Sightings of these animals were reported from the area till the mid-nineteenth century. However, their sudden reappearance in the area in the year 1971 led to the recognition of the area as of immense importance for the survival of these animals which occur over a very narrow geographical range.

Besides, Royal Manas National Park of Bhutan is situated in the northern boundary of MTR. This is an international corridor for migration of wildlife between Manas National Park and Royal Manas National Park in Bhutan.



Table 1.3: List of (Critically endangered, Endangered, Near threatened and Vulnerable) fauna of Manas Tiger Reserve as per IUCN Red Data list and the Wildlife (Protection), Act, 1972

Sl. No.	Common Name	Zoological Name	IUCN category	WLP (Schedule)
1	Pygmy Hog	<i>Porcula salvanius</i>	Critically Endangered	I
2	White-bellied Heron	<i>Ardea insignis</i>	Critically Endangered	I
3	Slender-billed Vulture	<i>Gyps tenuirostris</i>	Critically Endangered	I
4	White-rumped Vulture	<i>Gyps bengalensis</i>	Critically Endangered	I
5	Bengal Florican	<i>Houbaropsis bengalensis</i>	Critically Endangered	I
6	King Vulture	<i>Sarcogyps calvus</i>	Critically Endangered	IV
7	Orchid Tit butterfly	<i>Chliaria othona</i>	Data deficient	I
8	Golden Langur	<i>Trachypithecus geei</i>	Endangered	I
9	Tiger	<i>Panthera tigris</i>	Endangered	I
10	Fishing Cat	<i>Prionailurus viverrinus</i>	Endangered	I
11	Asian Elephant	<i>Elephas maximus</i>	Endangered	I
12	Indian Water Buffalo	<i>Bubalus arnee</i>	Endangered	I
13	Hispid Hare	<i>Caprolagus hispidus</i>	Endangered	I
14	Chinese Pangolin	<i>Manis pentadactyla</i>	Endangered	I
15	White-winged Wood Duck	<i>Cairina scutulata</i>	Endangered	I
16	Narrow-headed Softshell Turtle	<i>Chitra indica</i>	Endangered	I
17	Assam Roof Turtle	<i>Pangshura sylhetensis</i>	Endangered	I
18	Indian Wild Dog/ Dhole	<i>Cuon alpinus</i>	Endangered	II
19	Hog deer	<i>Axis porcinus</i>	Endangered	III
20	Yellow Tortoise	<i>Indotestudo elongata</i>	Endangered	IV
21	Short-nosed Vine Snake	<i>Ahaetulla nasuta</i>	Endangered	IV
22	Greater Adjutant Stork	<i>Leptoptilos dubius</i>	Endangered	IV
23	Leopard/Panther	<i>Panthera pardus</i>	Near Threatened	I
24	Asiatic Golden Cat	<i>Pardofelis temminckii</i>	Near Threatened	I
25	Great pied Hornbill	<i>Buceros bicornis</i>	Near Threatened	I
26	Large Indian Civet	<i>Viverra zibetha</i>	Near Threatened	II
27	Malayan Giant Squirrel	<i>Ratufa bicolor</i>	Near Threatened	II

28	Striped Keelback	<i>Amphiesma stolata</i>	Near Threatened	II
29	Banded Krait	<i>Bungarus fasciatus</i>	Near Threatened	II
30	King Cobra	<i>Ophiophagus hannah</i>	Near Threatened	II
31	Spot-billed Pelican	<i>Pelecanus philippensis</i>	Near Threatened	IV
32	Oriental Darter	<i>Anhinga melanogaster</i>	Near Threatened	IV
33	Painted Stork	<i>Mycteria leucocephala</i>	Near Threatened	IV
34	Black-necked Stork	<i>Ephippiorhynchus asiaticus</i>	Near Threatened	IV
35	Black-headed Ibis	<i>Threskiornis melanocephalus</i>	Near Threatened	IV
36	Ferruginous Duck	<i>Aythya nyroca</i>	Near Threatened	IV
37	Grey-headed Fish Eagle	<i>Ichthyophaga ichthyaetus</i>	Near Threatened	IV
38	Lesser Grey-headed Fish Eagle	<i>Ichthyophaga humilis</i>	Near Threatened	IV
39	Cinereous Vulture	<i>Aegypius monachus</i>	Near Threatened	IV
40	Pallid Harrier	<i>Circus macrourus</i>	Near Threatened	IV
41	Laggar Falcon	<i>Falco jugger</i>	Near Threatened	IV
42	Black-bellied Tern	<i>Sterna acuticauda</i>	Near Threatened	IV
43	Blyth's Kingfisher	<i>Alcedo hercules</i>	Near Threatened	IV
44	Rufous-vented Prinia	<i>Prinia burnesii</i>	Near Threatened	IV
45	Rufous-rumped Grassbird	<i>Graminicola bengalensis</i>	Near Threatened	IV
46	Brahminy Blind Snake	<i>Ramphotyphlops braminus</i>	Near Threatened	IV
47	Burmese Rock Python	<i>Python molurus bivittatus</i>	Near Threatened	IV
48	Common Water Snake	<i>Enhydris enhydris</i>	Near Threatened	IV
49	Common Wolf Snake	<i>Lycodon aulicus</i>	Near Threatened	IV
50	Green Cat Snake	<i>Boiga cyanea</i>	Near Threatened	IV
51	Checkered keelback Water Snake	<i>Xenochropis piscator</i>	Near Threatened	IV
52	Indian Rat Snake	<i>Ptyas mucosa</i>	Near Threatened	IV
53	Ornate Flying Snake	<i>Chrysopelea ornata</i>	Near Threatened	IV
54	Common Otter	<i>Lutra lutra</i>	Near Threatened	
55	Himalayan Keelback	<i>Rhabdophis himalayanus</i>	Near Threatened	II
56	White-lipped Pit Viper	<i>Cryptelytrops albolabris</i>	Near Threatened	IV
57	Brown roofed turtle	<i>Pangshura smithii</i>	Near Threatened	I
58	Chital Fish	<i>Chitala chitala</i>	Near Threatened	I
59	Capped Langur	<i>Trachypithecus pileatus</i>	Vulnerable	I
60	Clouded Leopard	<i>Neofelis nebulosa</i>	Vulnerable	I
61	Marbled Cat	<i>Pardofelis marmorata</i>	Vulnerable	I

62	Sloth Bear	<i>Melursus ursinus</i>	Vulnerable	I
63	Great Indian Rhinoceros	<i>Rhinoceros unicornis</i>	Vulnerable	I
64	Gaur/ Indian Bison	<i>Bos gaurus</i>	Vulnerable	I
65	Swamp deer	<i>Rucervus duvaucelii</i>	Vulnerable	I
66	Rufous-necked Hornbill	<i>Aceros nipalensis</i>	Vulnerable	I
67	Malayan Box Turtle	<i>Cuora amboinensis</i>	Vulnerable	I
68	Spotted Pond turtle	<i>Geoclemys hamiltonii</i>	Vulnerable	I
69	Water Monitor Lizard	<i>Varanus salvator</i>	Vulnerable	I
70	Yellow Monitor Lizard	<i>Varanus flavescens</i>	Vulnerable	I
71	Bear Cat or Binturong	<i>Arctictis binturong</i>	Vulnerable	I
72	Himalayan Black Bear	<i>Ursus thibetanus</i>	Vulnerable	II
73	Smooth Indian Otter	<i>Lutrogale perspicillata</i>	Vulnerable	II
74	Sambar	<i>Rusa unicolor</i>	Vulnerable	III
75	Eastern Imperial Eagle	<i>Aquila heliaca</i>	Vulnerable	IV
76	Greater Spotted Eagle	<i>Aquila clanga</i>	Vulnerable	IV
77	Pallas' Fish Eagle	<i>Haliaeetus leucoryphus</i>	Vulnerable	IV
78	Lesser Kestrel	<i>Falco naumanni</i>	Vulnerable	IV
79	Swamp Francolin	<i>Francolinus gularis</i>	Vulnerable	IV
80	Manipur Bush Quail	<i>Perdica manipurensis</i>	Vulnerable	IV
81	Wood Snipe	<i>Gallinago nemoricola</i>	Vulnerable	IV
82	Dark-rumped Swift	<i>Apus acuticauda</i>	Vulnerable	IV
83	Marsh Spotted Babbler	<i>Pellorneum palustre</i>	Vulnerable	IV
84	Jerdon's Babbler	<i>Chrysomma altirostre</i>	Vulnerable	IV
85	Black-breasted Parrotbill	<i>Paradoxornis flavirostris</i>	Vulnerable	IV
86	Slender-billed Babbler	<i>Turdoides longirostris</i>	Vulnerable	IV
87	Bristled Grass Warbler	<i>Chaetornis striata</i>	Vulnerable	IV
88	Hodgson's Bushchat	<i>Saxicola insignis</i>	Vulnerable	IV
89	Finn's Weaver	<i>Ploceus megarhynchus</i>	Vulnerable	IV
90	Yellow-breasted Bunting	<i>Emberiza aureola</i>	Vulnerable	IV
91	Red-necked Keelback	<i>Rhabdophis subminiatus</i>	Vulnerable	IV
92	Common Mock Viper	<i>Psammodynastes pulverulentus</i>	Vulnerable	IV
93	Lesser Adjutant Stork	<i>Leptoptilos javanicus</i>	Vulnerable	IV
94	Peacock Softshell Turtle	<i>Nilssonina hurum</i>	Vulnerable	II

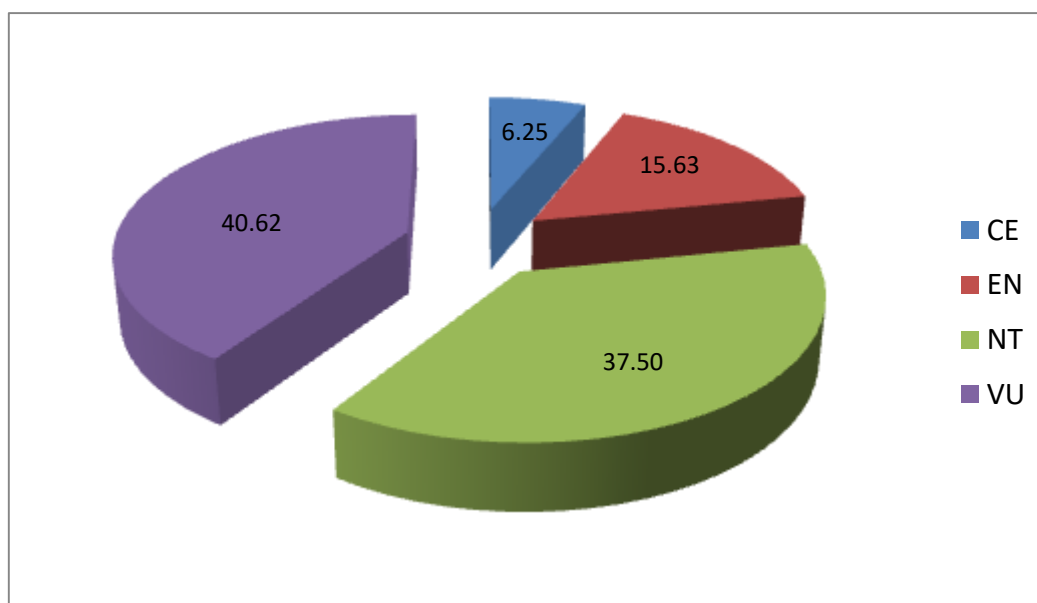
95	Tricarinate Turtle	<i>Melanochelys tricarinata</i>	Vulnerable	II
96	Bengal Monitor Lizard	<i>Varanus bengalensis</i>	Vulnerable	I
97	Assam Snail Eater	<i>Pareas monticolus</i>	Vulnerable	I

The Manas National Park harbours atleast 61 species of mammals, more than 475 species of birds of which 26 species are globally threatened, 42 species of reptiles, 17 species of amphibians, 79 species of fishes and more than 200 species of butterfly and over 100 species of invertebrates.

Manas National Park supports atleast six critically endangered, fifteen endangered, thirty-six near threatened and thirty-nine vulnerable faunas as per the IUCN Red Data List.

Fig 3: Extent (percentage) of IUCN Red Listed animals found in Manas National Park (CE = Critical endangered; En= Endangered; NT= Near threatened; VU= Vulnerable)





Besides this, 32 species are also listed in Schedule-I of Wildlife (Protection) Act, 1972. Pygmy Hog (*Porcula salvania*) is exclusively endemic to the Manas National Park and Barnadi Wildlife Sanctuary, and also included in the critically endangered status of the IUCN Red Data Book.

About 622 species of plants have been recorded in the Manas (Hajra & Baisya, 2002). 429 species are Dicotyledons, 162 species are monocotyledons, 30 species are Pterodiphytes, 1 species of Gymnosperm. Further, they are broadly categorized as 89 tree species, 49 shrubs, 37 undershrubs, 172 herbs, 36 species of climbers, 15 species of orchids, 18 species of ferns and 43 species of grasses. No detailed studies have been made regarding the algal and fungal species of Manas. Medicinal plants also have been recorded from the Park. The list of 462 plants are enclosed (Annexure-I) and rest 160 are in the process of identification up to species level.

The four species of endemic plants have been recorded from the Manas so far are: *Boesenbergia hamiltonii* (formerly *Curcomorpha longiflora*), *Echinocarpus assamicus*, *Parakaempferia synantha* and *Paspalum longifolium var lorirhachis*.

1.4. Conservation Values:-

Table 1.4: Categories of Biodiversity values as a World Heritage Site

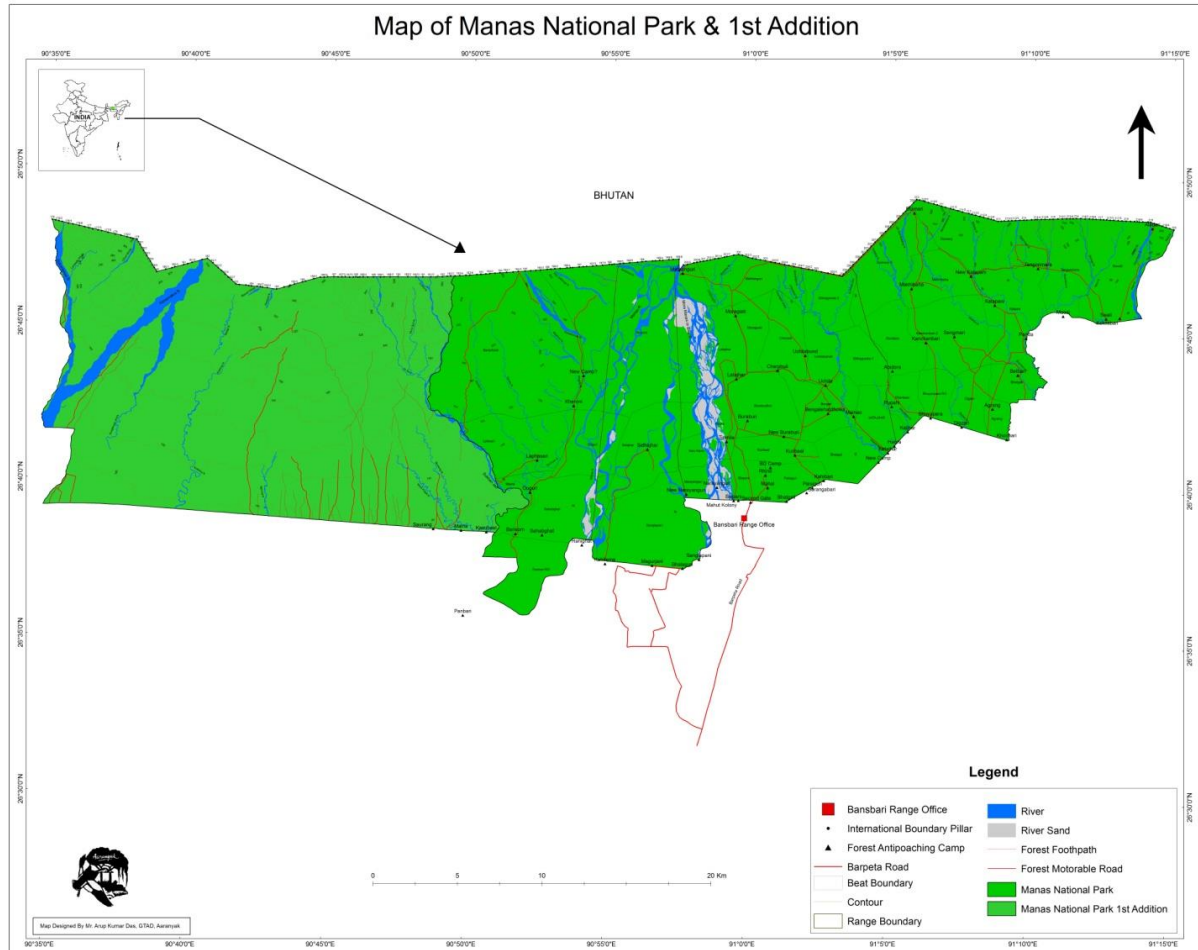
Sl. No.	Values	Illustrative constituents
1	Global	World Heritage Site. Criteria Natural-N (ii), (iii), (iv) - 1985.
2	National	Endemic & endangered fauna: Pygmy hog, Golden langur, Hispid hare, Bengal florican and Tiger. Flora: <i>Curcomorpha longiflora</i> , <i>Echinocarpus assamicus</i> , <i>Paspalum longifolium var. lorirhachis</i> , <i>Parakaempferia synantha</i> .

3	Regional	Asiatic water buffalo, Asiatic Elephant, Dhole.
4	State	Manas river, semi evergreen forest and terai grassland.
5	Local	Fuel wood, livestock grazing, NTFP collection, medicinal plant and water for irrigation and drinking.

Table 1.5: Categories of Socio-cultural values as a Manas Biosphere Reserve

Sl. No.	Value categories	Illustrative Constituents
1	Real/ Economic	• It captures and stores carbon dioxide • It provides water for irrigation • It generates employment through tourism • It generates mandays for local people.
2	Biological	• It is located in the confluence of 3-majore Bio-geographic Zones viz. Lower Gangetic plains (7B), Central Himalayas (2C) and Brahmaputra valley (8A). • It provides shelter to many endangered, threatened and rare species of animals like tiger, Asian elephant, pygmy hog, golden langur, hispid hare, Assam roofed turtle, Bengal florican, white bellied heron, great pied hornbill, etc. • It is a significant habitat for long ranging species (Elephant, Tiger and Gaur) and provides habitat connectivity.
3	Ecological processes and functions	• Catchment conservation of several major rivers (Beki, Pahumara, Pata, Burisuti and Basra) for downstream habitations and irrigation which sustain economic well being of the region. • Ecological security and environmental amelioration (pollution absorption) for the region. • It acts as a carbon sink of the region.
4	Conceptual	• It represents several elements of eastern Himalayan biodiversity hotspot.
5	Scientific	• Significant scope of Wildlife research and education. • It has socio-economic issues, ethnic diversity, and many endangered and endemic species. Thus, it provides an excellent opportunity to Scientists for improving understanding of the biological world.
6	Physical attributes	• It represents the fragile Shiwalik and Himalayan landscape and rock features. • It represents physical attributes of bhabar and terai eco-system.
7	Recreational	• Potential for eco-tourism, aesthetic value, wilderness experience, close canopy and dense old forest, bird watching. Scenic beauty of Beki River near Mathanguri.
8	Educational	• Significant scope for Nature interpretation and conservation awareness.

Sl. No.	Value categories	Illustrative Constituents
9	Religious Historical Cultural	• Sacred rock carved of Bathou religion. • Rack age sign of Gauripur king attacked on Manas TR and spiritual sites. • Bodo, Assamese and Tea tribe culture.



Manas National Park with 1st Addition Area

1.5. Constitution of Barnadi Wildlife Sanctuary:-

The name of second core of Manas Tiger Reserve is Barnadi Wildlife Sanctuary. The Sanctuary is located in the northwest within Baksa and Udalguri and lies between the geographical limits of 91° 42' E and 91° 47' E longitudes and 26° 45' N and 26°52' N latitudes. The total area of the sanctuary is 28.22 km². The southwest corner of the area falls in the area was known as Bornadi Reserve Forest and was notified vide Govt. notification GFR. 145/42 dated 25/4/42. Later on in the year 1980, it was upgraded into a Wildlife Sanctuary vide Govt. notification FRW. 14/80/1 dated 22/8/80.

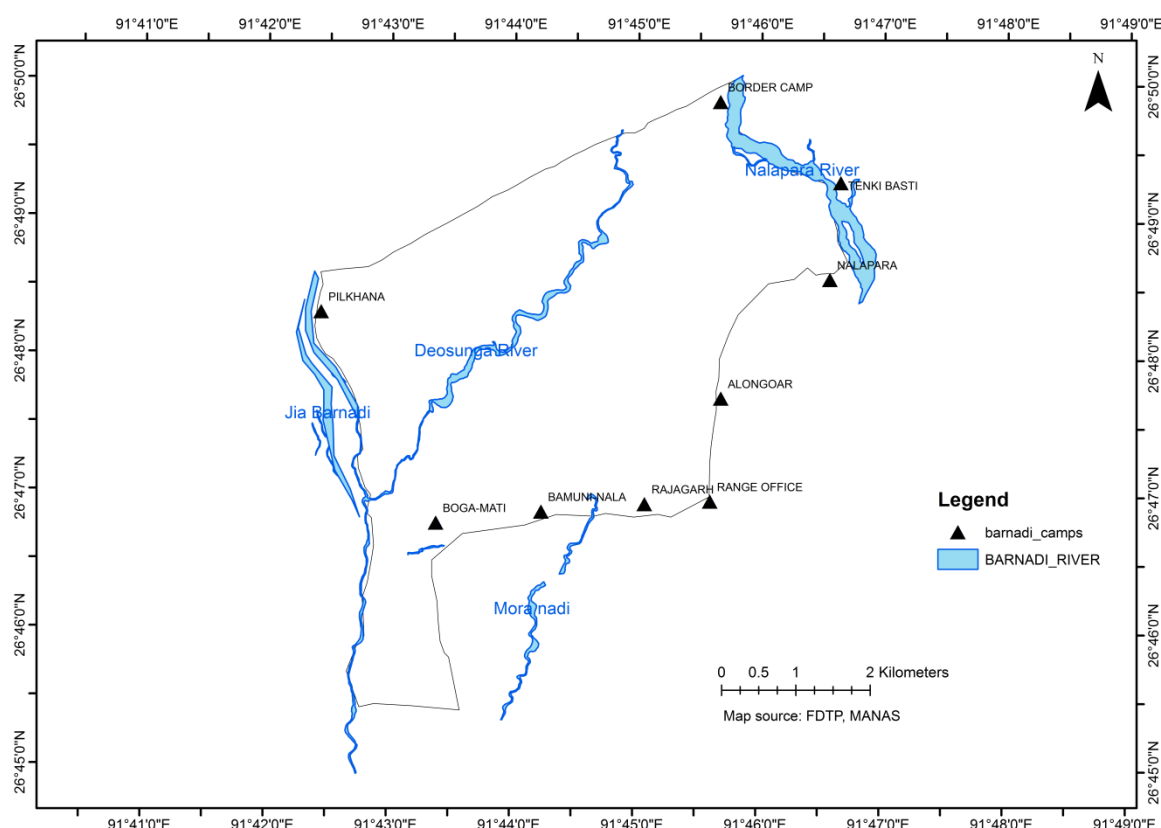
The river Barnadi forms the western boundary of the sanctuary which river Nalanadi forms the eastern boundary of the sanctuary. The northern boundary of the sanctuary is well

defined by the Indo-Bhutan border and demarcated on the ground by fixing pillars. The southern boundary is demarcated on the ground by digging trenches.

1.6. Approach and Access: The Sanctuary may be reached by any of the three routes:-

- i. Mangaldai - Kalaigaon-Bengabari-Panery-Dimakuchi-Suklai PWD road (65 km.)
- ii. Mangaldai - Kalaigaon-Tangla-Panery-Dimakuchi-Suklai PWD road (75 km.)
- iii. Baihata - Muktapur-Dipila-Khoirabari-Bhergaon-Dimakuchi-Suklai PWD road (83 km.)

Fig 1.4: Location map of Barnadi Wildlife Sanctuary



The Sanctuary has only one Range. The headquarters of the Range is located at Rajagarh. The area of the Range is thus, 26.22 sq. km. The description of the sanctuary boundaries is as follows:-

North:- From the point where the Bornadi crosses the Bhutan boundary between pillars 98 and 99 eastwards along this line to the point where it is crossed by Nalapara nadi between pillars 99 and 100.

East:- Thence along the right bank of the Nalapara nadi for about 155 chains the boundary pillar No.1 at northeast corner of Block 11 of the Bhadlapara Tea Estate thence along the northern boundary of this Block for about 52 chains to boundary pillar No.2 at its

northwest corner, thence along the western boundaries of Block 11,8 and 7A of the said Tea Estate for about 154 chains through boundary pillars 3,4,5,6,7,8 and 9 to boundary pillar 10.

South:- Thence a demarcated line at a bearing of 240° for about 28 chains to boundary pillar 11, on the track to Dharamjuli, thence at 270° for 77 chains to boundary pillar 12, thence at 292° for about 40 chains to boundary pillar 13, thence along the northern boundary of grant 300 of the Atharikhat Tea Estate for about 39 chains to boundary pillar 14, thence at 286° for 41 chains to boundary pillar 15, thence along the northern boundary of grant No. 119 N.R. of the same Estate for about 60 chains to boundary pillar 17, thence along the western boundary of grant NO.3/4N.R. Through boundary pillars 18,19,20,21 and 22 for about 115 chains to boundary pillar 23. Thence along a demarcated line at a bearing of 249° for about 7 chains to boundary pillar 24, thence at 247° for about 6 chains to boundary pillar 25, thence at 250° for about 15 chains to boundary pillar 26, thence at 251° for about 40 chains to boundary pillar 27, thence at $252\frac{1}{2}^\circ$ for about 28 chains through boundary pillar 28 ending on the left bank of the Bornadi.

West:- Thence up the left bank of the Barnadi for about 340 chains to the starting point.

The Range is divided into five Blocks measuring a little over 5 sq. km. on an average. The area of each block is given below:-

Block Number	Block Area (ha)
1	3.75
2	5.2
3	4.8
4	6.5
5	5.97



CHAPTER TWO

BACKGROUND INFORMATION AND ATTRIBUTES

2.1. Geology, Rock and Soil:-

Manas National Park and Barnadi Wildlife Sanctuary are located at the foothills of the Bhutan Himalayas in Baksa, Chirang and Udalguri districts of Assam. The geology consists of tract zone with sandy loam soil with granite and igneous as bed rocks. There is a well marked *Bhabhar* tract of rocky soil towards the boundary of the National Park which contains sand stone, lime stone and shale, and have very little moisture retaining capacity. The *Bhabhar* tract generally remains drier. It is characterized by maximum relief, dissection and drainage density within it.

The formation is alluvial, comprising of mixture of boulders and sand, covered by debris, sand soil, silt and clay brought down by the rivers. Boulders are of granite, gneiss and quartzite and are well rounded to sub-round. The gravel deposits contain Granite, Gneiss, Phyllite, and Slate Schist. This leads to the formation of alluvial terraces, comprising deep layers of deposited rock and detritus overlain by sandy loam and then a thin layer of humus. Towards further south is the ill drained clayey *Terai* tract. These *Terai* tracts are more or less flat. The *Terai* tract in the south consists of fine alluvial deposits with underlying pans. The area of the Beki basin, in the west of the Park, is sometimes inundated during the monsoon but never for very long due to the sloping relief. The flood plain abuts against the dissected mountain front of the Sub-Himalayas.

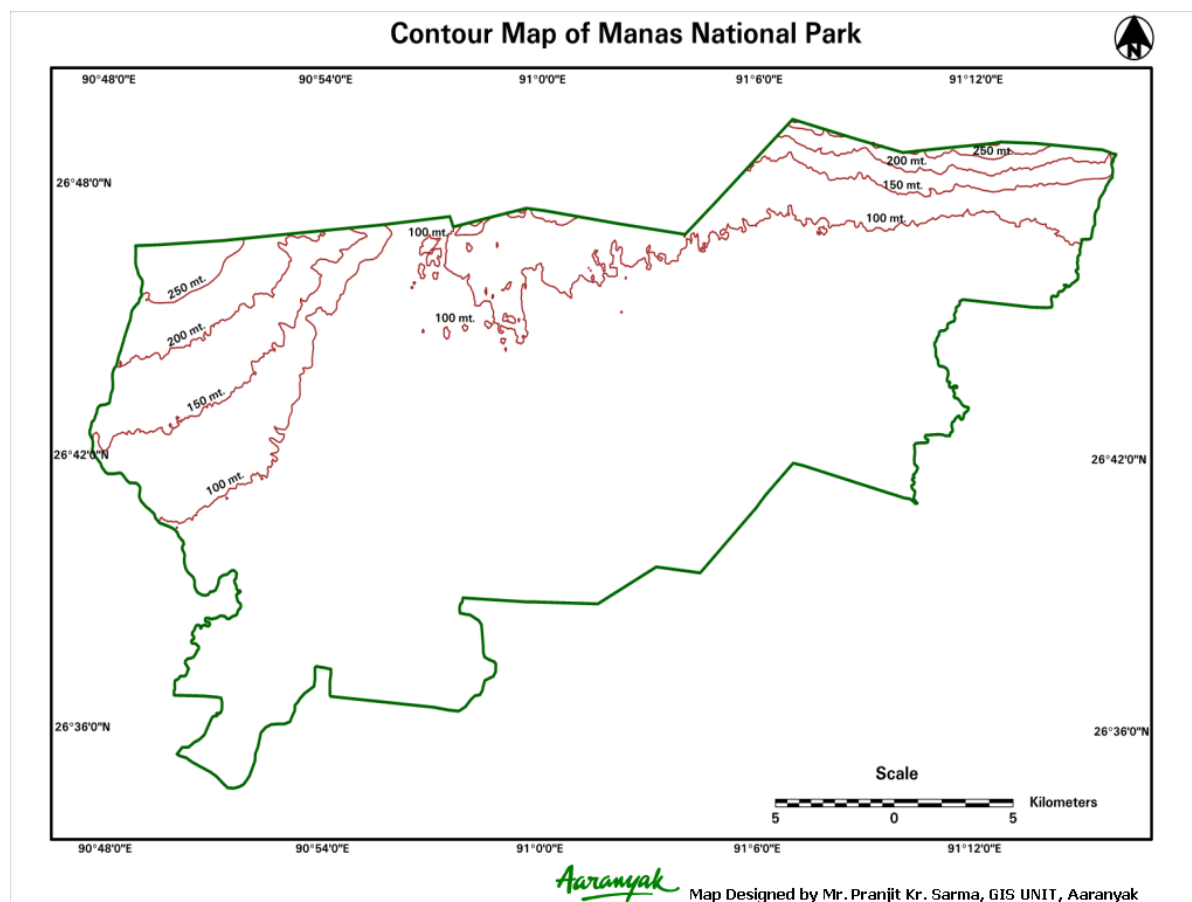
Over the limestone and sandstone bedrock of the *Bhabhar* savannah area in the north, this has formed shifting river channels and swamps and a soil of porous alluvial terraces of coarse detritus under layers of sandy loam and humus where the water level is very low. The *Terai* grasslands in the south consist of deep deposits of fine alluvium with underlying pans where the water table lies very near the surface, making it potentially useful farmland. Elevation ranges from 50 m MSL on the southern boundary to 250 m MSL along the Bhutan hills.

The geological formations normally encountered towards the south of the Reserve are one of Sub-recent to recent origin and comprise of the following:-

- a) *Bhabhar* Formation:- This formation is represented by loose gravels, boulders and river deposits that are highly variable in composition and texture. This is also known as older alluvium. Sub-surface data indicate that clay is mixed in varying proportion and demarcation of distinct clay bed cannot be made. Except during monsoon, the formation is apparently devoid of water and the streams carrying water disappear in the porous structure of the formation and reappear further down south in the form of springs.
- b) *Terai* Formation:- This formation is transitional in character between the alluvial formation in south and *Bhabhar* formation in the north. It is better stratified and has more clay than in the *Bhabhar* formation.
- c) Alluvial Formation:- It is mainly represented by silt and clay without much gravel or boulder. It constitutes the flat plains to the South of the Reserve which is under extensive cultivation.

The soil is uniform throughout consisting of a light, friable loam varying in depth from 15 cm to 90 cm. In the uplands to the north of duars the soil is ferruginous clay.

Fig 2.5: Contour Map of Manas National Park –



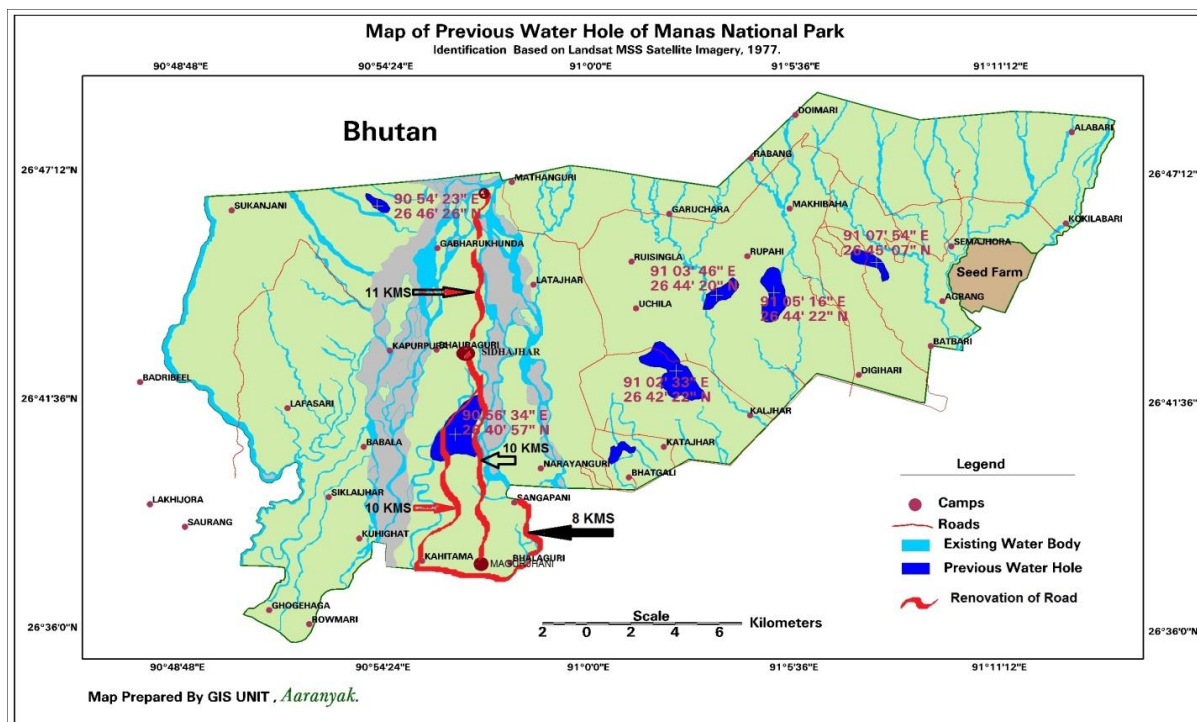
2.2. Terrain:-

The park is situated in the eastern duar and has extensive *Bhabhar* and some *Terai* areas, typical of Himalayan foothills. These *Terai* like tracts are more or less flat. The northern belt of the tract with major grassland areas of Manas is almost flat and well drained. The natural gradient of the land is a gentle sloping southward and area along the southern boundary is more flat and get water-logged during the rains. The river Manas, named Mangde Chu (in Bhutan) joined another stream Dangme Chu, flowing down through the Manas National Park and by splitting up into two major streams as Manas and Beki. The fast flowing Manas river on entering the plains from the steep hills loses its speed and as a result deposits enormous quantities of boulders, stones, sand, silt and other debris that are carried down by the water and this leads to the formation of alluvial terraces, comprising deep layers of rocks and sands deposits. The soil is deep alluvial Himalayan wash.

2.3. Hydrology and Water Sources:-

a) Natural:- The river Manas, named Dagme Chu (in Bhutan) joins another stream Mangde Chu, entering into Manas National Park splits up into three major streams known as Manas, Hakuwa and Beki, flows through the park and joins the river Brahmaputra some 50 kms further south. They carry enormous amounts of silt, rocks and debris from the foothills during

monsoon. There are number of rivers and perennial streams that drain across the Park from north to south. In bhabbar tract most of the streams, nallahs and rivers dry up in winter. The Manas river, a major tributary of Brahmaputra, provides not only perennial water to the park but also forms crucial habitat of some fresh water fish and aquatic migratory birds and wild buffalos as well. Other perennial rivers like Burisuta, Pahumara, Rupahi, Semajhora, Satarupa, Anglichinga and some smaller streams also provide water in abundance even during dry months. Some small beels located inside the woodland areas of the bhabbar tract like 'Daula Beel', 'Thekrai Beel', 'Garucharajhar Beel', 'Roisinglajhar Beel' etc. serve as a perennial source of water even during dry period of the year. The hydrology of the area does not have any similarity with the flood plain protected area of the Brahmaputra valley.



Map showing Water Sources of Manas National Park

The rivers, streams, ponds constitute water source of the National Park. The perennial rivers like Manas, Hakua, Beki, Burisuta, Anglichinga, Kasimdaha, Bangale-hat-dhua, Pota serve as the major source of water. In *Bhabhar* tracts most of the streams, nallah and rivers remain dry during winter. Other perennial source of water are: Pahumara, Rupahi, Semajhora, Satarupa, and host of smaller streams and natural ponds. Some bigger landlocked water bodies known as 'beels' are also available inside the park. Some important beels are: 'Daula beel', 'Thekrai beel', 'Garucharajhar beel', 'Roisinglajhar beel'. During lean period rivers like Doimari, Garuchora, Rabang remain dry upstream at *Bhabhar* tract in India but provide water in abundance inside Bhutan territory.

One of the most important changes is the Manas river having changed its course in 2004 during the high flood season. It has resulted into major change in hydrology and compartmental change of habitat in Manas. The drastic change of river course of Manas that occurred in 2004 due to heavy flood is visible. Meandering through sub-Himalaya in Bhutan, the river Manas appears in the park as a single channel at Mathanguri and splits into many smaller channels forming distributive network system in the plains. This distributive network system forms a part of the crucial habitat of wild water buffalo, fresh water fish and

migratory birds. The impact on wildlife was not ascertained. It emerges out of the park just west of Bansbari Range headquarter. Further, the impact on human populated areas on the down south outside the park was tremendous and devastating because of abrupt change of this river course. The situation assumed far more devastating during the high flood in 2007.



The river Manas originates in the Bhutan hills. It also carries enormous amount discharge from hills of adjoining Tibet. In hilly region a large number of sub-tributaries carry discharge to join on to a single river near the foot hill of Bhutan and to take the name Manas within Bhutan itself. The catchment of this river system covers nearly 50% of the geographical area of Kingdom of Bhutan over and above some area of Tibet also.

At the international boundary of India and Bhutan, the Bhutan-Manas debouches at Mathanguri into the plains of Assam with a sudden drop of gradient. This change in gradient result in energy dissipation and consequent silt, debris and boulder deposition for which the river spread and trifurcated. The trifurcated courses have their own names. The eastern most course is known as Beki, the central course is Hakua and the western most course retain the name Manas. Both Manas and Hakua has almost right angle inclination with respect to the alignment of Bhutan-Manas whereas Beki is almost aligned with Bhutan-India straight.

The river Beki is embanked at its left bank right from the foot hills at Mathanguri to old North Trunk Road for about 37 km of which the upper 15 km lies within the Manas National Park. As the name implies, this 15 km portion is covered with thick forest both at the C/Side and R/Side of the embankment.

A message was received through the External Affairs Ministry of Govt. of India on 27th May 2004 to the effect that there has been a huge artificial lake formation at upstream of a hydel power project of Bhutan (Kurichu Power Project) in the month of Sept, 2003 due to

landslide. May is a month of the flood season in Assam. The message carried further information that the said artificial dam forming the lake may burst at any moment of time causing devastation. The message carried further information to take precautionary measures. To this date of 27th May, 2004, the riparian state of Assam was never informed that a power has been constructed and that there has been an artificial lake formation in the winter (dry) season of 2003 (September). Such a late message left no other alternative but only to alert the population likely to be affected in a stretch of 40 to 45 km outside the park traversing through several villages before it joins mighty Brahmaputra.

The warning came true. The artificial lake got burst on 10th July, 2004 at 5 pm. The message from Bhutan at that moment was that the flood water was rushing down at unimaginable speed with more than 3.00 meter above the highest flood level and that it was on the increase to be added by rising flood of other major sub-tributaries of Manas in upper & middle Bhutan territories.

The on rushing water created havoc within the Bhutan territory and partially damaged the Kurichu Power Project. Huge quantities of trees, boulders and debris came along with the flow and reached the plain area of Mathanguri. The flow obviously took the straighter course through Beki and most of the carried materials entered the inclined course of Hakua and Manas, resulting in dampening of the velocity in this two river courses thereby resulting in the deposition of the all the carried materials & choking the rivers in totality. Therefore, this obviously resulted in diversion of the flow of Manas and Hakua to Beki. The combined flow of the three rivers passing through the Beki alone eroded its banks and innumerable numbers of trees of the National Park were uprooted and carried down. Thus this flow also got heavily laden with uprooted trees, debris, boulder etc, which got deposited along the bed and finally choked the course of the Beki also at Narayanguri, for which Beki developed a new course at Narayanguri bursting the left bank (L/B) embankment. This avulsed channel met a local field drainage channel called Kalpani which met river Palla further at downstream. Neither of these channels had enough capacity to accommodate this unprecedented discharge and the entire area of Barpeta District including Barpeta town had to face the devastating menace of Beki inundating several villages. The PWD road from Barpeta Road to Manas National Park breached at five locations disrupting the communication to the Park as well as to the adjacent villages. The cultivated and homestead land in all the villages at downstream of Kalpani river have been badly affected. The National Highway 31 in Howly was also overtopped and was under knee-deep water for number of days. The Barpeta - Howly road was breached disrupting road communication to Barpeta Town and other parts of the district. Due to rise of river Morachaulknowa, Barpeta Town was also inundated and remained under water for several days. The monument that is older than 500 years old religious and cultural, the Barpeta Xatriya Kirtan Ghar (a temple) which was never been subjected to flooding was affected by flood.

Several villages under Gobardhana Mouza - Narayanguri, Chouraguri, Kalpani Bazar, Kaldam, Narsingbari, Jengrabari, Mortunga, Bilasipara, Karaibari were badly affected. More than 100 villages were under deep submergence including cultivated land comprising 40 to 50 km in length and 7 to 8 km in width for the entire flood season and there after till November, 2004 rendering destruction and possibilities of late cultivation and crippling the entire economy of the area. Many roads and bridges (wooden/RCC and culverts) were badly damaged or washed away. Thousands of people were rendered homeless and had to live in relief camps. There have been a number of losses of human life and livestock. The Manas

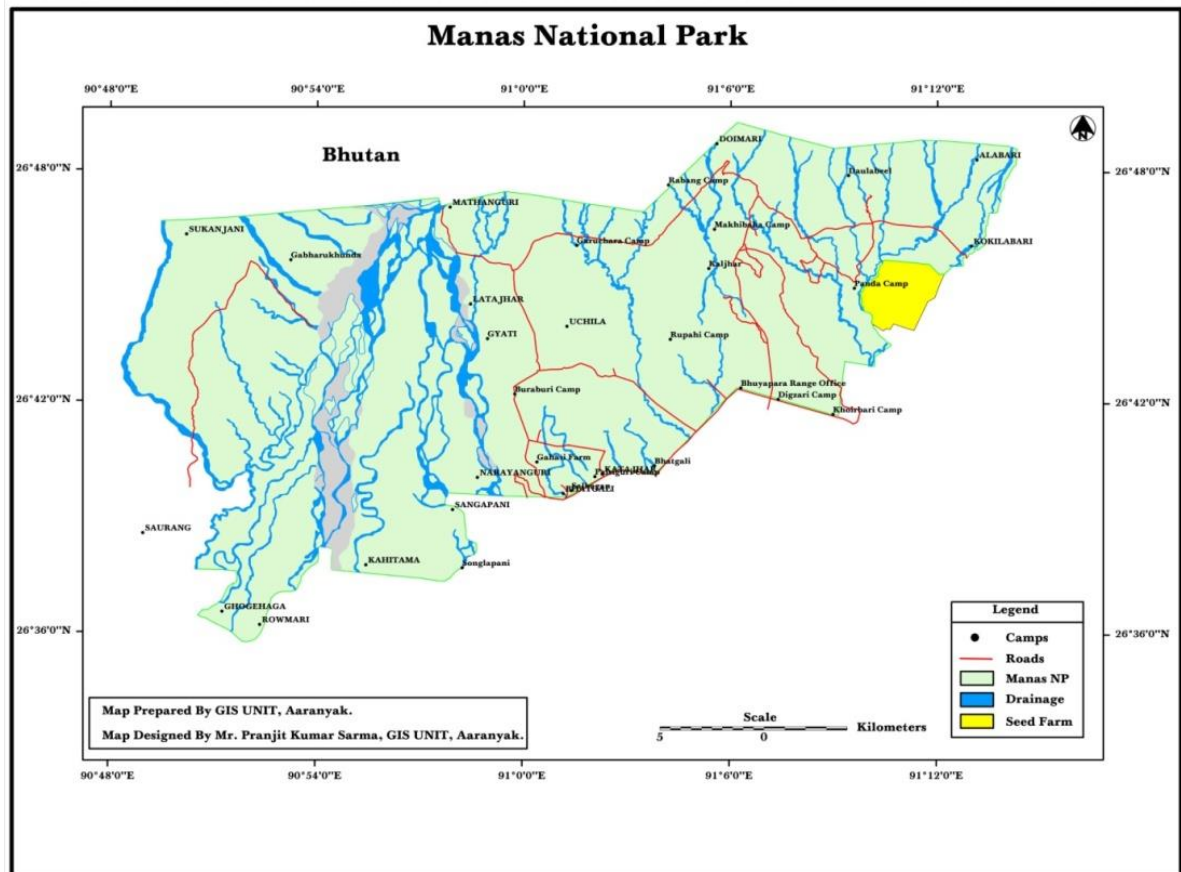
National Park suffered immeasurably and its link to the main land remained cut off due to severe damages to the roads. There were untold miseries.

The artificial dam reformed once again due to further landslide and a huge volume of estimated 20 million cubic meters was still under trap of reformed artificial dam at upstream of Kurichu in Bhutan. The Government of India sent central team and formed task force who visited the spot and were astonished by the magnanimity of the damage and losses. Therefore, the task force categorically recommended most immediate measures to cater to the problem so that the area can be saved from further fury of flood in the approaching flood season of 2005.

Further apprehending damages of another lake burst and catastrophes, the Govt. of India formed an India-Bhutan joint group of experts' team to arrive at some solution to the problem along with allied problems.

The Joint Group of Experts (JGE) in its first meeting held at Thimphu and Phuntsholing, Bhutan decided to have a joint visit to the problem creating area of eastern Bhutan during December, 2004 which did not materialize. During informal discussion with the leader of the Bhutanese delegation by the member of JGE from Assam (CE, WR Department Assam), the leader agreed to the proposal made by this member to remove the artificial dam well before the coming flood season to get rid of the risk and impending threat. The entire team supported this view and wanted to arrange for the said joint visit but did not materialise.

Fig 2.6: Drainage and road network of Manas National Park:-



List of rivers and nallahs inside Manas National Park:-

1. Kasimdoha
2. Madrijhora
3. Fotika
4. Bhatgali
5. Kaljhar
6. Pahumara
7. Dhonbeel/Rupahi/Bangale hat-dhuwa/Pahumara
8. Digjari
9. Agrang
10. Angulisinga/Doimari/Tangonmara/Disami/Jajenga
11. Kalanadi
12. Simphu
13. Teklai
14. Maujigendri
15. Garumara
16. Alabari
17. Pota (Dry during the winter season)
18. Hakuwa river
19. Mora Manas
20. Burisuta/Sukanjan
21. Garabdara
22. Marapagla
23. Jiya pagla
24. Lafasari nala
25. Kanyasanti nala
26. Artificial waterbodies.

There is no record of maintaining artificial water source in Manas National Park although there are signs on the ground that waterholes were created in the past inside the park. Occasional gully plugging of natural nallahs and streams are done during dry period to restrict the flow of water. A well-laid plan for improvement and development of existing water bodies to mitigate the shortage and scarcity of water in the event of drought is absent.

2.4. Climate:-

The climate of Manas is moist tropical with an annual rainfall between 3000 mm to 4000 mm. The climate can be divided into four distinct seasons based on the variation in the rainfall, temperature and winds. These are as follows:-

- a) Winter (December - February): Characterized by cool weather and fog. The temperature remains 20°C + 5°C. January is the coldest month. Average total rainfall is 114 mm with relative humidity of 77% + 5.
- b) Pre-monsoon (March - May): It is a transitional period between relatively dry winter and hot summer and is characterized by a rapid rise in temperature. As the season advances, the amount and frequency of rainfall increases due to frequent thundershowers with hailstorms. Average total rainfall during the season is 518.70 mm. The season is marked progressively by a greater number of cloudy days. Average temperature and humidity in this season are 23°C + 5°C and 70% + 5 respectively.

c) Monsoon (June-September): It is the characteristic major rainy season of the year. The average monthly rainfall is 2860 mm. The average temperature during this season is 27.17°C with an average diurnal range of over 6°C. The humidity increases to 82% + 5. August is the hottest month.

d) Retreating monsoon (October-November): Towards the end of September, the monsoon weakens with an abrupt retreat followed by fair weather. With the advancing of the season the temperature falls and moving mist and fog appears. The average temperature is 27°C + 2. The average monthly rainfall is 1400 mm and the rainy days become fewer. Relative humidity is 82% + 5.

2.4.1. Rainfall pattern and distribution: -

Heavy rainfall is confined in between the period from June to September of the year. The average rainfall during monsoon period is 4000 mm and the mean annual rainfall is 3000 mm. The period from December to February is relatively dry with rare showers of (rainfall 120 mm).

2.4.2. Temperature pattern and distribution: -

The temperature seldom touches mercury level 40°C and below 6°C in the area. The hottest months are June-July; the temperature ranging in between 31-38°C and the coldest is January.

2.4.3. Humidity pattern and distribution: -

The dry spell prevails during the period from November to March with relative humidity around 65 %. During the period from April to October the relative humidity swings as high as 86 % with a maximum of 94 % at times.

2.4.4. Wind speed pattern and distribution: -

The area experiences strong to moderately strong wind in the months of February-April. In other months the wind velocity is low.

2.4.5. Drought and its periodicity: -

There is practically no record of drought in the Park. The rainfall is, however, rare in the months from later part of December to February. But water scarcity is not acute during dry spell, owing to the presence of number of available perennial water sources.

2.5. Bio-Geographic classification: -

Manas National Park and Barnadi Wildlife Sanctuary along with the buffer areas represents a unique Tropical Humid Forest Biome under Brahmaputra valley [9a] province of the biogeographic zonation of India, in the Indo-Malayan realm. The entire reserve is spread along the Himalayan foot hills in the north of Brahmaputra valley, in a linear belt of about 40 kms wide at the broadest portion in the west and gradually narrowing in the east. The reserve encompasses Reserve Forests, National Park, Wildlife Sanctuary, Civil districts and village owned forest, alluvial savannah woodlands and alluvial grasslands.

2.6. Vegetation Cover Types in Manas National Park: -

The Forests of Manas National Park are classified into 6 types in accordance with the classification system of Champion and Seth (1968). These are as follows: -

a) 2 B/C/s - Sub Himalayan High alluvial Semi Evergreen Forests: -

This formation occurs in the northern belt of the Park. There is an emergent layer of Bhelu (*Tetrameles nudiflora*) trees which is characteristic of this type. Below this emergent

layer of deciduous species, the top storey is formed by Badam (*Mansonia dipikae*), Bogijam (*Eugenia jambos*), Bonsum, Amari (*Amoora wallichii*), Parali, Bogipoma (*Chukrassia tabularis*), Khokan (*Duabanga grandiflora*) etc. The middle storey is made up of Jia (*Lannea grandis*), Udal (*Sterculia vilosa*), Gohera (*Zanthoxylum rhetsa*), Brajanali, Lauraceous plants etc. The ground cover is made up of evergreen shrubs. Climbers are abundant and some of the species met with such formation are *Vitis*, *Thunbergia*, *Piper* and *Mikania* spp etc.



b) 3C/cb – Eastern *Bhabhar* Sal Type Forests: -

The Pure patches of Koroi (*Albizia procera*) occur in the moister parts along the bank of streams and rivers. Koroi occasionally pre-dominates such patches and associates are Simul (*Bombax ceiba*), Jam (*Eugenia jambolana*), Gamari (*Gmelina arborea*) and Udal (*Sterculia vilosa*). The middle storey is made up of young Bhelkhor, *Macaranga* species and occasionally Palash (*Butea monosperma*). The ground cover consists of fern, *Colocassia* spp, *Solanum* spp, etc. with occasional *Zizyphus* spp and *Eupatorium odoratum* in open locations. Infestation of the climber *Mikania scandens* is rather heavy and it forms a thick cover on the ground.

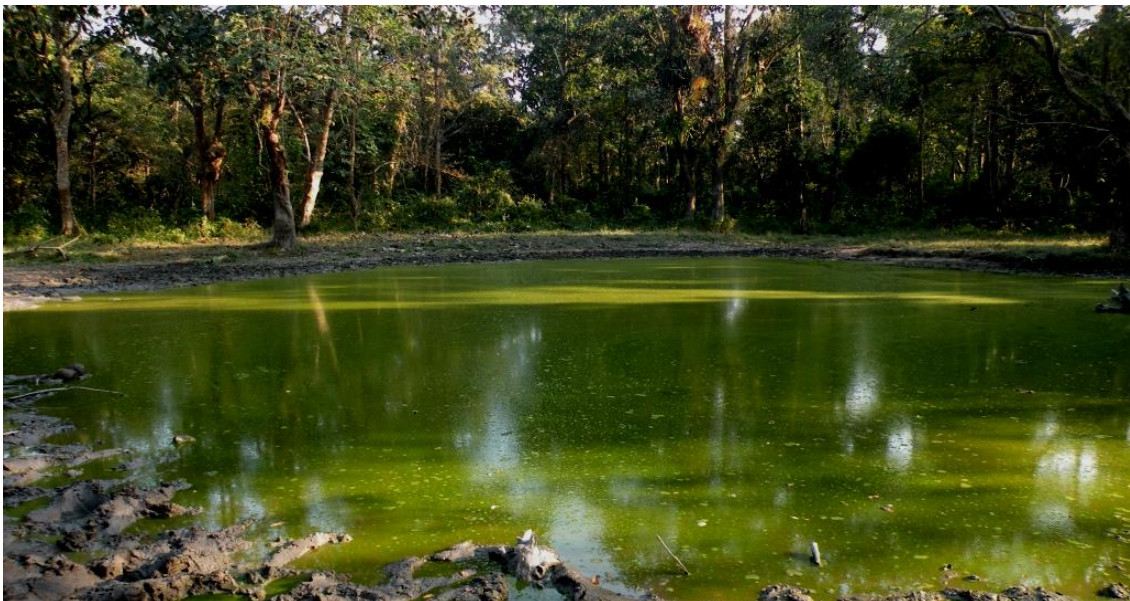
c) 3c/c3 – East Himalayan Moist Mixed Deciduous Forests: -

The formation covered by this type occupies some of the hill slopes near the northern boundary and the plain in *Bhabhar* areas. This type also occurs as strips and belts along the watercourses in the midst of savannah formations. The forests appear to be transitional in nature and are likely to pass on to the next stage (Semi evergreen) in presence of favourable circumstances like protection from fires in course of succession. Some of the other top storey spp met within the above formation are *Premna* spp Kathia, Koroi (*Albizia procera*), Kanchan (*Bauhinia purpurea*), Hatipolia (*Pterospermum acerifloium*), Dudhi, Siris (*Albizia lebbek*), Brajanali (*Zanthophyllum rhetusa*) etc. The middle storey is occupied by sapling of Sida, Bohera (*Terminalia belerica*), Hilikha (*Terminalia chebula*), Simul (*Bombax ceiba*), Parali, Jia, Poma, Kuhir and Hatipolia etc.



d) 3/s – Low Alluvial Savannah Woodlands: -

This type of forest occupies extensive area, which are subject to annual fires. Very scattered and stunted growth of Sida, Udal, Oxi, Kum and occasional Gamari is common site in such areas. Due to the absolute open conditions no differentiations into top-storey, mid storey is practicable. However, smaller saplings of tree species mentioned above along with Amlakhi (*Emblica officinalis*), Khair (*Acacia catechu*), Gundali etc. are also observed in such formation. Rare and solitude Sal (*Shorea robusta*) trees as well as in small groves are found in a few locations in the Park. Grasses occurring in this type are *Imperata cylindrica*, *Saccharum arundinaceum*, *Narenga porphyroconia*, *Arundinella bengalensis* etc. *Brynea bengalensis*, *Grewia sapida*, *Premna herbacea* etc. and terrestrial orchids are characteristic associates in this grassland.



e) 2B/c/ (a, b) – Assam Valley Semi-Evergreen Forests: -

This type occupies in patches in the moister soil of terrain belt of the Park. The top storey species in this formation are Paruli, Hatipolia, Owtenga (*Dillenia indica*), Poma, Uriam (*Bischofia javanica*) etc. The middle storey is made up of Kuhi, Kathia Koroï etc. The ground cover is represented by *Leea* spp *Desmodium* spp and *Alpinia* spp and various monocots. Epiphytic orchids like *Cymbidium aloifolium*, *Acampe multiflora*, *Dendrobium aphyllum*, *Dendrobium jenkinsii*, *Aerides multiflora*, *Rhynchostylis retusa*, etc. are wide spread.

f) 4D/2S2 – Eastern Wet Alluvial Grassland: -

On badly drained and low-lying locations, there is a change in composition of the crop and in such locations occasional Koroï, Urium (*Bischofia javanica*), Owtenga (*Dillenia indica*), Bhelkor and Simul (*Bombax ceiba*) are common. Some of the grasses found in such areas are *Saccharum procerum*, *Saccharum spontaneum*, *Apluda aristata*, *Erianthus* spp etc. In the extreme form of this type of forest containing perennial water bodies (swamps) and occasionally found trees are *Salix* spp, and *Polygonum* spp.

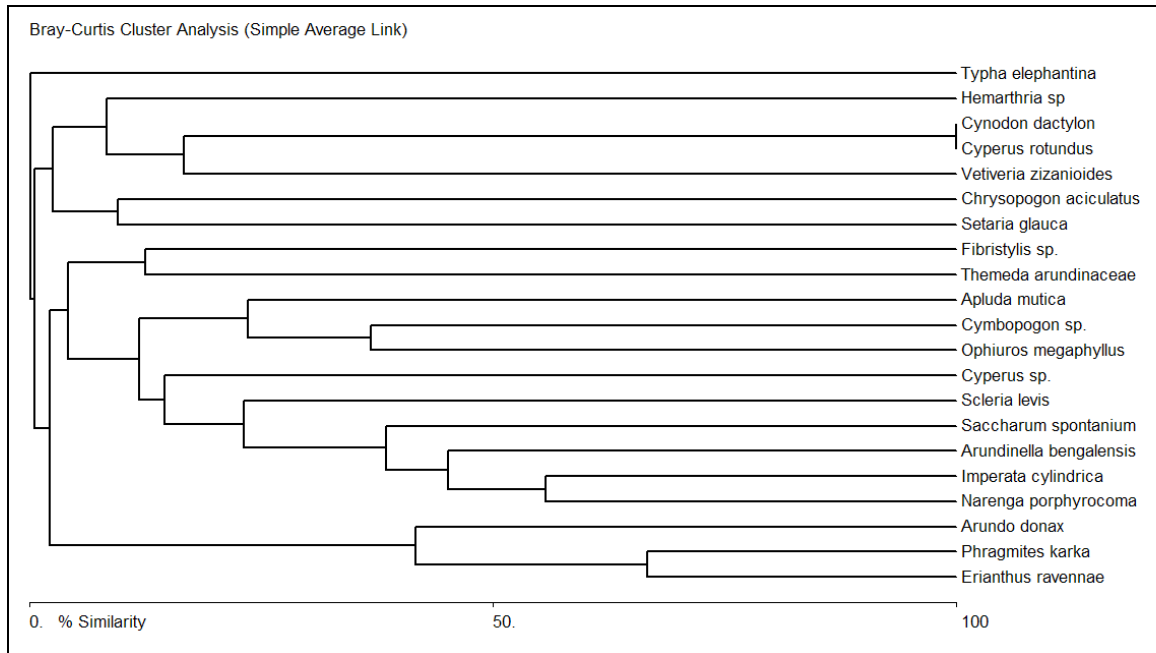


2.7. Distribution and status of Grassland types within Manas National Park: -

The lowland grasslands are amongst the most productive grassland in the world, which supports vertebrate biomass greater than in most other ecosystem (Seidensticker, 1976).

The large tracks of grasslands of Manas NP are some of the last remaining examples of terai grasslands in the Indian sub-continent. These grasslands are the key sites for biodiversity conservation and is not only restricted as unique habitat but also support wide range of endangered fauna. When Manas National Park was declared that time perhaps 60% of the park was occupied by grassland (Deb Roy, 1994). However, in recent years, the grassland ecosystem of Manas has been facing severe threats like habitat destruction, uncontrolled fire, livestock grazing and invasion of exotic weed etc. Currently these threats lead in reduction of grassland ecosystem of the park to about 45 percent.

There are seven types of grass species associations found in Manas National Park (Lahkar, 2008).

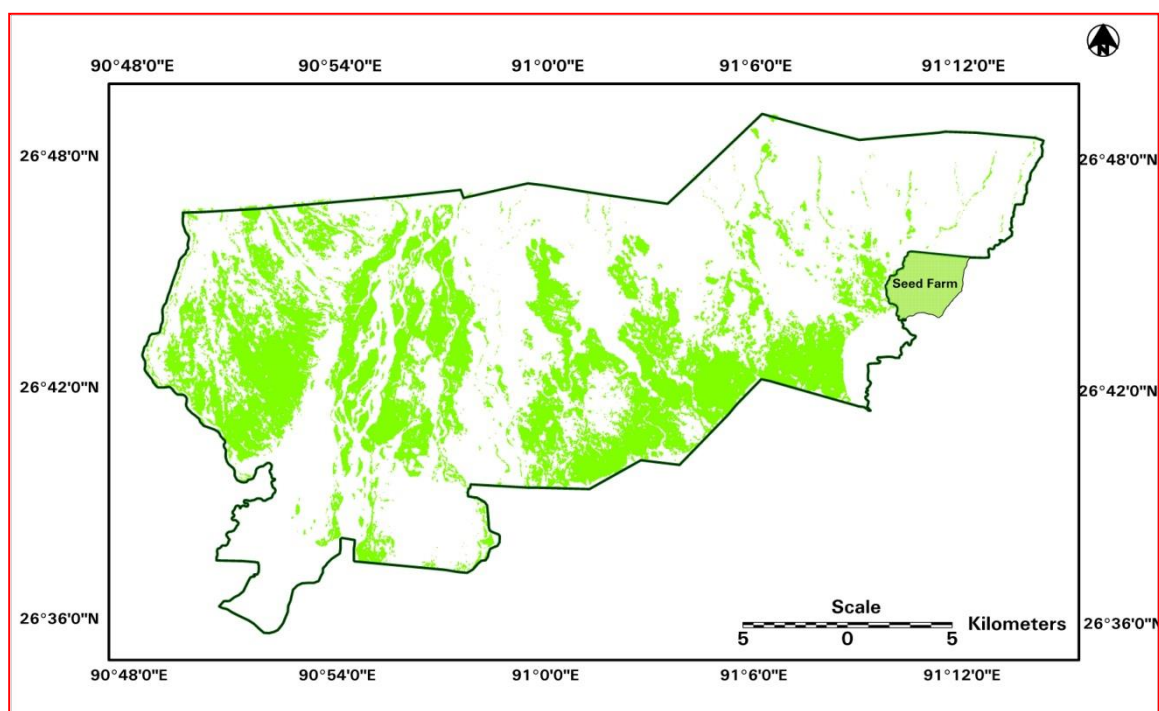


Cluster analysis of different grass species in Manas NP (Lahkar, 2008)

Further, grassland of Manas can be divided into Dry grassland and Swampy grassland. The details of these two types of grassland are as follows-

Dry grassland: - The area under this LSE type is 161.98 sq. km. (Fig. 6). This LSE type is distributed in northeastern part of the Park and in the southern boundary of the Park touching villages. The number of fragments in the LSE is 300. The mean patch size of the various fragments is 53.99 ha with a total edge of 2853.55 km, having an edge density of 176.1 m/ha. The mean shape index of this LSE is 1.24.

Map 2.6: Distribution of dry grassland patches



Some association which found in Dry grassland are as follows: -

***Imperata cylindrica*:** *I. cylindrica* was dominant, 25-100% cover, with *Saccharum spontaneum* 0-50%, *Arundinella bengalensis* 0-50%, *Narenga porphyrocoma* 0-50%, *Cymbopogon* sp. 0-50%, cover associated and sometimes codominants. Several other grass species occurred with *I. cylindrica* sward were *Ophiuros megaphyllus*, *Scleria levis*, *Vetiveria zizanioides*, *Setaria glauca*, *Cyperus* sp. *Grewia sapida* was strongly associated species. *I. cylindrica* sward was distributed all over the National Park. Sward height 0.5-2 m.



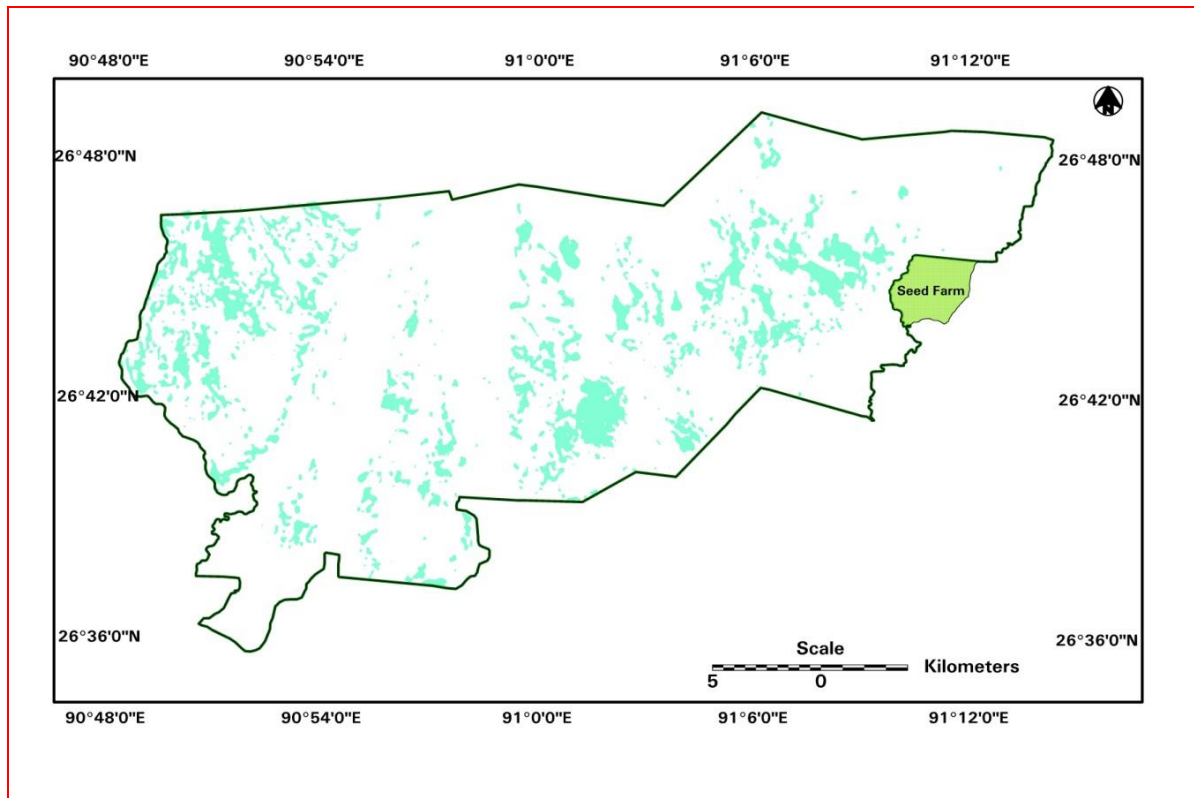
***Chrysopogon aciculatus*- *Setaria glauca*:** This assemblage was identified in the livestock grazed area, with over 75% cover dominated by *Chrysopogon aciculatus*. Other associated species were *Hedyotis unicella*, *Borreria hispida*, *Imperata cylindrica*, *Leucas aspera* and *Leea*. The soil moisture was found between 8-15%. Sward height 0.5 m.

***Cynodon dactylon*- *Cyperus rotundus*- *Vetiveria zizanioides*-*Hemarthria* sp:** *Cyperus rotundus*, *Vetiveria zizanioides* codominated with *Cynodon dactylon* which forms the cover between 10-75%. This assemblage occurred along the marshy land. *V. zizanioides* was found to occur in standing water, where as *C. dactylon* occurred in the highland near water body. This assemblage acts as a grazing lawn for herbivores.

***Cymbopogon* sp.-*Ophiuros megaphyllus*-*Apluda mutica*:** *Cymbopogon* sp., with 80% cover, was codominant with *Ophiuros megaphyllus*, 20% cover as a subdominant. *Apluda mutica* was weakly associated. *Scleria levis*, *Leea alata*, *Clarodendrum serratum* were the species that has been found. They were also recorded in association with this assemblage. This assemblage is more common in frequent burnt dry areas, with a sward height of 3-5 m. The soil moisture was found between 40-80%. This assemblage was found across the Bansbari range.

Swampy grassland: The area under this LSE type is 44.49 sq. km. (Fig. 7). This LSE type is scattered all over the Park. The number of fragments in the LSE is 39. The mean patch size of the various fragments is 114.07 ha with a total edge of 2878.1 km, having an edge density of 646.9 m/ha. The mean shape index of this LSE is 1.2.

Map 2.7: Distribution of swampy grassland patches



***Typha elephantina*:** This was a mono specific assemblage, dominated by *Typha elephantina*, with cover of as high as 80%. This was only common in permanently water logged areas and area of recent silt deposited around rivers. This assemblage was found in standing water and was particularly common in eastern parts of Bansbari Range and in Bhyunpara Range, especially in pools and ditches and on recent silt deposited riverbanks of Beki and all other rivulets inside the park. Sward height is 3-4 m.

***Phragmites karka-Erianthus ravennae-Arundo donax*:** *P. karka*, 5-75% cover codominant with both *Erianthus ravennae* and *Arundo donax*. *S. spontaneum* was found to be weakly associated. This assemblage occurred mainly in Bhuyanpara, Panbari and Bansbari range, on very wet sites, usually with standing water.

***Saccharum spontaneum*:** *S. spontaneum* dominant with greater than 80% cover. Occurred on coarse alluvial deposits on the riverbanks which were seasonally flooded, but completely dry in the dry season. Sward height varies from 1-5 m. Widely distributed along rivers in Beki, Hakuwa and other rivulets where it was the primary colonizing assemblages on newly deposited alluvium.

***Narenga porphyrocoma*:** *N. porphyrocoma* sward was widespread in the Manas National Park, where it dominated large areas of old river terrace in Bansbari, Bhuyanpara and Panbari

range. Tall, dense sward of *N. porphyrocoma* occurred on the wetter sites and often with scattered *Bombax ceiba* and *Dillenia pentagyna* trees.

2.8. Vegetation Cover Types in Barnadi Wildlife Sanctuary: -

As per Champion and Seth (1968), the forest types of Barnadi can be categorised as follows:-

- Pioneer Euphorbiaceous Scrub (1/2/2/B/C1/2S1)
 - Eastern Himalayan Moist Deciduous Forest (3C/C3b)
 - Eastern Hollock Forests-Terminalia -Duabanga (1S2(b))
 - Eastern Wet Alluvial Grasslands (1/4/4D/2S30)
 - Khair-Sissoo Forests (11/5/1S2)
- a) Pioneer Euphorbiaceous Scrub: In moist evergreen and semi-evergreen forests, if a heavy or clear felling is made and the area is left to its natural regrowth, it very commonly occurs that a cover of quick growing but short lived small trees is quickly established. The Euphorbiaceous general *Macaranga*, *Mallotus* and *Trema* usually predominate as a first in the secondary sere providing shade and shelter under which the slower and the less adaptable of the latter stages become established and ultimately push through and supplant the pioneers. The principal species are *Alpinia mollucensis*, *Casuarina verca*, *Laportea crenulata*, *Malastoma malaburicum*, *Phrynium* spp.
- b) Eastern Himalayan Moist Mixed Deciduous Forest (3C/C3b): This type consists of deciduous forests occupying well –drained soils on the bhabar terraces and comparatively higher uplands. The forest is tall and more or less closed. The individual trees often run to large size. The species are well mixed by small groups. There is abundant under wood and shrubby undergrowth without grass unless burnt. With burning, grass may become heavy through coarse tufted species are absent.
- c) The principal species are *Langerstroemia parviflora*, *Terminalia bellerica*, *Sterculia villosa*, *Salmaalina malabarica*, *Schima wallichii*, *Careya arborea*, *Bauhinia purpurea*, *Amoora* spp. etc. However, this is not a seral type, the succession being slow on the intensively drained soils occupied.
- d) Eastern Hollock Forests-Terminalia -Duabanga (1S2(b)): This develops on the young alluvium of large rivers. It is an irregular forest in which the *Terminalia myriocarpa* and *Duabanga* usually predominate being more or less evergreen and contributes the dominant canopy and form a fairly complete second story. The other species found are *Pterospermum*, *Ailanthus grandis* and *Vatica Lanceaefolia*.
- e) Eastern Wet Alluvial Grasslands (4D/2S2) : The grasslands occur in the cut-off meanders of the river Brahmaputra and similar low alluvial sites. These are deeply flooded (2-3m) during the monsoon but the stiff soil dries out completely in hot weather. This alternation appears to be too severe for tree growth and presumably the grassland formation will remain until slow siltation has raised the level considerably. Controlled annual burning, an important management intervention in habited management arrests the vegetation

progression. Thus this type may be regarded as an early arrested stage of the primary sere. The grasses are up to 5m high and very dense. The characteristic grass is *Saccharum procerum*, associated with it are *Phragmites kerka*, *Saccharum spontaneum* etc. Scattered trees of *Bombax malabaricum*, *Albizzia procera* and *Bischofia javanica* occur.

- f) Khair-Sissoo Forests (5/1S2): It is a deciduous forest in which *Dalbergia sissoo* predominates. The canopy is light but fairly complete and 18 to 25m high. *Acacia catechu* is usually but not always present, it does not grow as tall as the *Dalbergia* and in the mixture is often relatively inconspicuous, but sometimes it occurs pure. The older woods have more or less definite understorey, which is mainly composed of young trees, which will in time replace the *Khair-Sissoo* as the natural succession takes place. There is often dense deciduous shrubby undergrowth in the older woods still living much of the sandy soil exposed, the opener parts carry a few herbs of which *Cannabis sativa* is locally dominant and the grass of one or two species among which the xerophytic *Saccharum spontaneum* is very characteristic. These woods have one marked feature in which they resemble the moist more than the dry deciduous in that they come early leaf (March) and are in full leaf throughout the hot weather, this is however, actually a specific character of the dominant *Dalbergia* not shared by most of its associates.



2.9. Wild Fauna, Habitats and Trophic Niches: -

The Manas National Park harbours 61 species of mammals, 450 species of birds, 42 species of reptiles, 9 species of amphibians, 79 species of fishes and more than 200 species of butterfly and 100 species of invertebrates.

Manas NP supports one critically endangered, seven endangered, ten vulnerable mammals; five critically endangered, two endangered, eighteen vulnerable birds and four endangered and nine vulnerable reptiles.

- a) Mammals: The main carnivores of MTR are Tiger (*Panthera tigris tigris*), Leopard (*Panthera pardus*), Clouded Leopard (*Neofelis nebulosa*), Leopard Cat (*Prionailurus bengalensis*), Fishing Cat (*Prionailurus viverina*), Golden Cat (*Catopuma temmincki*), Jungle Cat (*Felis chaus*), Marbled Cat (*Pardofelis marmorata*), Himalayan Black Bear (*Ursus thibetanus*), Sloth Bear (*Melursus ursinus*), Mongoose (*Herpestes edwardsi*), Wild dog (*Cuon alpinus*), Hog badger (*Arctonyx collaris*), Civet Cat (*Viverricula indica*), Indian fox (*Vulpes bengalensis*), Jackal (*Canis aureus*) etc.
- b) Among the herbivores of Manas Tiger Reserve, the pre-dominants are Elephant (*Elephas maximus*), Wild Buffalo (*Bubalus bubalis*), great Indian one horned Rhino (*Rhinoceros unicornis*), Gaur (*Bos gaurus*), Sambar (*Rucervus unicolor*), Swamp deer (*Cervus duvaucelli duvaucelli*), Barking deer (*Muntiacus muntjak*), Hog deer (*Axis porcinus*), wild pig (*Sus scrofa cristatus*), Hispid Hare (*Caprolagus hispidus*). Other key mammals of the park are like golden langur, capped langur, slow loris, pygmy hog, Malayan giant squirrels and Chinese Pangolin (*Manis pentadactyla*) etc.



In the following pages, an up to date status and conservation assessments of important fauna have been described. The greater understanding of these will be essential towards retaining the national and international designations.

2.10. Conservation status of Great One Horned Rhinoceros:-

The Great One horned Rhinoceros (*Rhinoceros unicornis*) is an important flagship species for Manas and Assam and its conservation has been one of the critical factors towards reinstatement of Manas as a World Heritage Site in 2011. A detailed Chapter 13 is therefore dedicated to the management and action plan for conservation of Rhinos in Manas National Park.

2.11. Conservation status of Pygmy hog: -

The Pygmy hog (*Porcula salvania*) is a critically endangered species belonging to the Family Suidae. It was previously spread across India, Nepal, and Bhutan, but now only confined to a few areas in Assam. Locally it is called as Nal Gahori, Tukuri Borah in Assamese, Oma Thaoukri in Bodo and Sano Banel in Nepali language. Current world population is estimated at about 150 individuals or fewer (Narayan *et.al.*, 2008). The species was formerly referred to as *Sus salvanius* as it was believed to be closely related to the Eurasian wild pig (*Sus scrofa*). However, recent mitochondrial DNA studies have revealed that it belongs to a separate monotypic genus *Porcula* (Funk *et al.* 2007).

Under the Pygmy Hog Conservation Programme (PHCP), a collaborative conservation programme of Assam forest Department and partners, a camera trap exercise was conducted in 2018 September to access pygmy hog population in Kuribeel area. But, elephant and grassland fire damaged majority of the Camera Traps and no photograph was captured. Again, with active cooperation from Pygmy Hog Conservation Programme (PHCP), a detailed sign survey was carried out after grassland burning to record evidence of Pygmy hogs. It was started in November, 2018 and completed in 2019 April in all the ranges.

Figure 2.2: Field Identification characters for Pygmy Hog (Photograph: PHCP/Durrell)



From Clockwise: A Pygmy hog, freshly build nest, Pygmy Hog pellets, A burned Nest.

Location→ Sign↓	Sidhajar	Panbari	Rupohi	New Buraburi	Mahal	Podum Pukhuri
Nest	47	30	0	0	0	0
Suspected Nest	0	0	1	2	3	6
Pellets	43	80	0	0	0	0
Foraging sign	6	0	0	0	0	0

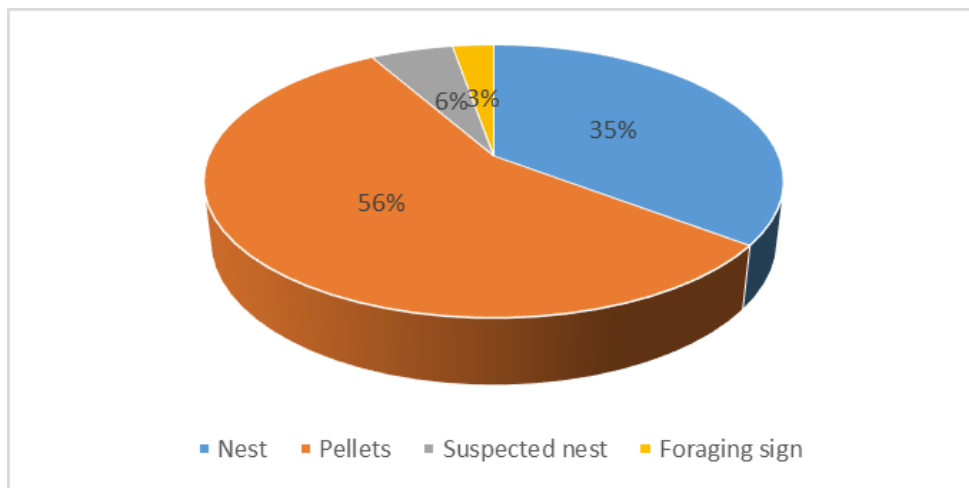


Figure 2.3: Percentage of pygmy hog signs in Manas NP

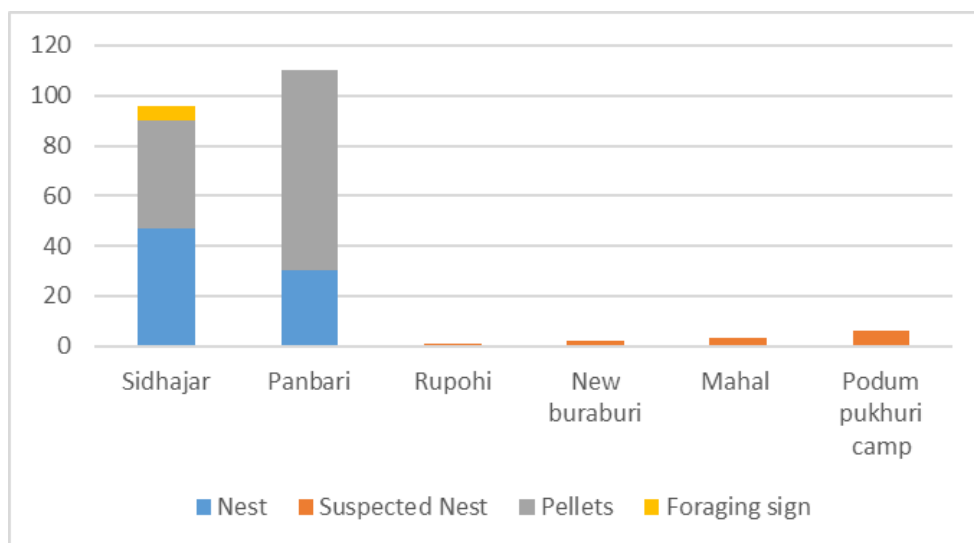


Figure 2.4: Pygmy hog signs in different location of Manas NP

Almost all locations of Pygmy hog presence were reported in the grasslands, indicating a clear preference for the species to remain in such areas.

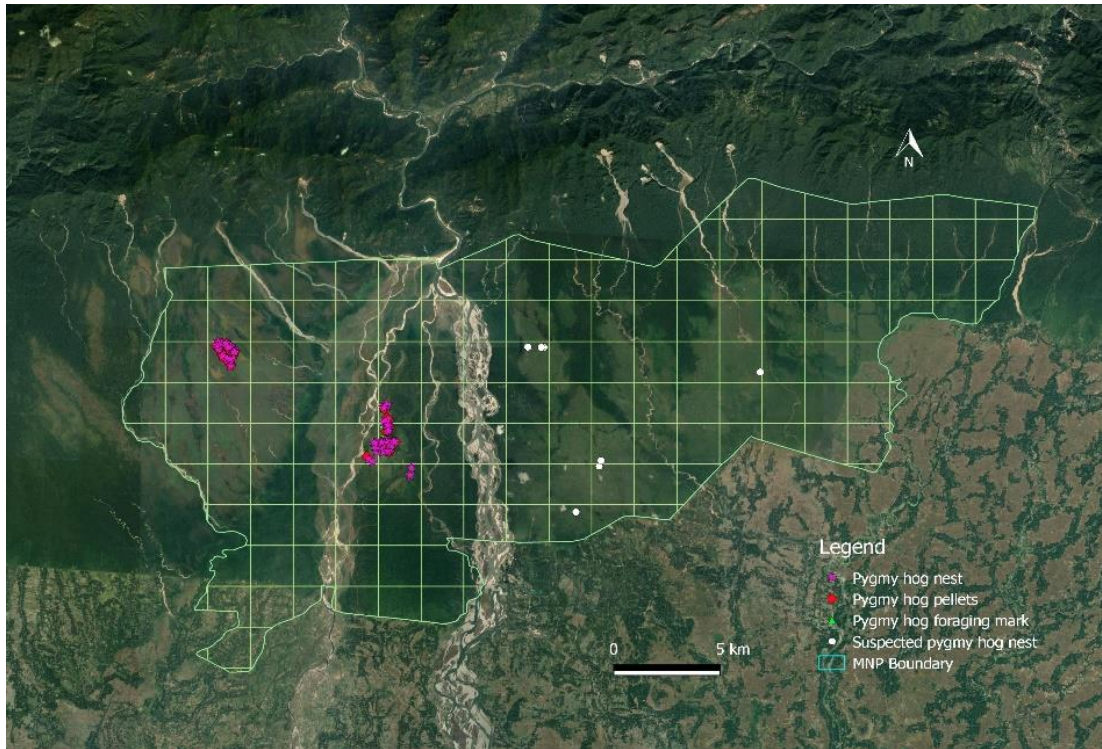


Figure 2.5: Pygmy hog distribution recorded during sign survey 2018-2019

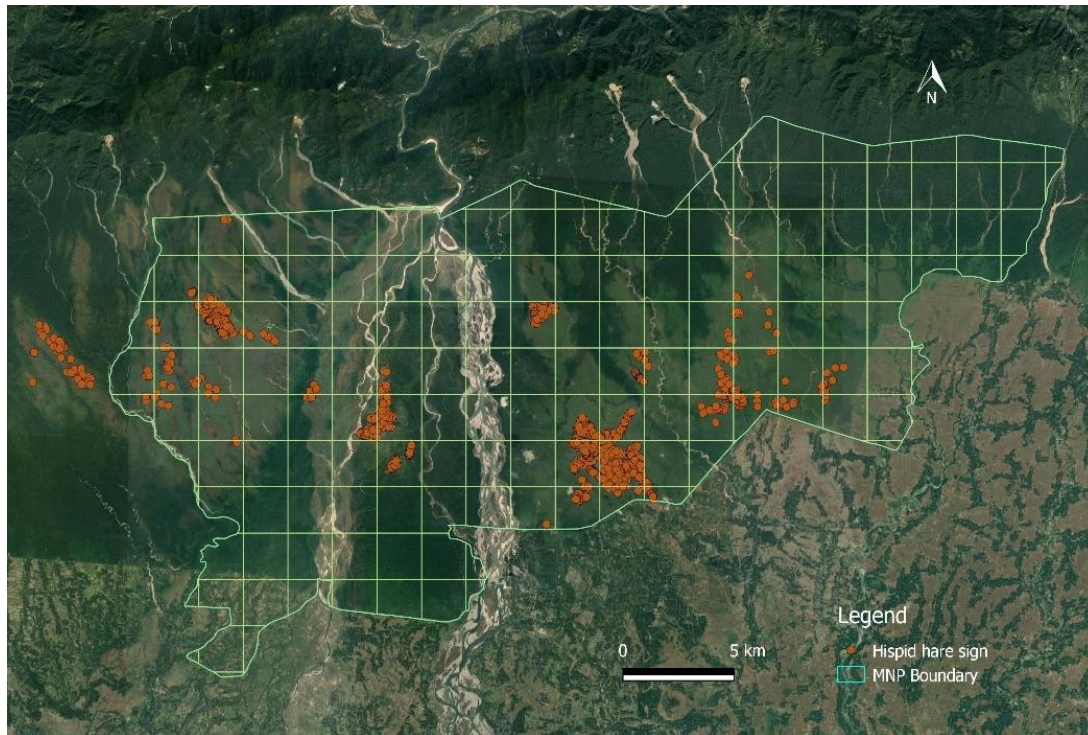
2.12. Conservation status of Hispid Hare: -

Hispid hare (*Caprolagus hispidus*) belongs to order Lagomorpha and the monotypic genera *Caprolagus* of Family Leporidae and is distributed along the Bhabhar-Terai belt of India, Nepal and Bhutan and possibly a few locations in Bangladesh. The English name is Assam Rabbit or Bristly hare whereas it is known as Sesa in Bodo and Hoha pahu and Khagrakata in Assamese. In comparison to the Indian hare, they have shorter hind legs, smaller ears (5-6 cm) and a shorter tail (3 cm). The skull is with prominent supra-orbital bones and a long nasal region. The genus *Caprolagus* is monotypic *i.e.*, having only a single species the Hispid hare (Maheswaran, 2002).

Figure 2.6: Field identification characters for Hispid Hare



Figure 2.7: Distribution of hispid hare (based on pellet samples) in Manas National Park



Location→			
Sign↓	Bansbari	Bhuyanpara	Panbari
Hispid hare sign	771	236	236

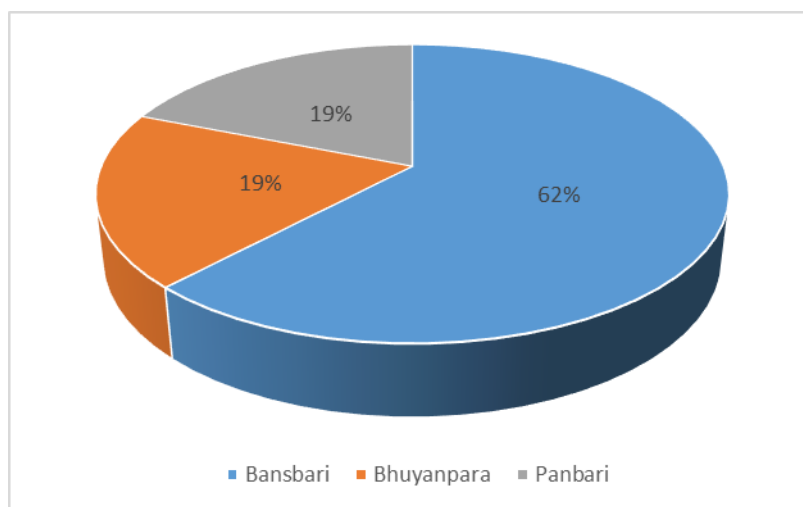


Figure 2.8: Percentage of Hispid hare sign in 3 Range of Manas NP

On plotting the Hispid hare presence locations on a forest/grassland map, it was clearly indicated that they showed a habitat preference for the short alluvial grasslands.

Figure 2.9: Field identification characters for Hispid Hare (photos by Dr Kaushik Deuti, Hispid Hare photo: Dr Bhaskar Choudhury)



Fig 2.10: Distribution of hispid hare (based on pellet samples) in Manas National Park

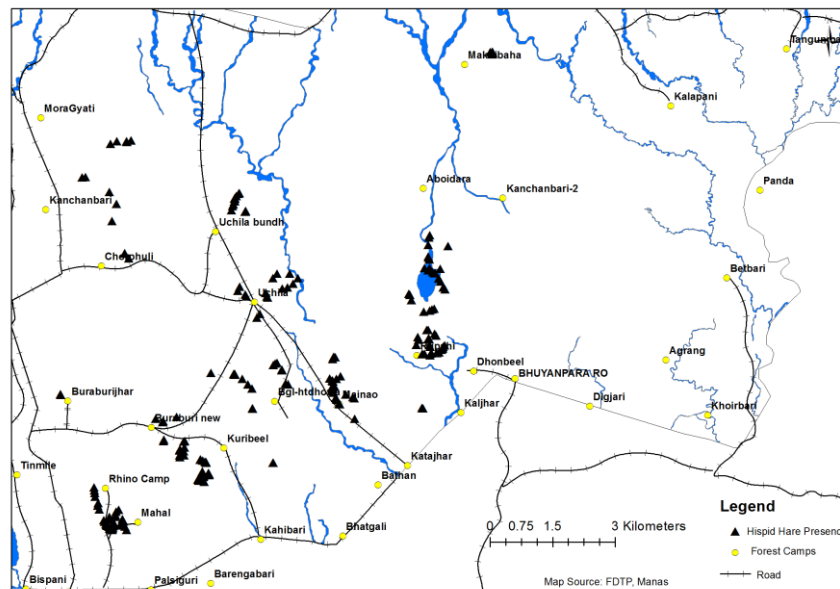
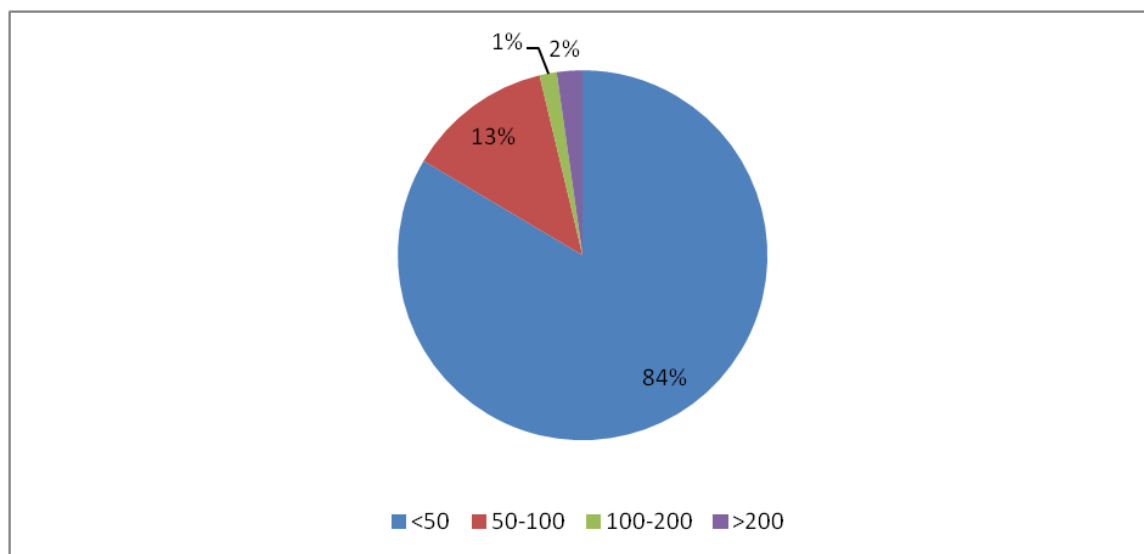


Table 2.1: Average Pellet frequency recorded for Hispid Hare in Manas National Park

No. Of Pellets	Frequency	Pellet pile	Frequency
<50	224	Fresh	35
50-100	34	Old	224
100-200	4	Degenerated	9
>200	6		

Figure 2.11 : Percentage of pellet groups recorded for Hispid Hare in Manas National Park

Based on the total km walked, the highest number of pellets were found at Rhino camp, although the total encounter rate/km was highest in Kuribeel followed by Uchila Bandh.

Table 2.2 : Encounter Rate of Pellet pile of Hispid Hare in different camp site.

Sl. No.	Name of the camp	Total Km walked	No. of pellet pile	Encounter rate/km
1	Kuribeel	4.4	37	8.40
2	Rupahi	4.5	33	7.33
3	New Buraburi	6.2	21	3.38
4	Uchila Bandh	2.2	14	6.36
5	Makhibaha	2	9	4.50
6	Rhino Camp	10.02	50	4.99
7	Bengal	9.46	18	1.90
8	Kanchanbari	5.8	9	1.55
9	Mainao	4.9	31	6.32
10	Uchila	7.33	17	2.31
11	Abaidara	7.67	22	2.86

Table 2.3 : Number of Hispid Hare pellet piles with relation to total km walked at different camp sites in Manas National Park

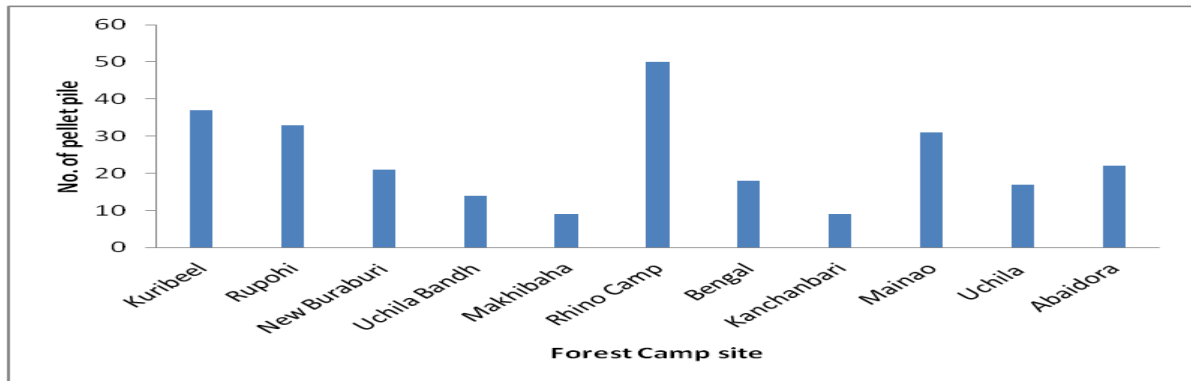
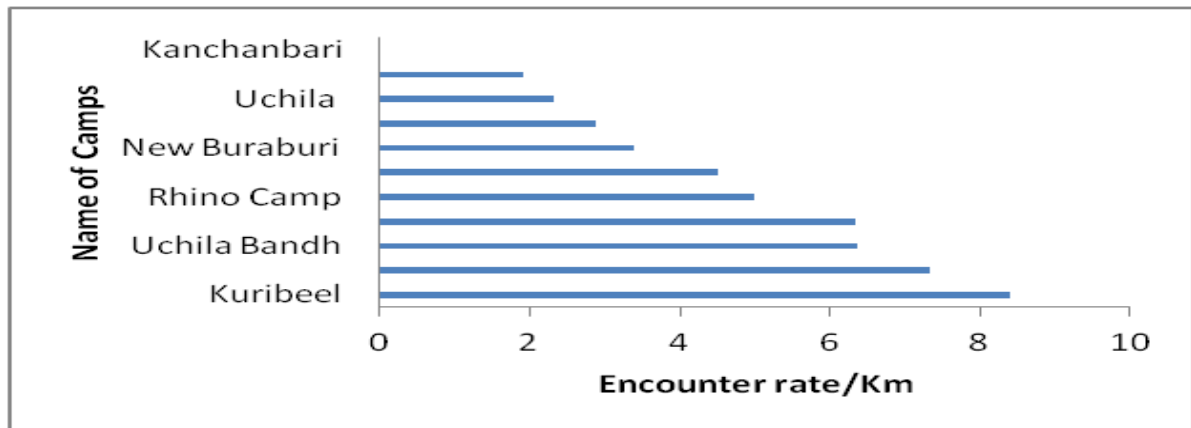


Figure 2.12: Encounter rate pellet groups/km for Hispid Hare at Manas National Park



On plotting the Hispid hare presence locations on a forest/grassland map, it was clearly indicated that they showed a habitat preference for the short alluvial grasslands. A few locations that were located at Uchila bundh were at the forest-grassland edge, indicating a temporary refuge in the intervening savannah during the burning season.

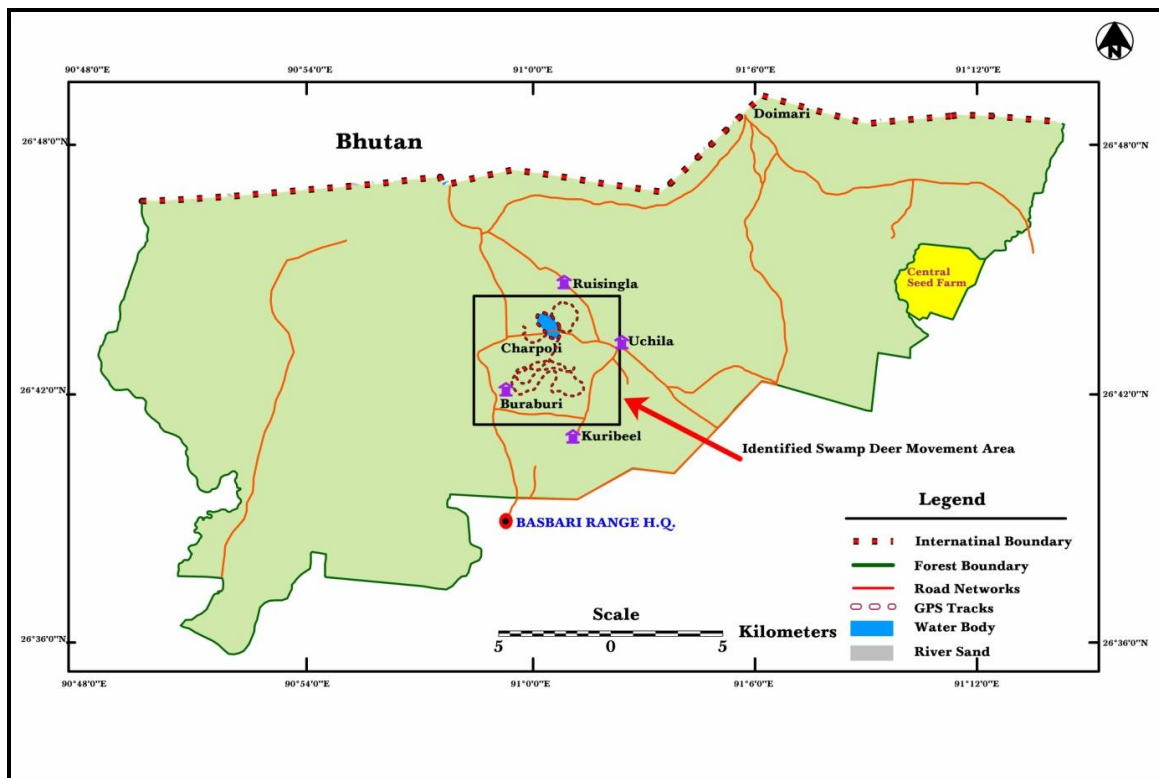
2.13. Conservation status of Swamp Deer : -

The Eastern Swamp deer (*Rucervus duvaucelii ranjitsinhi* Groves, 1982) is called Dol Horina (দল হরিণা) in Assamese. This sub-species was very common in the flat alluvial plains covered with tall grasses in the Brahmaputra valley and in the grasslands of flat to moderately hilly terrain especially along the Assam-Bhutan border (Jerdon, 1872). There was a healthy population of Eastern Swamp deer with more than 500 individuals in 1987 in the grassland of Manas National Park prior to the civil unrest (Deb Roy, 1991; Saikia *et al.*, 2012 & Borah *et al.*, 2013). But, the populations of this sensitive herbivore species were almost exterminated due to the politico-ethnic disturbance that started in and around the landscape in the late 1980s (Das *et al.* 2009; Goswami & Ganesh, 2011, 2014). Swamp deer were hunted locally for their ornamental antlers and meat by opportunistic poachers and anti-government forces.

Manas National Park still contains a small population of Eastern Swamp deer despite the onslaught of hunters during the period of unrest which was confirmed by camera trapped

photographic evidences of Eastern Swamp deer at Manas NP by Borah *et al.*, in 2013. This small population however risked of getting obliterated with sudden biological and anthropological changes in the park. Therefore, as a part of the Eastern Swamp deer population recovery in Manas National Park, a translocation program was developed on recommendation from UNESCO World Heritage Site Committee by Assam Forest Department in collaboration with Wildlife Trust of India. Under this program, a group of 19 individuals and 17 individuals of Eastern Swamp deer were translocated subsequently in two batches from Kaziranga National Park to Manas National Park in December, 2014 and February, 2017 respectively following a strict Swamp deer translocation protocol (UNESCO, 2016, WTI, 2018). Both the herds of Eastern Swamp deer were successfully acclimatized and released into the wild of Manas National Park. In the recent population estimation exercise of Manas NP (2019), a total of 83 individual of Eastern Swamp deer were recorded in both Bansbari and Bhuyanpara the ranges of Manas National Park. In concurrence of the translocation protocol, the annual population estimation exercises would be conducted through “block count” method to assess the progress of the restocking exercise. In the near future, restocking with a few individuals would be considered to supplement the keep the population ecologically viable.

Fig 2.13 Distribution of Swamp deer in Manas National Park



2.14. Conservation status of Hog deer: -

Hog deer *Hyelaphus porcinus* (earlier *Axis porcinus*) is a tropical deer belonging to family cervidae. Hog deer was known to occur from Pakistan in the west to the Vietnam in the east through northern India, Bhutan, Nepal, Bangladesh and Myanmar (Dhungel and Gara

1991, Biswas and Mathur 2000). But presently it has been wiped out from many of its historical distributional range and has been categorised as endangered by IUCN. In India, hog deer is included in Schedule I, the highest protected category of Wildlife (Protection) Act 1972.

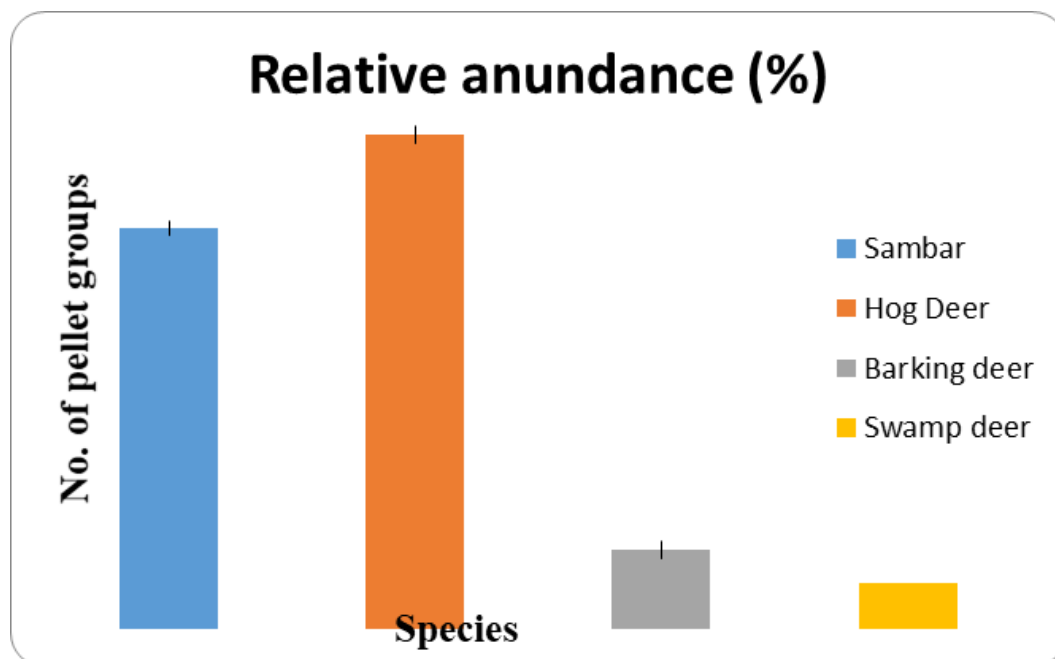
Hog deer is grassland dependent species and in India it is found mainly in the terai grasslands along the Himalayan foothills and the flood-plains of the Rivers Ganges and Brahmaputra (Johnsingh *et al.* 2004, Biswas 2004). Hog deer is relatively abundant in the protected areas of Assam viz., Kaziranga & Manas Tiger Reserve and Orang National Park. A total of 10,000 hog deer were reported during 1983 (Tikader 1983) in Manas Tiger Reserve. The last survey indicated that there were >1000 hog deer in Manas and reportedly, Manas has the potential for the best site for hog deer provided adequate protection is ensured (Biswas *et al.* 2002).

Current distribution and status of hog deer in Manas National Park: -

Hog deer distribution in Manas is patchy. In the management regime of Bansbari and Bhuyanpara ranges, the grass cover is more towards the southern side of the park. While in Panbari range the grass cover is towards the northern side. Hog deer being obligate of the grasslands; its distribution too corresponds with the grassland distribution of the park.

The encounter rate for hog deer in Bansbari and Bhuyanpara range is 1.89/km (based on six-month data January- June). As per the forest department census report of 2008 a total of 1626 individuals of hog deer are present in the park. Though primarily solitary in nature, they congregate for feeding and the group size may range from 2-22 in certain locations in Manas.

Assessing the pellet groups following dung plots; the relative abundance of hog deer pellet group is 51.02 ± 0.92 (A., Sinha, 2009). Hog deer was found to prefer significantly grassland over woodland ($\chi^2 = 6.46$, $p < 0.05$, $DF = 1$).



Major Threats of Hog deer in Manas: -

- Spread of invasive species: - The spread of invasives like *Mikania micarantha* and *chromolaena odorata* is deteriorating the prime grassland habitat, which is a serious concern. Also the occurrence of *Bombax ceiba* saplings and *Dillenia pentagyna* in the grassland patches are emerging as potential threat for the species.
- Grassland fire: - The fawning season of hog deer which starts from late January and reaches its peak in March also coincides with the grassland burning. Though soon after the burning new sprouts are nutrient rich forage for hog deer; but uncontrolled burning may lead to the loss of necessary cover during fawning making them vulnerable to predation.
- Livestock grazing: - Grazing of livestock substantially reduce the forage quantity and quality for the hog deer. In Manas, nearer the southern boundary livestock grazing is quite rampant. These areas are also extensively used by the deer. Transmission of diseases from this livestock is another potential threat.

2.15. Conservation status of Asian elephants: -

The elephants are one of the widely studied animal across its range. Although the Asian Elephants have also been studied in all aspects during the last one century (Daniel, 1980; Ishwaran, 1984; Jackson, 1985; Oliver, 1978; Santiapillai & Suprahman, 1986; Storer, 1981; Sukumar, 1989), particularly in southern India. However, its status and ecology in northeast India remains poorly known (Choudhury, 1999).

Despite the importance of the population in Manas, there has never been a systematic evaluation of the conservation status of elephant population here, apart from sporadic survey by the government. Prior to 1980, information about Manas elephant population was scarce. Nevertheless, it is clear that Manas supported a large and a very important elephant population as the Park area has exclusive share of its northern boundary with dense tropical forest in Bhutan. The elephant population in Manas survived during and after the civil turbulence in the region. There is an urgent need for information on elephant population in Manas to improve and plan future conservation actions.

Status: - Reliable assessment of large mammal population sizes are crucial for the management protected areas (Waltert et al., 2008). The Asian elephant are long – lived animals that reproduce slowly and live in forested habitat, hence, observations in the wild are difficult to obtain (Williams et al., 2007). Estimates of population numbers or densities are some of the basic information required to formulate proper management and conservation strategies (Williams et al., 2007). Hedges et al (2005) mentioned that Sukumar (1992) provided only general estimates of elephant population in the Indian subcontinent therefore, it not a surprise that the frequently cited global estimate of 34,000 – 51,000 Asian elephants is acknowledged as little more than an educated guess (Kemf and Santiapillai, 2000; WWF, 2002; Blake and Hedges, 2004).

Earlier estimates of population size: - In 1981, the Department estimated about 1200 elephants in the Manas Tiger Reserve comprising an area of 2837 sq. km. (Census report, 2008). Again in 2002, department census revealed the presence of 500 elephants in the Park (Census report, 2008). Now the Park holds more than 780 elephants (Census report, 2008). Recent census by the department reported an estimated population of approximately 780

elephants in the Park with a density of 1.68 per km² in the year 2008. It is a major challenge to estimate accurate large mammal population size in protected area like Manas, which is crucial for both monitoring success of existing management actions for formulating future management strategies.

Das (2011) has extensively carried out population estimation of Asian elephants in Manas National Park following dung count method using line transect. This was for the first time dung count method was used in the Park to assess the population status of elephants.

He assessed elephant density as 1.79/ km² in Manas NP at CV = 10.08 % and approximately 895 ± 112.4 numbers of elephants with a CV of 18.4 % in the Park.

He further calculated the density in dry and wet seasons in the Park. The result showed a density of 2.17/ km² at a CV = 10.43 % during dry season with a population of 1085 ± 143.8 elephants. In the wet season, the density goes down to 1.25/ km² at a CV = 22.54 % with 625 ± 104 elephants. The semi evergreen forest, the overall density was estimated at 2.15/km² at a CV = 21.42 % with elephant number 375.28 ± 65.3.

The mixed moist deciduous forest in the Park covers an area of 65.61 km² (Sarma et al., 2008). The density in this type of forest was estimated to be 1.58/ km² at a CV = 19.35 % with elephant number ranges from 103.66 ± 58.6.

In the grasslands (in the both types of dry savannah and wet alluvial) the overall density of the elephants was 1.76/ km² at a CV = 15.8 %. The total area of grasslands in the park was 206.47 Km² (Sarma et al., 2008). The total number of elephants in the grassland, irrespective of any season was 363.38 ± 114.82.

Das (2011) further sighted 97 (95 % CI = 69-115) adult male in the park which forms 10.83 % of the total population estimated. There were 18 adult males having tusks that shows that >80 % males were tuskless.

The mean herd size encountered was 4.64 ± 1.28 (95 % CI) in the park, while in the grasslands it was 5.72 ± 2.42 (95 % CI). The mean herd size in the mixed moist deciduous forest was 5.53 ± 2.48 (95 % CI) and in the semi evergreen forest, it was 1.96 ± 0.59 (95 % CI). The smaller herds frequented more in the study area could be the reflection of the forested habitats like elsewhere (Peek et al., 1974; Leuthold, 1976). The bigger size herds that were encountered few times in the study area could be aggregation of different family units (Laws et al., 1975) and have no long term cohesion (Ishwaran, 1984). The sex ratio of the population was estimated as 1: 1.72 (male: female) with more than 80 % tuskless male.

Distribution: - The elephants in Manas are widespread across the landscape as they once were. However, in the recent years, their distributional range has been heavily fragmented and shrunk in the western part of the Tiger Reserve, primarily because of human activity. Continued fragmentation and habitat destruction may influence the viability of the remaining population in the landscape. Because of habitat loss and fragmentation, there are chances of the population may get isolated in small pockets and hence there will be constraints in demographic and genetic variables. Already the increased intensity in conflict in the fringe areas has suggested the impact of habitat loss. Fragmented population may also go extinct faster than continuous population even when overall population size is the same (Burkey, 1999).

Management: - The population in Manas has always drawn attention because of international importance as the Park is touching its northern boundary with Bhutan and reserve forests on the east and western side. Hence the Park is utilized significantly by the

elephants during both seasons. This ‘open’ population gains added importance as it continuously crossing into Bhutan and maintaining a better genetic sustainability across the larger landscape. While the civil unrest problem in the region is regrettable, the continued presence of a considerably healthy population in the landscape is remarkable. The increased conflict in the fringe areas of the Park (Lahkar et al., 2008) and considerable change in the land-cover types in the study area (Sarma et al., 2008) has potential threat to the long term existence of elephants in the region. This will be the biggest challenge for us in the coming years how we can manage these issues for the future of elephants. The western part of the Ripu Chirang Elephant Reserve has extensive deforestation during the last decade or so and the existing gaps have further widened and some large prime habitat of elephants have already been lost, e. g. parts of Kachugaon and Holtugaon forests (Choudhury, 1999). Little is known about how much unfragmented habitat remains inside the species’ geographical range. This is essential for long term conservation of elephant, because elephant depend on entire landscape rather than a few habitat patches (Leimgruber et. al., 2003) and Manas is a supreme landscape for the elephants.

The population in Manas National Park can be mentioned as demographically healthy from the population characteristics. The inter crossing of herds from Bhutan and other Reserves needs to be maintained well to ensure the chances of genetic flow at a larger landscape level. Except few incidences of elephant death, there has not been any poaching incident recorded officially. However, increased conflict in the fringe areas is a cause for worry as it exposed the inadequacy of protection resources.

Figure 2.14 Density of elephants in three different habitats in two seasons

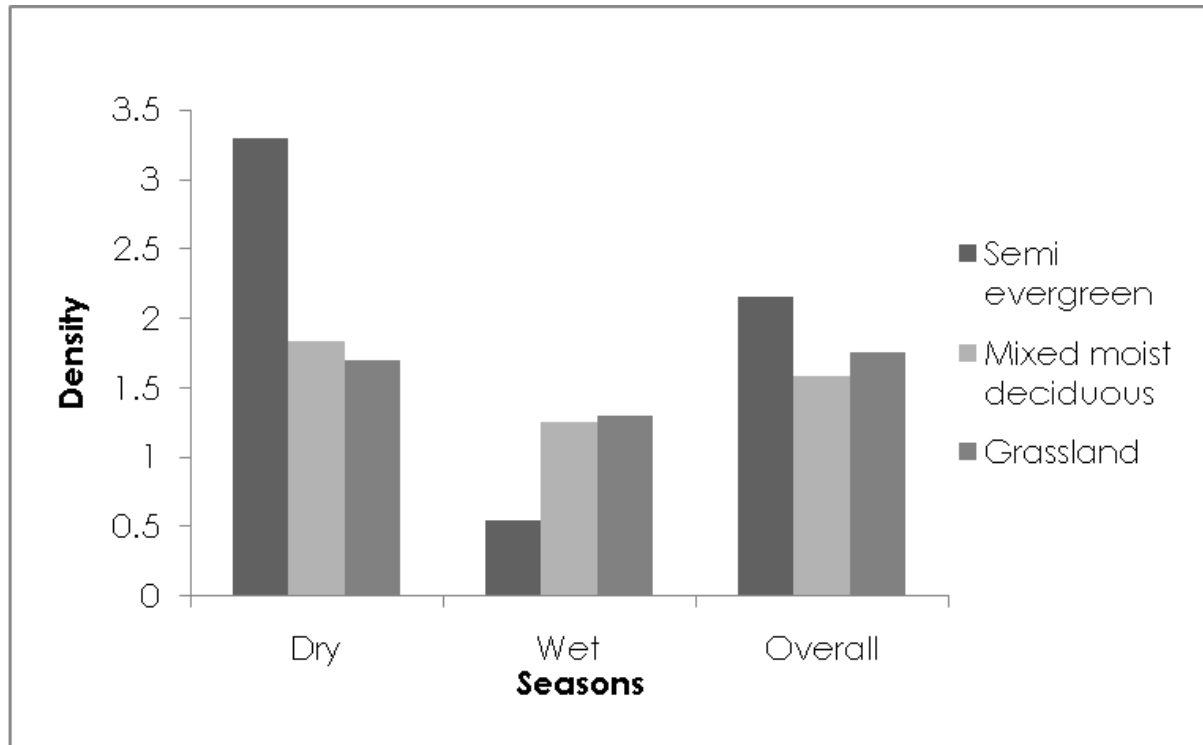
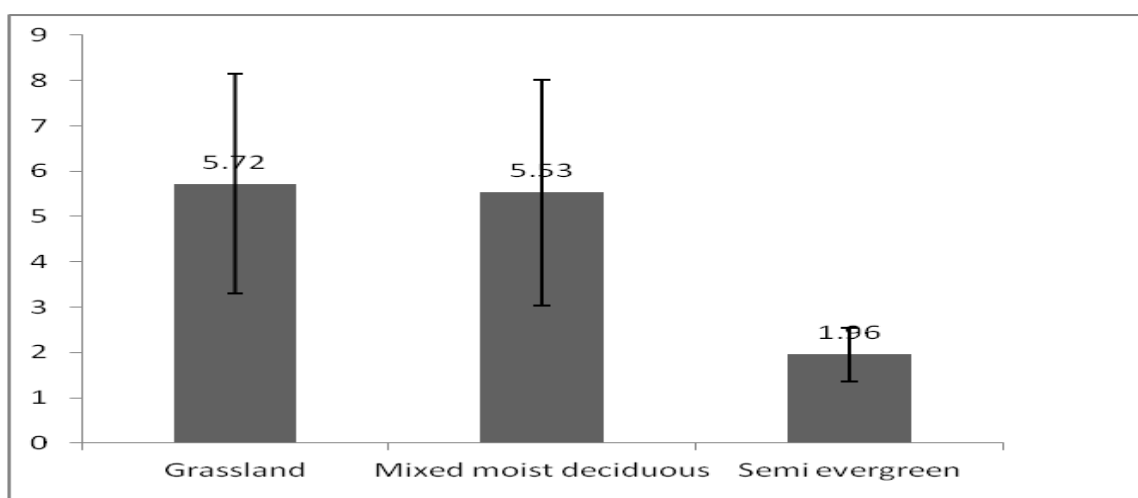


Table 2.4. Age-sex classes of sighted elephants by Das (2011)

Age Class	Mean	95 % lower CI	95 % upper CI
Adult male	71	53	90
Adult female	126	103	148
Subadult male	47	24	62
Subadult female	82	62	104
Calves	86	61	112

**Figure 2.5 Mean herd size in three different habitats after Das (2011)**

2.16. Conservation status of bats: -

The Chiropteran fauna of the north eastern part of India is exceptionally diverse with at least 70 species, a few of which have recently been reported from India (Bates and Harrison, 1997; Sinha, 1999; Ruedi *et al.* 2012). This constitutes well over fifty percent of the total bat species diversity (123 species) from India (Ruedi *et al.* 2012; Sanecha and Dookia, 2013). However, compared to the whole north eastern region, the bat diversity of the state of Assam is seemingly poor at about 29 species (Bates and Harrison, 1997; Sinha, 1999; Boro and Saikia, 2013) which may partly be attributed to the lack of field studies in the state. Despite the tremendous ecological role played by bats in maintaining a healthy ecosystem, they are probably the least explored mammalian group especially in the north-east Indian context. In this backdrop, the authors initiated a series of preliminary field surveys in Manas National Park of Assam to assess the bat diversity of the park especially in the Bansbari Range area located in the north-western part of the state. It is bordered by Bhutan in the North, Bhuyanpara Range in the East, in the western region it is bordered by the Panbari Range of the park and towards the south it is bordered by the fringe villages of the Baksa district itself. The range covers an area of approx. 526.22 sq. km. Vegetation is dominated by tropical moist deciduous type and sporadically semi-evergreen forest.

Methodology: -

The field surveys were conducted between 29th August of 2014 and 1st September of 2014 in selected pockets of Bansbari Range office namely, Mathanguri, 17 Specimen were collected using mist net at the evening hours and after getting the character matrix it was released back where it was captured.

Results and Discussion:

During the field surveys, a total of 17 specimens were collected and were identified into 9 species in 3 families. Thus the present species inventory stands at 9 species under 6 genera and 3 families as listed-

Sl. No.	Family	Species	IUCN Conservati on status	Habitat/ Surrounding	Location
1	Pteropodidae	<i>Pteropus giganteus</i> (Brunnich, 1872)	Least Concern	Observed in flying condition.	Seen nearby Bansbari Range office at the evening hours.
2		<i>Cynopterus sphinx</i> (Vahl, 1797)	Least Concern	It was seen feeding guavas.	At Mothanguri Campsite.
3	Megadermatidae	<i>Megaderma lyra</i> (E. Geoffroy, 1810)	Least Concern	Damaged/Un used House./Thick Semi Evergreen Deciduous Forest	Narayanguri Campsite.
4		<i>Megaderma spasma</i> (Linnaeus, 1758)	Least Concern	Damaged/Un used House./Thick Semi Evergreen Deciduous Forest	Mothamguri Campsite [N 26°46'47.0" E 90°57'44.1"].
5	Vespertilionidae	<i>Scotophilus heathi</i> (Horsefield, 1831)	Least Concern	Nearby human habitation at crevices of betelnuts./Hu man villages with scattered forest patches.	Fringe villages on southern border near Bansbari Range office.
6		<i>Scotophilus kuhlii</i> (Leach, 1821)	Least Concern	Nearby human habitation at crevices of coconut./Hum	Fringe villages on southern border near Bansbari Range office.

				an villages with scattered forest patches.	
7		<i>Pipistrellus tenuis</i> (Temminck, 1840)	Least Concern	At roof of camphouse./Grassland with scattered forests.	Seen at all sites, including Mothamguri Camp, Buraburi Camp [N 26°42'8.9" E 91°00'5.7" and Uchila Camp [N 26°43'20.1" E 91°02'51.3"].
8		<i>Pipistrellus coromandra</i> (Gray, 1838)	Least Concern	At roof of camphouse./Grassland with scattered forests.	Seen at Uchila Camp site [N 26°43'20.1" E 91°02'51.3"].
9		<i>Myotis muricola</i> (Gray, 1846)	Least Concern	Inner side of culvert ring joint. (The specimen were sighted in the narrow gap of inner side of culvert ring.)/ Forest stream, with moist semi evergreen forest with fringe grassland nearby.	Pohumara Culvert [N 26°42'30.9" E 91°02'08.4"], Near Uchila Campsite.

Considering the coverage of survey area and that mainly in a landscape dominated by semi evergreen trees and also some grassland, this represents significant bat diversity and we expect it to go up considerably with further intensive surveys.

It is clear from the above discussions that although the ever increasing human pressure on the environment and consequent deterioration of habitat quality is clearly taking a toll on bat populations across many regions, a few bat species are able to cope with the changing environment to some extent which is evident by their presence in unused houses even though these were in close proximity with used houses around the forest camp*. This gives a silver lining in the grim biodiversity conservation scenario of this region as educating people about the importance of these animals and persuading them to protect them can go a long way in future conservation efforts of these less understood animals. Unfortunately, the Indian Wildlife Protection Act, 1972 is yet to include bats in the protected category of animals (except for two species) and we can only hope this will happen sooner than later.

Conservation implications: -

1. It is ought to be mentioned here that when culverts are made, there, if possible, should be a slight gap of about 1 inch left in between the two culvert rings. Because, it supports as a good habitat for the bats belonging to *Myotis* genus. The joint should not be plastered from the inner side of the rings, especially top portions.
2. Damaged houses, where there are no inhabitants, if possible, to be left in an undisturbed condition.

2.17. Distribution and Status of Bengal florican: -

Bengal Florican belongs to order Gruiformes and in the suborder Otididae. It is one of the three bustards of old world family Otididae. The family Otididae has 11 genera comprising 24 species. The species was first described by Gmelin in 1789 as *Otis bengalensis*. Blanford termed it *Sypheotis bengalensis* 1898, while Baker (1929) in his Fauna volumes termed it *Houbaropsis bengalensis*. Ali and Ripley (1969) and Sibley & Monroe (1990) had termed it *Eupodotis bengalensis* but BirdLife International (2001) and all subsequent workers call it *Houbaropsis bengalensis*. It has two subspecies: *Houbaropsis bengalensis bengalensis* (Gmelin 1789) found in the Indian subcontinent, and *H. b. blandini* (Delacour 1928) found in Cambodia and Vietnam. The present distribution and status is related to *Houbaropsis bengalensis*.

The systematic classification is as follows: -

Order: Gruiformes > Family: Otididae > Genus: *Houbaropsis*> Species: *bengalensis*

Bengal florican is a medium sized ground bird which is about 60 cm tall while standing. It shows distinct sexual dimorphism. The adult males have black head, neck and body with white wings which is distinctly visible while flying. However, when standing the white wings are seen as a thin patch on either side of the body. The back is mottled with buff-brown. However, during the breeding season males have a thick bunch of feathers hanging under the breast. On the other hand, the female and immature male is dull brown and molted on the back. The females are slightly larger in size than its male counterparts. Female Bengal floricans had been found to be elusive and cryptically coloured. Consequently, females were less frequently seen than the conspicuous territorial males. They are omnivorous and known to feed on various seeds, grain, tender shoots of grass and insects like grasshoppers, ants, beetles and even frogs. In burned areas, the Bengal florican is also seen eating burned seeds.

The breeding season of Bengal florican starts from February and continues till early part of July. During the breeding season the male Bengal Floricans establish individual territories in the open areas in short grasslands. The adult males show a characteristic flight display within the territory to attract female Floricans for mating. In one clutch a Bengal florican lays one to two eggs.

Bengal Florican is a Critically Endangered (IUCN, 2008) bird, restricted to the terai grassland regions of the Indo-gangetic floodplain and the Brahmaputra floodplains. This is the highest of IUCN's categories of endangerment, and is only applied to the species closest to extinction. The population of Bengal Florican is not more than 350 birds in India. It is a grassland habitat specialist which acts as an indicator of a healthy grassland ecosystem (Narayan 1992). The Bengal Florican has been protected in India since Independence.

Currently it has got the highest protection status as it is listed in Schedule I of the Indian Wildlife (Protection) Act of 1972. It is now in the Critically Endangered list of the IUCN. It is also listed in the CMS Convention, and CITES Appendix I, to both of which India is a signatory. Bengal Florican has been identified as one of the species for recovery programme under the Integrated Development of Wildlife Habitats (Centrally Sponsored Scheme) of the Ministry of Environment and Forests, Government of India, 2009.

Once it was widely distributed from Uttar Pradesh, Bihar, West Bengal, to the foothills of Assam and Arunachal Pradesh in India. However, at present Bengal Florican is found only in the few protected pockets in India viz. Manas National Park, Kaziranga National Park, Orang National Park, Sonai-Rupai Wildlife Sanctuary, Dibru-Saikhoa National Park and Burachapori Wildlife Sanctuary in Assam, D'Ering Wildlife Sanctuary in Arunachal Pradesh, Jaldapara and Gorumara Wildlife Sanctuary in West Bengal and Dudwa National Park in Uttar Pradesh (Birdlife 2001, Narayan 1992).

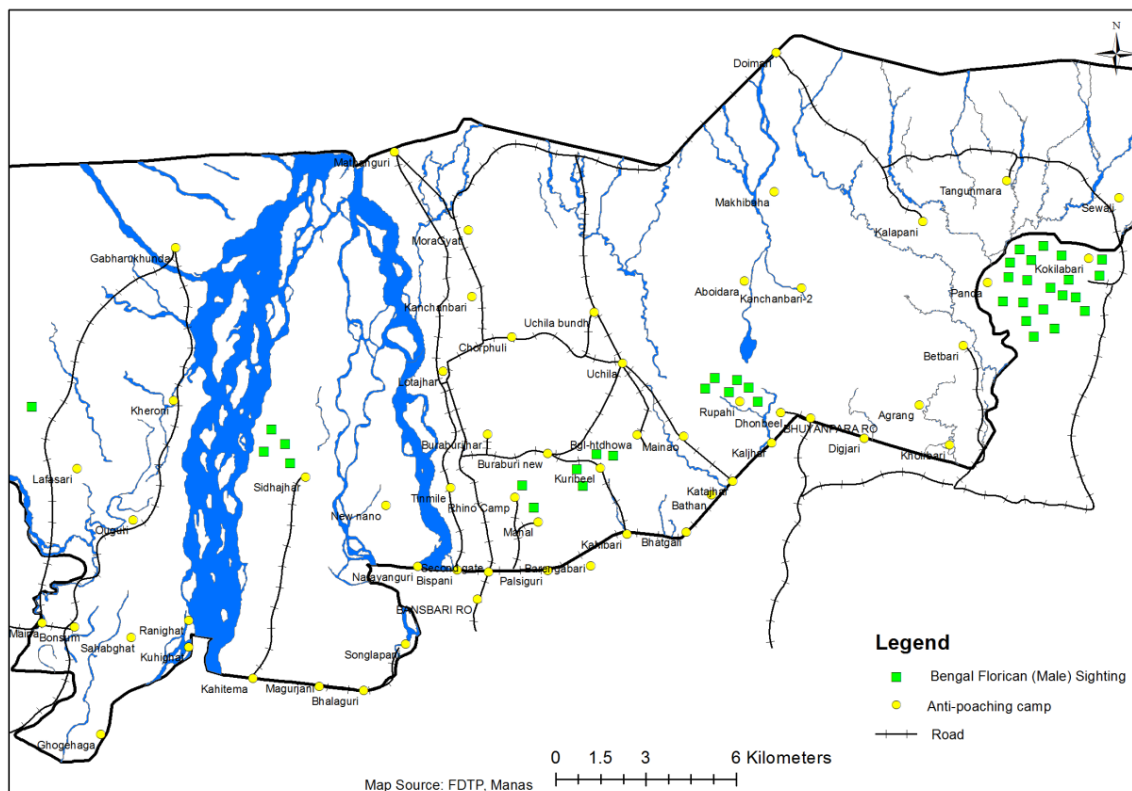
Populations of Bengal Florican have declined as a result of habitat loss and hunting in the Indian subcontinent, the species no longer occurs outside protected areas (BirdLife International, 2001). In nineties, Bombay Natural History Society (BNHS) had conducted a survey in India and found that Manas had highest number of Bengal Florican population (Rahmani et al. 1990). Around 80 birds were estimated during the survey which is perhaps the largest known population of Bengal Florican in any single locality. Manas National Park had been severely affected during more than a decade long Bodo agitation during late eighties to beginning of new century. As result of that Manas lost population of threatened wildlife like rhino, swamp deer and along with deterioration of habitat like grassland.

Current status of Bengal Florican in Manas National Park: -

In Manas National Park, a total of 32 males having confirmed territory sites were recorded along with 5 females. As females were more difficult to be located, population estimates were based on the assumption of an equal sex ratio (Baral et al., 2003). Assuming equal sex ratio, the estimated population of Bengal Florican is around '60' individuals in Manas National Park which is similar to previous years of information available.

Table: Location of Bengal florican sightings-

Sl.No.	Name of nearest camp	Range	Florican(Males) display sites
1	Kuribeel	Bansbari	4
2	Rhino Camp	Bansbari	2
3	Rupahi	Bhuyanpara	6
4	Abaidara	Bhuyanpara	-
5	Sidajhar	Kahitema	4
6	Lafasari	Panbari	1
7	Maozi/Panda	Bhuyanpara	15 + 5 (Females)

Figure 2.16: Bengal florican male display sites in Manas National Park

The short survey for grassland species in Manas National Park brings out important evidence for the presence of Bengal Florican at the study site. It also indicates an increasing trend since the last survey carried out in 2009 which is encouraging (Brahma, 2009). The survey also brought in new information from unsurveyed areas in the past such as Kapurpora and Lafasari grassland areas in Kahitama Beat and Panbari Range respectively. Within the Park, highest concentration of Bengal florican was found at Kuribee and Rupahi grassland areas. Four floricans were also observed at Kapurpora area however it could not be ascertained if they had also established breeding territories out there. No floricans could be sighted in areas such as Digjari-Khoirbari and Agrang where floricans had been reported earlier (Brahma, 2009).

However, the highlight of the survey has been the phenomenal presence of at least 20 Bengal floricans in the Kokilabari Agricultural Farm. It also highlights the need to protect agro-biodiversity sites such as KAF for long term conservation of the species. Estimated population of Bengal Florican is now around sixty individuals in and around Manas National Park in Assam. The survey also clearly indicates the success of the method wherein the collaboration between forest frontline staff along with invited experts and local guides was instrumental in obtaining a quick result.

While it is estimated that around 40% of the Bengal Florican population has been lost since 1989-1990 (Brahma, 2009); grass height seems to be the main factor for the establishment and maintenance of the territory for the endangered bird. It is assumed that they are very site selective in establishing their territory. The decline in wet alluvial grasslands is therefore a cause of concern besides several other factors as states below.

Major Threats to Bengal florican and its habitat: -

Bengal florican is an extremely “habitat specialist”, particularly in terms of the use of short and tall grasslands of terai and flood plain grasslands.

Indiscriminate conversion of grasslands into agricultural land, over grazing, thatch collection and unsystematic burning have resulted in deterioration in habitat and change in species composition of vegetation in the grassland. Furthermore, hunting of the species and collection of egg have brought the critically endangered species Bengal florican almost in the verge of extinction (Birdlife, 2001).

Table : Location of Bengal florican sightings-

Sl.No.	Name of nearest camp	Range	Florican(Males) display sites
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3	Rupahi	Bhuyanpara	6
4	Abaidara	Bhuyanpara	-
5	Sidajhar	Kahitema	4
6	Lafasari	Panbari	1
7	Maozi/Panda	Bhuyanpara	15 + 5 (Females)

2.18. Conservation status of Herpetofauna: -

Till now very scanty information existed on reptiles and amphibians of the park. To address this issue a rapid herpetofaunal survey was undertaken from 16 June to 20 June 2014. The inventory was part of a trans-boundary conservation initiative and conducted in Mathanguri, Doimari, Lotajhar, Kuribeel and Uchila Grassland area of the park. We employed Visual encounter search, active search and pit fall method to record herpetofaunal species.

We recorded 17 species of Amphibians, 9 species of lizards and 6 species of Snakes during that survey (see table below). Among Lizards, Scincidae and Gekkonidae is represented by four species each. Agamidae and Varanidae are represented by one species each.

The recorded snake diversity includes members of the Typhlopidae, Pythonidae and Colubridae. The families Typhlopidae and Pythonidae are represented by one species each, i.e., *Ramphotyphlops brahminus* and *Python bivittatus*. All recorded species of amphibians were anurans belonging to families Dicroglossidae, Ranidae, Microhylidae and Rhacophoridae. The families Bufonidae was represented by a single species, *Duttaphrynus melanostictus*. The highlight of the present study is the record of rare and poorly known forest species such as *Feihyla vittatus*, *Rhacophorus maximus*, *Microhyla butleri*, *Lycodon jara*, *Rhabdophis himalayanus*. *Micryletta cf innornata* is probably an undescribed taxon found in this survey. Bush frog of the genus *Philautus* was conferred to its closely related species and one skink species could not be identified. The positive identification of these species will need additional studies. *Polypedates maculatus himalayaensis* and *Cyrtodactylus khasiensis* encountered during the survey are regarded as members of cryptic species complexes. Among the recorded species, *Python bivittatus* and *Varanus bengalensis* have been accorded the highest legal protection status, under Schedule I of the Indian Wildlife (Protection) Act, 1972. *Naja naja*, *Ophiophagus hannah* and *Xenochrophis piscator* are listed in Schedule -II, all other snake species are listed under Schedule -IV of the Act.

Manas National Park is known to be the habitat of Turtles such as *Cuora amboiensis* (Vulnerable), *Melanochelys tricarinata* (Vulnerable), *Melanochelys trijuga* (near threatened), *Indotestudo elongata* (Endangered), *Pangshura sylhetensis* (Endangered) and *Pangshura smithii* (near threatened).

Habitat patches at Lotajhar and Doimari inside Manas National Park were found to be particularly rich in forest species whereas grassland-wetland areas such as Kuribeel under Bansbari Range were identified as critical turtle habitat in the park.

Our results are based on the survey constrained by time, and presumably represent a small subset of the actual diversity. This assumption is supported by the sharp slope in the species accumulation curve. Considering the scarcity of knowledge on diversity, distribution of herpetofaunal taxa, the present study assumes significance. We recommend a long term study in this Tiger Reserve to generate species diversity and ecological information on herpetofaunal assemblages that will help in conservation of habitat and diversity of this world heritage site.

Table : List of Herpetofaunal species recorded during 16 June 2014-20 June 2014 from Manas National Park

Species	Common Name	Microhabitat
Amphibians		
<i>Duttaphrynus melanostictus</i>	Common Asian Toad	near forest rest house, along trail
<i>Euphlyctis cyanophlyctis</i>	Indian skipping frog	Ponds, waterlogged area
<i>Fejervarya teraiensis</i>	Teral Cricket frog	ground vegetation along forest road
<i>Fejervarya pierrei</i>	Pierre's Cricket Frog	moist grasses near human habitation
<i>Hylarana leptoglossa</i>	Assam forest frog	near water puddle, pond
<i>Hylarana tyleri</i>	Leaf Frog	aquatic plants at forest edge
<i>Humerana humeralis</i>	Bhamo frog	along waterlogged forest road
<i>Hoplobatrachus tigerinus</i>	Indian Bull frog	grassland-wetland edge (Pitfall)
<i>Microhyla ornata</i>	Ornate narrow Mouth Frog	leaf litter near waterlogged forest interior
<i>Microhyla butleri</i>	Butler's Pigmy Frog	Under log of open grassland
<i>Micryletta cf. innornata</i>	False Narrow-mouthed Frog	rotten tree stump, forest understory
<i>Uperodon globulosus</i>	Balloon frog	along waterlogged forest road
<i>Feihyla vittatus</i>	Two Striped Pigmy Tree Frog	on leaf around waterlogged forest interior
<i>Polypedates teraiensis</i>	Teral Tree frog	on shrub; ca. 1 m above the ground
<i>Polypedates himalayensis</i>	Himalayan Tree Frog	along waterlogged forest interior
<i>Rhacophorus maximus</i>	Large tree frog	tree at 5.6 m height
<i>17. Philautus cf. garo.</i>	Garo Hill Bush Frog	on fern, at 3 feet height above the ground
Lizards		
<i>Calotes versicolor</i>	Common garden lizard	branch, leaf above ground

<i>Cyrtodactylus khasiensis</i>	Bent Toed Gecko	tree bark, dry branch, under rock
<i>Eutropis dissimilis</i>	Striped grass skink	Leaf litter along forest road
<i>Eutropis macularia</i>	Bronze Grass Skink	Leaf litter along forest road
<i>Eutropis sp.</i>	Grass Skink	On leaf at 60 cm height near forest road
<i>Hemidactylus platyurus</i>	Flat tailed gecko	under rotten log; mixed deciduous forest
<i>Hemidactylus frenatus</i>	Asian House Gecko	Rest House Wall
<i>Gekko gekko</i>	Tokay Gecko	Rest House crevices
<i>Varanus bengalensis</i>	Bengal Monitor	forest road near grassland; <i>Ficus</i> tree bark
10. <i>Lygosoma albopunctata</i>	White spotted Supple Skink	under hay inside abandoned house
Snakes		
<i>Ramphotyphlops brahminus</i>	Brahminy Blind Snake	under rocks, tin shed, loose soil
<i>Python bivittatus</i>	Burmese Rock Python	grassland, near river
<i>Rhabdophis himalayanus</i>	Himalayan Keelback	understory shrub ca. 2 m above
<i>Lycodon jara</i>	Twin Spotted Wolf Snake	Inside abandoned house
<i>Xenochrophis piscator</i>	Checkered Keelback	Near small stream
<i>Ophiophagus hannah</i>	King Cobra	Grassland, Wetland
7. <i>Naja naja</i>	Binocled Cobra	Grassland near forest road

2.19. Conservation status of butterflies in Manas National Park: -

Manas National Park was surveyed on August 28-Sept 2nd 2014. The survey resulted in 113 species of butterflies. Important sightings include Spotted Angle *Caprona agama*, Mussorie Bush Bob *Pedestes masuriensis*, Atkinson's Bob *Arnetta atkinsoni*, Similar Awlking *Choaspes similis*, Forest Hopper *Asticopterus jama*, De Niceville's Spotted Flat *Celaenorrhinus plagifera* and they all belong to skipper Family of butterfly.

Spotted Angle *Caprona agama* is widely distributed across India but not reported recently from other places of Assam. The species occurs both in the grasslands and woodland habitat of Manas NP. Hence, the sighting from Manas NP is significant.

Mussorie Bush Bob *Pedestes masuriensis* is not reported in so low elevation. The species occurs in mid elevations of Himalayas and more seen in W. Himalayas and Sikkim. The species is also not reported in present political boundary of Assam.

Other skipper butterflies like Atkinson's Bob *Arnetta atkinsoni* occur in the grassland associated with the woodlands and in hill stream. This is another rare skipper butterfly.

Awlkings are called king of skipper butterflies. They are extremely rare. The most widespread and common species of this group is Indian Awlking *Choaspes benjaminii*. But, survey in Manas resulted in finding of rare Similar Awlking *Choaspes xanthropogon*, which shows that the diversity of skipper butterfly is extremely high in Manas NP.

De Niceville's Spotted Flat *Celaenorrhinus plagifera* is known from Sikkim, Bhutan, Manipur. It's another interesting flat skipper recorded in Manas NP.

Among the Blue butterflies, species like Pallid Royal *Tajuria albiplaga*, Indian Cupid *Everes lacturnus* were recorded. Indian Cupid occurs in Bhutan foothills in Assam and hence restricted to Manas biosphere reserve. The species however occurs in other parts of India too. Pallid Royal *Tajuria albiplaga* is a rare royal butterfly and darker form of the species exists in Cachar-Manipur. The species is extremely rare. Of the blues recorded, Orchid Tit *Chliaria othona* is legally protected under Schedule I WL(P)A.

Among the Brown and brush footed butterflies, Dark Evening Brown *Melanitis phedima*, a rare butterfly was found pretty common flying morning and evening in Manas. Rare species like Scarce Tawny Rajah *Charaxes aristogiton* are seen puddling in early morning.

Some species like White-line Bushbrown *Mycalesis malsara* were recorded and they occur within Manas biosphere region in Assam.

Species like Short banded Sailer *Phaedyra columella* is legally protected as Schedule I WL(P)A, 1972.

Among the swallowtails, species like Tailed Jay *Graphium agamemnon*, Common Raven *Papilio castor*, Yellow Helen *Papilio nephelus*, Common Birdwing *Troides helena* were seen. These are mainly spring butterflies in Assam and not the right season in Manas.

Among the white and yellow butterflies, Redspot Jezebel *Delias descombesi*, Redbase Jezebel *Delias pasithoe*, Painted Jezebel *Delias hyparete* was seen. The Grass Yellows, Emigrants were found in plentiful. However, in previous survey (June, 2013), Bath White *Ponita daplidice* was recorded. The species was not known to NE India till 2013, but recently got recorded from Central Assam and Manipur (Jatishwor and Gogoi 2013) and Pakkhe, Arunachal Pradesh and Nagaland (Naro and Sondhi 2013).

2.20. Conservation status of odonates in Manas National Park: -

Dragonflies and damselflies are commonly known as Odonates; a flagship group and an important component of aquatic ecosystem, in which they can often be top predators. Odonates are the most important amphibiotic invertebrate group. From the taxonomic point of view point both dragonflies and damselflies belong to the order Odonata of the phylum Arthropoda. Odonata consists of three groups: Anisoptera (which includes dragonflies), Zygoptera (which includes damselflies), and Anisozygoptera (a relict group represented by only two living species).

Globally, there are approximately 6500 species worldwide representing in about 600 genera. Odonates occupy almost all kinds of habitats along the habitat permanent gradient ranging from permanent running water and lakes to small temporary rain pools. These are the most common insects which are flying over forest, range land, meadows, crop fields, stream and rivers and one of the dominant groups of aquatic and terrestrial insects.

Dragonflies	Damselflies
Body large, sturdy.	Body smaller, always slender.
Fast and long lasting flight.	Slow, fluttering flight
Wings spread more or less horizontally while perching.	Wing folded together on top of abdomen
Hind wing wider than forewing.	Fore and hind wing almost identical.
Eyes very large, touching each other on top of the head. Exception: clubtail dragonfly (Gomphidae)	Eyes on the sides of the head, never touching each other.

Like most insect orders, the Odonata (dragonflies and damselflies) remain poorly studied and therefore come under IUCN least Concern of Data Deficient categories. Reviews also show that although Assam is bearing a very suitable habitat for Odonates with lots of ponds, streams, rivers and wetlands; there is very little work done in documenting this order. In this regard, a first ever rapid survey in a Protected Area (in Assam) for invertebrates was undertaken in Manas National Park from 28th August to 1st September. The survey was led by Gaurab Jyoti Kalita of North Orissa University, Monsoon Gogoi of Assam University, Silchar, Dr. Kushal Choudhury of Kokrajhar Science college, Bipul Das of Aaranyak and Manas forest department staff.

The survey revealed the presence of 18 dragonfly (**Anisoptera**) species belonging to 2 families under 15 genera and 23 damselfly (**Zygoptera**) species belonging to 6 families under 13 genera in the four different zones (Semi-evergreen, riverine, grassland and moist-mixed deciduous forests) of Manas national Park.

Out of these 18 dragonfly species **16.67%** belong to Gomphidae family & rest **83.34%** belongs to Libellulidae family. And out of 23 damselfly species **4.35 %** belongs to Protoneuridae family followed by Platycnemididae **8.70%**, Lestidae **8.70%**, Calopterygidae **13.04%**, Chlorocyphidae **13.04%** and Coenagrionidae **52.17%**.

Finding of 41 Odonates species only within one forest range in a national park indicate the potentiality of a habitat to support biodiversity. Infact all three species under Gomphidae family were found in a single location and this clearly indicates the presence of undisturbed natural habitat.

a) **Birds:** The avifaunal diversity of Manas is very rich as confluence of wide range of habitats. Over 450 bird species has been recorded so far and Manas has been declared as one of the Important Bird Sites in India. Some of the globally threatened bird species of Manas are King Vulture (*Sarcogyps calvus*), Slender-billed Vulture (*Gyps tenuirostris*), White-rumped Vulture (*Gyps bengalensis*), White-bellied Heron (*Ardea insignis*), Bengal Florican (*Houbaropsis bengalensis*), Lesser Adjutant Stork (*Leptoptilos javanicus*), Swamp Francolin (*Francolinus gularis*), Manipur Bush Quail (*Perdica manipurensis*), Eastern Imperial Eagle (*Aquila heliaca*), Greater Spotted Eagle (*Aquila clanga*), Pallas' Fish Eagle (*Haliaeetus leucoryphus*), Rufous-necked Hornbill (*Aceros nipalensis*), Great pied Hornbill (*Buceros bicornis*), Pea Fowl (*Pavo Cristatus*), Marsh Spotted Babbler (*Pellorneum palustre*), Jerdon's Babbler (*Chrysomma altirostre*), Black-breasted Parrotbill (*Paradoxornis flavirostris*), Slender-billed Babbler (*Turdoides longirostris*), Rufous-vented Prinia (*Prinia burnesii*), Rufous-rumped Grassbird (*Graminicola bengalensis*), Bristled Grass Warbler (*Chaetornis striata*), Hodgson's Bushchat (*Saxicola insignis*), Finn's Weaver (*Ploceus megarhynchus*) etc. (Annexure).



b) **Reptiles:** Among reptiles, turtles, lizards, various kinds of Snakes such as King Cobra (*Ophiophagus hannah*), Banded Krait (*Bungarus fasciatus*), Monocellate Cobra (*Naja kaouthia*), Indian Python (*Python molurus*) and Burmese rock Python (*Python molurus bivittatus*), turtles such as Yellow Tortoise (*Indotestudo elongate*), Narrow-headed Softshell Turtle (*Chitra indica*), Assam Roof Turtle (*Pangshura sylhetensis*), Tricarinate Turtle (*Melanochelys tricarinata*), Malayan Box Turtle (*Cuora amboinensis*), in addition to that there are sporadic records of Gharial (*Gavialis gangeticus*) in Manas.



c) **Fishes:** Numerous rivers and streams in the forests of this Reserve contain a variety of fish of which large size fishes are *Tor putitora*, *Tor progenies*, *Tor tor*, *Ladeo boga*, *Ladeo gonius*, *Ladeo rohita*, *Ladeo calbasu*, *Wallago attu*. There are innumerable small fishes in the rivers and streams. Most common are species are *Puntius ticto*, *Botia Dario* and *Puntius tetrapagus*.



Microphis fluviatilis



Canthophrys gongota



Xenentodon cancila



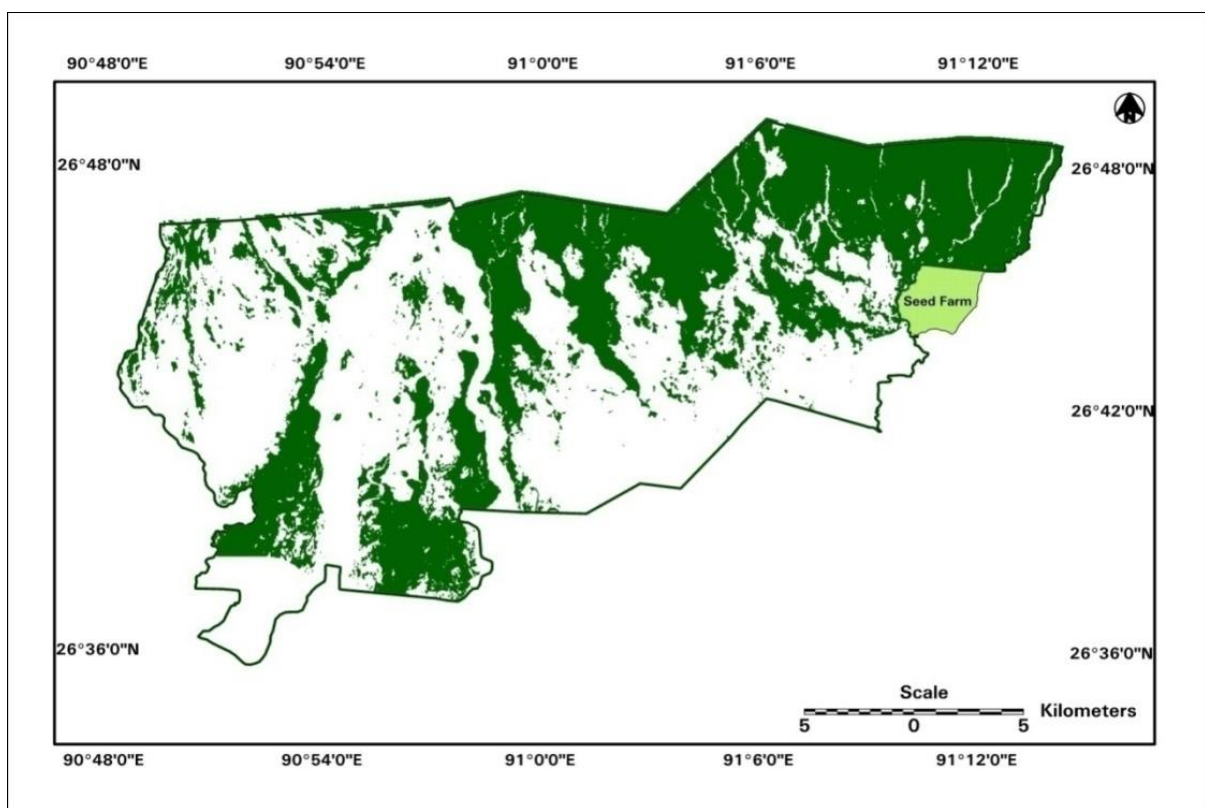
Rasborada niconius

2.21. Distribution of Habitats and Animals: -

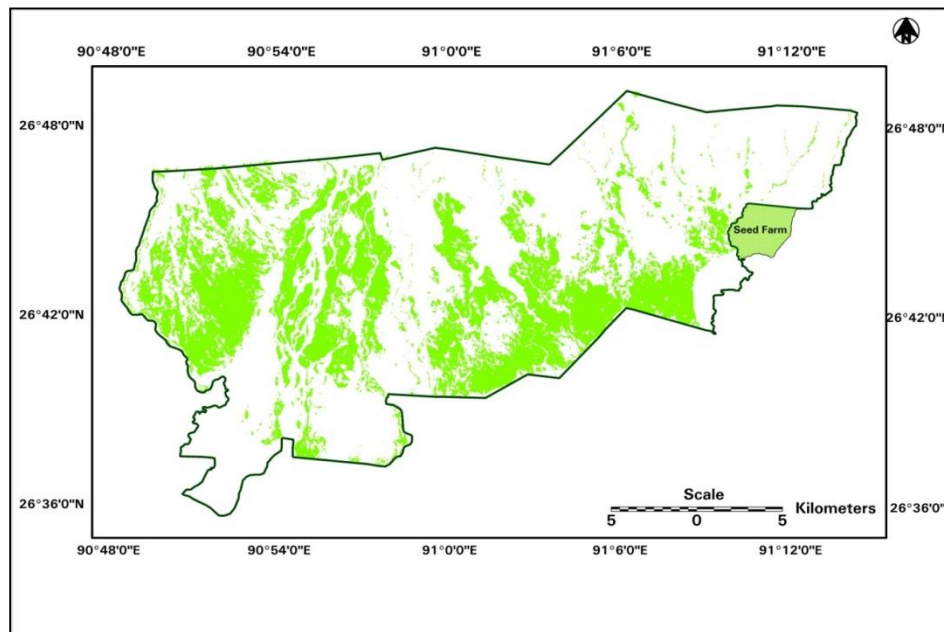
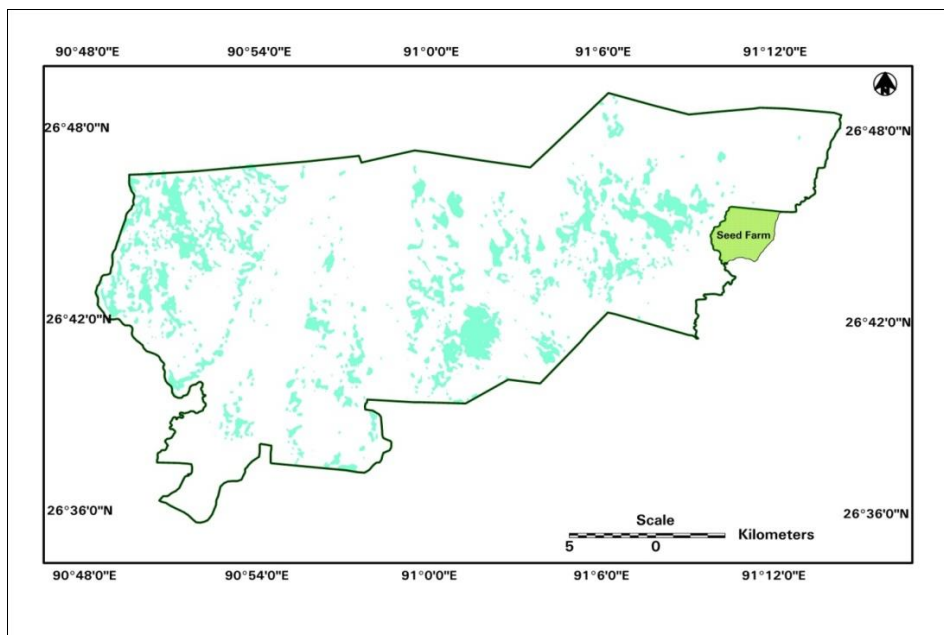
A broad scale habitat zonation of Manas National Park was attempted using Landsat satellite data between the years 2006-2010. The following broad categories and area statistics are as mentioned below: -

- a) Woodland (semi evergreen and moist deciduous): The area under this LSE type is 233.31 sq. km. (Fig. 7). This LSE type is distributed mostly in northern part of the Park and in the extreme south-west of the Park. The number of fragments in the LSE is 70. The mean patch size of the various fragments is 333.3 ha with a total edge of 1992.55 km, having an edge density of 85.40 m/ha. The mean shape index of this LSE is 1.56.

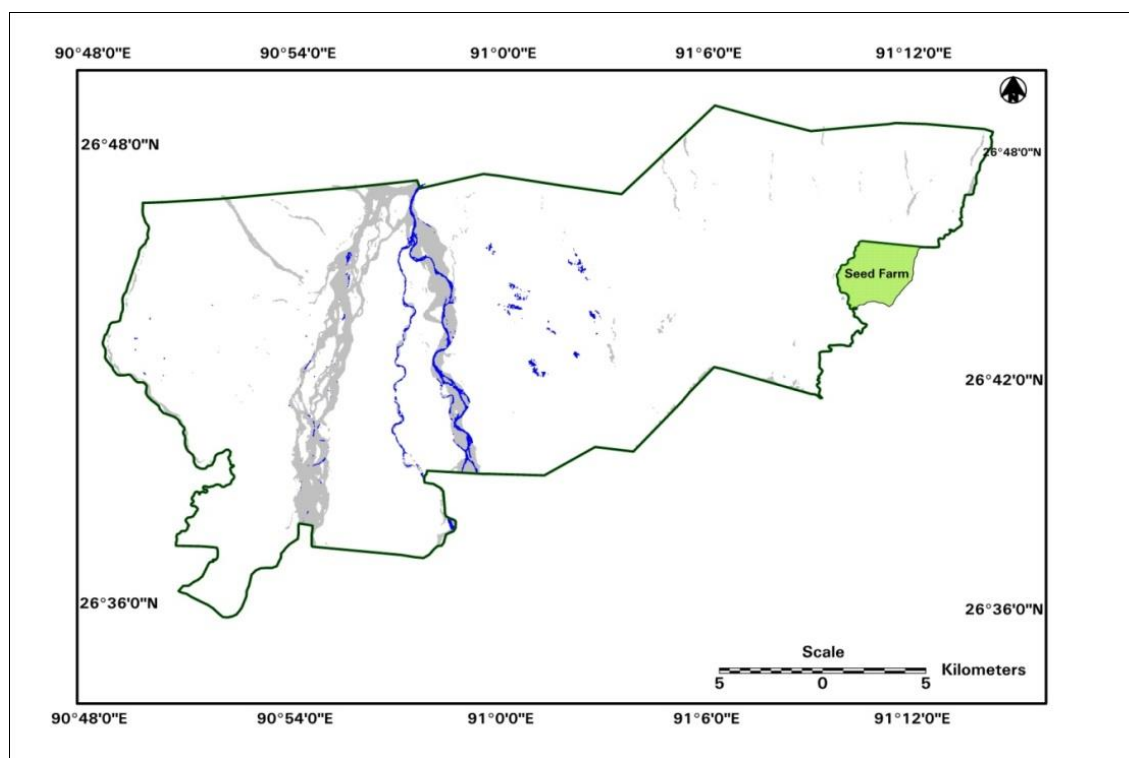
Fig 2.7 : Distribution of woodland patches in Manas National Park



- b) Dry grassland: The area under this LSE type is 161.98 sq. km. (Fig. 8). This LSE type is distributed in northeastern part of the Park and in the southern boundary of the Park touching villages. The number of fragments in the LSE is 300. The mean patch size of the various fragments is 53.99 ha with a total edge of 2853.55 km, having an edge density of 176.1 m/ha. The mean shape index of this LSE is 1.24.
- c) Swampy grassland: The area under this LSE type is 44.49 sq. km. (Fig. 9). This LSE type is scattered all over the Park. The number of fragments in the LSE is 39. The mean patch size of the various fragments is 114.07 ha with a total edge of 2878.1 km, having an edge density of 646.9 m/ha. The mean shape index of this LSE is 1.2.

Fig 2.8: Distribution of dry grassland patches**Fig 2.9: Distribution of swampy grassland patches**

- d) Riversand: The area under this LSE type is 35.82 sq. km. This LSE type is mainly concentrated around dried river Manas. The number of fragments in the LSE is 20. The mean patch size of the various fragments is 17.91 ha with a total edge of 618.05 km, having an edge density of 172.54 m/ha. The mean shape index of this LSE is 1.22.
- c) Waterbodies: The area under this LSE type is 3.94 sq. km. (Fig. 10). This LSE type is distributed mostly in Bansbari range. The number of fragments in the LSE is 17. The mean patch size of the various fragments is 23.17 ha with a total edge of 185 km, having an edge density of 469.5 m/ha. The mean shape index of this LSE is 1.28.

Fig 2.10. Distribution of River sand and waterbodies**2.22. Distribution of wildlife: -**

The large tracks of grasslands of Manas NP are some of the last remaining examples of *Terai* grasslands in the Indian sub-continent. These grasslands are the key sites for biodiversity conservation and is not only restricted as unique habitat but also support wide range of endangered fauna (Lahkar 2008). About 43% area of Manas National Park is cover by grassland habitat.

Out of 22 the mammals of Schedule-I, five (5) species are obligate to grassland where as nine (9) species are dependant partially on grassland habitat.

A total of 118 bird species has been recorded by Lahkar (2008) and out of 118 species recorded, as many as 95 species of birds were found to be resident. Out of 118 species of bird 33 species could be identified as ‘obligate grassland birds’. In eastern Himalayan biodiversity hotspot, there are 12 globally threatened associated with grassland habitat and all the species are found only in Manas National Park (Lahkar, 2008).

Conservation staus of endangered species in Manas:**1. Great One Horned Rhinoceros:-**

The Great One horned Rhinoceros (*Rhinoceros unicornis*) is an important flagship species for Manas and Assam and its conservation has been one of the critical factors towards reinstatement of Manas as a World Heritage Site in 2011. A detailed Chapter 13 is therefore dedicated to the management and action plan for conservation of Rhinos in Manas National Park.

The Great One Horned Rhinoceros had been historically found in the flood plain grasslands on the north-Bank of Brahmaputra, including areas within Manas National Park. Prior to 1989, about 100 rhinos had been estimated in the Park. Published information was rather scarce while sourcing for past history of rhino occurrence in Manas National Park. It is well known that Manas was declared reserved forests where 'Game' could be hunted for a price way back in 1905. A compilation of published literature is therefore limited to a report by Menon (1996) for WWF-TRAFFIC-India.

According to this report, the IUCN /SSC Asian Rhino Specialist Group (AsRSG) proclaimed that in 1989, there only remained three of the seven refuges for Rhino in India (Kaziranga, Manas and Orang) that were known to have a viable population of the species. Unfortunately, by 2001 it was confirmed that most of the 100 rhinos in Manas had been poached.

Present Rhino Conservation status (Post-2005): -

At the Centenary celebration of Kaziranga and Manas National Park in 2005, it was decided to reintroduce Rhinos to areas where it had been exterminated as per a multi-stakeholder plan which is popularly known as IRV-2020 (India Rhino Vision-2020).

The Indian Rhino Vision 2020 as conceived is a joint conservation initiative of the Assam Forest Department, WWF India and International Rhino Foundation, supported by the Bodoland Territorial Council, United States Fish and Wildlife Service, Wildlife Areas Welfare and Development Trust and other partner organizations. Under this programme, wild-to-wild translocation of rhinos to Manas from two other rhino bearing protected areas in Assam was initiated in 2008 with 2 rhinos. As of 2012, this had increased to a cumulative total of 18 rhinos. In parallel, 9 rescued rhinos from other areas were also rehabilitated in Manas

2. Pygmy hog: -

The Pygmy hog (*Porcula salvania*) is a critically endangered species belonging to the Family Suidae. It was previously spread across India, Nepal, and Bhutan, but now only confined to a few areas in Assam. Locally it is called as Nal Gahori, Tukuri Borah in Assamese, Oma Thaoukri in Bodo and Sano Banel in Nepali language. Current world population is estimated at about 150 individuals or fewer (Narayan *et.al.*, 2008). The species was formerly referred to as *Sus salvanius* as it was believed to be closely related to the Eurasian wild pig (*Sus scrofa*). However, recent mitochondrial DNA studies

3. Hispid Hare: -

Hispid hare (*Caprolagus hispidus*) belongs to order Lagomorpha and the monotypic genera *Caprolagus* of Family Leporidae and is distributed along the Bhabhar-Terai belt of India, Nepal and Bhutan and possibly a few locations in Bangladesh. The English name is Assam Rabbit or Bristly hare whereas it is known as Sesa in Bodo and Hoha pahu and Khagrakata in Assamese. In comparison to the Indian hare, they have shorter hind legs, smaller ears (5-6 cm) and a shorter tail (3 cm). The skull is with prominent supra-orbital bones and a long nasal region. The genus *Caprolagus* is monotypic *i.e.*, having only a single species the Hispid hare (Maheswaran, 2002).

4. Swamp Deer: -

The Eastern Swamp deer (*Rucervus duvaucelii ranjitsinhi* Groves, 1982) is called *Dol Horina* in Assamese. This sub-species was very common in the flat alluvial plains covered with tall grasses in the Brahmaputra valley and in the grasslands of flat to moderately hilly terrain especially along the Assam-Bhutan border (Jerdon, 1872). There was a healthy population of Eastern Swamp deer with more than 500 individuals in 1987 in the grassland of Manas National Park prior to the civil unrest (Deb Roy, 1991; Saikia *et al.*, 2012 & Borah *et al.*, 2013). But, the populations of this sensitive herbivore species were almost exterminated due to the politico-ethnic disturbance that started in and around the landscape in the late 1980s (Das *et al.* 2009; Goswami & Ganesh, 2011, 2014). Swamp deer were hunted locally for their ornamental antlers and meat by opportunistic poachers and anti-government forces.

Manas National Park still contains a small population of Eastern Swamp deer despite the onslaught of hunters during the period of unrest which was confirmed by camera trapped photographic evidences of Eastern Swamp deer at Manas NP by Borah *et al.*, in 2013. This small population however risked of getting obliterated with sudden biological and anthropological changes in the park. Therefore, as a part of the Eastern Swamp deer population recovery in Manas National Park, a translocation program was developed on recommendation from UNESCO World Heritage Site Committee by Assam Forest Department in collaboration with Wildlife Trust of India. Under this program, a group of 19 individuals and 17 individuals of Eastern Swamp deer were translocated subsequently in two batches from Kaziranga National Park to Manas National Park in December, 2014 and February, 2017 respectively following a strict swamp deer translocation protocol (UNESCO, 2016, WTI, 2018). Both the herds of Eastern Swamp deer were successfully acclimatized and released into the wild of Manas National Park. In the recent population estimation exercise of Manas NP (2019), a total of 83 individual of Eastern Swamp deer were recorded in both Bansbari and Bhuyanpara the ranges of Manas National Park. In concurrence of the translocation protocol, the annual population estimation exercises would be conducted through “block count” method to assess the progress of the restocking exercise. In the near future, restocking with a few individuals would be considered to supplement the keep the population ecologically viable.

5. Hog deer: -

Hog deer *Hyelaphus porcinus* (earlier *Axis porcinus*) is a tropical deer belonging to family cervidae. Hog deer was known to occur from Pakistan in the west to the Vietnam in the east through northern India, Bhutan, Nepal, Bangladesh and Myanmar (Dhungel and Gara 1991, Biswas and Mathur 2000). But presently it has been wiped out from many of its historical distributional range and has been categorised as endangered by IUCN. In India, hog deer is included in Schedule-I, the highest protected category of Wildlife (Protection) Act 1972.

Hog deer is grassland dependent species and in India it is found mainly in the terai grasslands along the Himalayan foothills and the flood-plains of the Rivers Ganges and Brahmaputra (Johnsingh *et al.* 2004, Biswas 2004). Hog deer is relatively abundant in the protected areas of Assam viz., Kaziranga & Manas Tiger Reserve and Orang National Park. A total of 10,000 hog deer were reported during 1983 (Tikader 1983) in Manas Tiger Reserve. The last survey indicated that there were >1000 hog deer in Manas and reportedly, Manas has the potential for the best site for hog deer provided adequate protection is ensured (Biswas *et al.* 2002).

Current distribution and status of hog deer in Manas National Park: -

Hog deer distribution in Manas is patchy. In the management regime of Bansbari and Bhuyanpara ranges, the grass cover is more towards the southern side of the park. While in Panbari range the grass cover is towards the northern side. Hog deer being obligate of the grasslands; its distribution too corresponds with the grassland distribution of the park.

The encounter rate for hog deer in bansbari and bhuyanpara range is 1.89/km (based on six-month data January- June). As per the forest department census report of 2008 a total of 1626 individuals of hog deer are present in the park. Though primarily solitary in nature, they congregate for feeding and the group size may range from 2-22 in certain locations in Manas.

2.23. Major Conspicuous Changes in the Habitat since Inception: -

- a) Due to shifting river courses:- Wildlife habitat has been destroyed due to recurrent flood in the flood plains of river Beki. Manas river having changed its course in 2004 during the high flood season. It has resulted into major changes in hydrology and compartmental change of habitat in Manas. An area of about 5 km belt of forest area along the Beki completely washed away in the flood. Usually during the month of July and August when the monsoon is at its peak, the hilly streams and rivers are in spate. Trees, boulders, etc. are carried down and deposited at various places forming barrier. These barriers sometimes gradually enlarge and act like partial dams. The courses of streams are diverted with the consequent erosion of banks. Earth movement is sometimes responsible for the change of big rivers course.
- b) Due to civil unrest: - The civil unrest starting from 1989 to 2003 in the area has damaged the protection mechanism in the park or rather resulted in complete collapse of administration and management. The forests of the Manas Tiger Reserve have been threatened by illegal logging since the early 1990s. In 10-15 years approximately one third to one half of the three Reserve Forests, Ripu, Chirang, and Manas, encompassing 350,000 acres, had been deforested. A complex political situation led to this major deforestation. Political agitation in this region began in the late 1980s by Bodo tribal groups frustrated by the changing emigration of non-Bodo peoples into Assam, creating a minority of the indigenous Bodo tribal people. Two militant groups sprung up as an answer to the situation and began an armed struggle for Bodo autonomy from the Indian government, which ultimately resulted in forming of Bodoland Territorial areas district (BTAD), popularly known as the BTC (Bodoland Territorial Council) in 1993. These groups had somewhat similar but competing aims basing their armed struggle from within the forests of western Assam and Bhutan. These were two of over 15 militant groups that emerged in Assam, creating a chaotic atmosphere with resulting deforestation and ethnic violence. Targeted for killing and kidnapping, the Assam Forest Department staffs were unable to enter and protect the forests allowing illegal log smugglers to cut the forest. The ethnic violence additionally resulted in 250,000 refugees living in camps adjacent to the Reserve Forests by 1998 which have been slowly repatriated back to their forest homes. Wide spread encroachment of forest land and indiscriminate felling of trees have severely degraded the forests. Local communities are continuing to clear the forestland and occupy it, with the mistaken hope that they will get allotment of the occupied land in future. People also took advantage of the poor law and situation order that prevailed during the period to occupy the forestland. It is estimated that at present more than 30% of the

forestland in BTC is under the vicious grip of encroachers. During the turbulent period, 80% of the infrastructure like buildings, roads, bridges and culverts in the forest areas was destroyed. Due to lack of accommodation, field staffs of the department were forced to stay away from the forest areas. Further, due to lack of transport and necessary funds, it was not possible to effectively mobilize the forest staffs and forces required to support the field staffs for the protection of the forest. In the absence of forest staffs and taking advantage of the disturbed situation prevailing in the area, the miscreants got opportunities to freely indulge in illegal felling of trees.

As a result, attention was not focussed on the habitat management of the park, especially in the grassland management that is so vital. The change detected by study of grassland habitat found that-

- The dry grassland has increased from 120.86 to 161.97 sq. km. This indicated that there is an effect on the management on the biodiversity too.
- There is a reduction of rhino habitat in the core zone of the Manas Tiger Reserve due to the increase of the dry grassland and simultaneous reduction of the wet grasslands from 94.38 to 44.37 sq. km. The situation seems to be more complicated.
- The wet grassland habitat is the home for a number of endangered species of birds, mammals and reptiles. So, it is very necessary to increase the wet grassland habitat. The gravity of the problems also aggravated due to the reduction of the water bodies other than the rivers from 8.88 to 4.99 sq. km.

Table 2. 5: Landuse classification of MNP: -

Land use class	1977 (Area in sq. km.)	2006 (Area in sq. km.)
Woodland	253.10	233.21
Dry grassland	120.86	161.97
Swampy grassland	94.38	44.37
Water body	8.88	4.99
River sand	23.74	35.97
Others		20.47

- c) Grazing: - Grazing by cattle inside the Tiger Reserve is a serious problem as it leads to the competition for the availability of grassland with the wild herbivores and exposes them to the risk of cattle born diseases.
- d) Encroachment: - As a result of civil unrest, around 15.5 sq. km. and 15 sq. km. habitat has been under encroachment in Panbari and Betbari area of Western and Eastern Range respectively.

CHAPTER THREE

STATUS OF TIGER AND CO-PREDATORS

3.1. Distribution of Tigers: -

Distribution of tiger in the core area of the Manas Tiger Reserve is not uniform in any part of the habitation. The distribution of tiger in the core area i.e. Manas National Park is mainly dependent on the availability of prey species in a particular area. The distribution of the tiger in the Manas National Park fluctuates with the fluctuating population of the prey. However, it has been observed that in certain areas of the tiger bearing landscape usually has the higher density of tiger than the other areas. Such higher density area has several habitat characteristics, which is favourable for the tiger for its survival. The higher density areas are the Hakua river bed, Mathanguri area, Garuchara area, Sukanjan area, Gundabeel area, Kalpani area, Rabang, Garuchara, Doimari, Alabari areas. The areas with the low-density are: Buraburi-jhar, Second gate, Makhibaha, Semajhora, Teklai, Latajhar, Narayanguri and Panda camp area etc. The tiger density estimates are provided in section below.

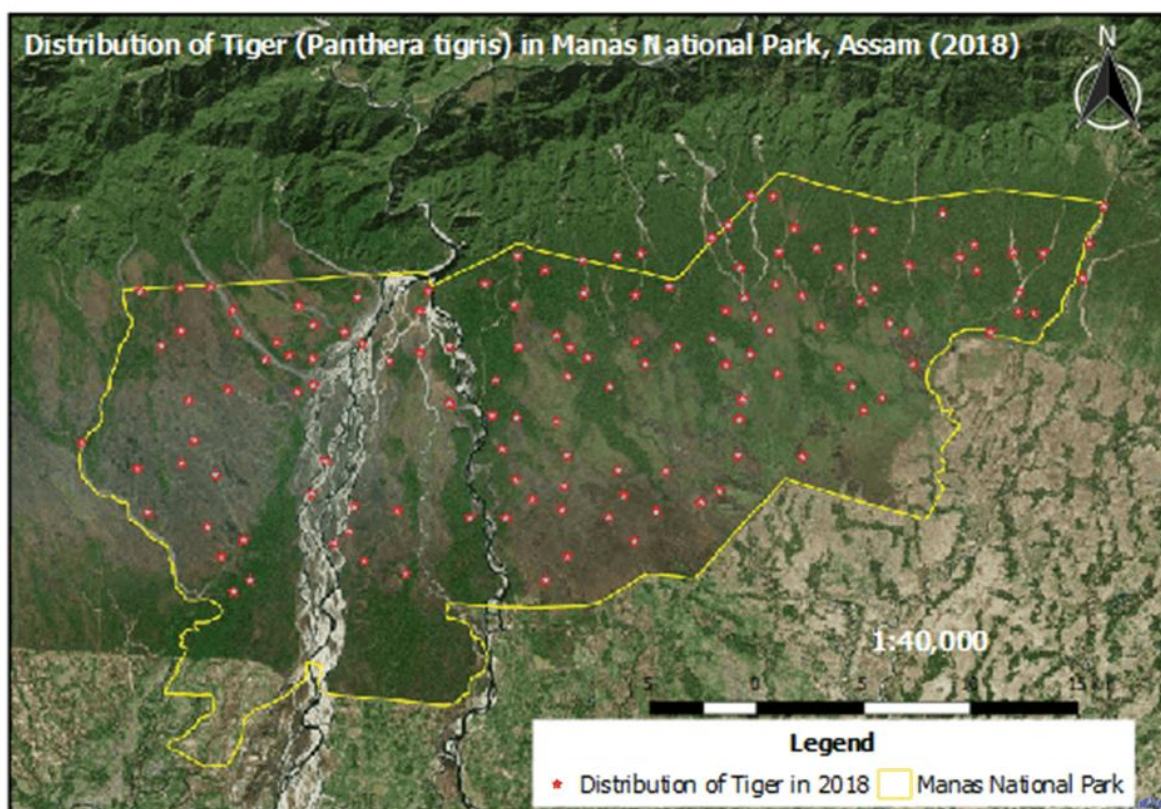


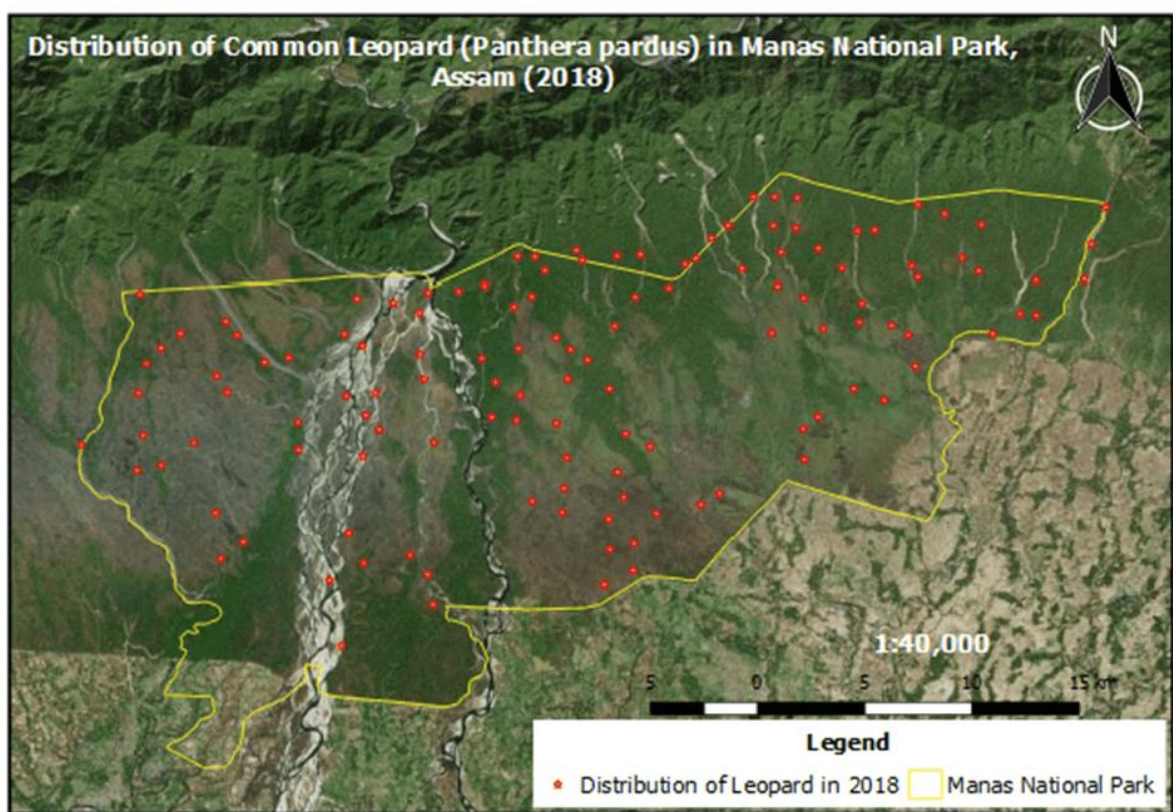
Fig 3.1: Distribution of tiger in MNP based on camera trap study in 2018

3.2. Distribution of Leopards: -

The leopard in Manas National Park is very unique with its less distribution in the areas of higher distribution of tiger. The distribution of leopard is more in the southern

boundary of the Manas National Park. The distribution of the leopard is found to be more in the secondary vegetation growth area near the fringe of the national park with the villages where abundant domesticated cattle enter regularly. The higher density distribution area of the leopard are the Lafasari, Kuhighat, Sidajhar, Narayanguri, Manas & Hakua river bed lower side, Pahufield, Khoirbari, Palsiguri, Buraburhijhar, Uchila, Makhibaha, Tangonmara, Teklai etc. However, though leopard existed in the entire national park area still the low density of leopard is observed in the areas like Mathanguri, Sukhanjan, Gabharukhunada, Garuchara, Rabang, Doimari, Kalpani, Chorfuli, Roisinglajhar. The density estimates for the leopards using maximum likelihood spatially explicit capture–recapture was $3.4 \pm \text{SE } 0.82$ (Borah et al. 2013). The distribution map of the leopard is as follows: -

Fig 3.2: Distribution of leopards in MNP based on camera trap study in 2018



3.3. Abundance Status of Tigers: -

3.3.1. Past Abundance: - The tiger censuses are being carried out in Manas since 1972 but not in regular interval. 10 tigers were recorded in Manas in 1972 and 65 in the year 2000 using pugmark census methods. In 2006, estimation of tiger population was carried out using double sampling approach, as part of monitoring tigers, co-predators, prey and their habitat. The first phase of data collection was completed but the second phase exercise was not done due to various reasons. However, in subsequent years after 2006, proper phase wise exercise was carried out for estimating tiger population as per NTCA protocols (Appendix 39).

The following is the record of the Tiger Population from 1972 to 2001: -

Table 3.1 Abundance of tiger population in Manas: -

Year	Male	Female	Cub	Total	Remarks
1972	10			10	
1975	20	16	5	41	
1976	28	17	6	51	
1977	Census not carried out, 8 tigresses observed with cubs				
1978	Census not carried out, 7 tigresses located with cubs				
1988-89	18	31	4	53	Records 3 tigers found dead
1991-93	32	37	12	81	Records 8 tigers found dead
1994-95	29	44	7	80 (core)	Records 9 tigers found dead
(Tiger reserve)	4	8	2	14 (buffer)	
1996-97	27	54	8	89 (core)	
(Tiger Reserve)	15	13	6	36 (buffer)	Records 2 unidentified
2000-01	22	38	5	65	

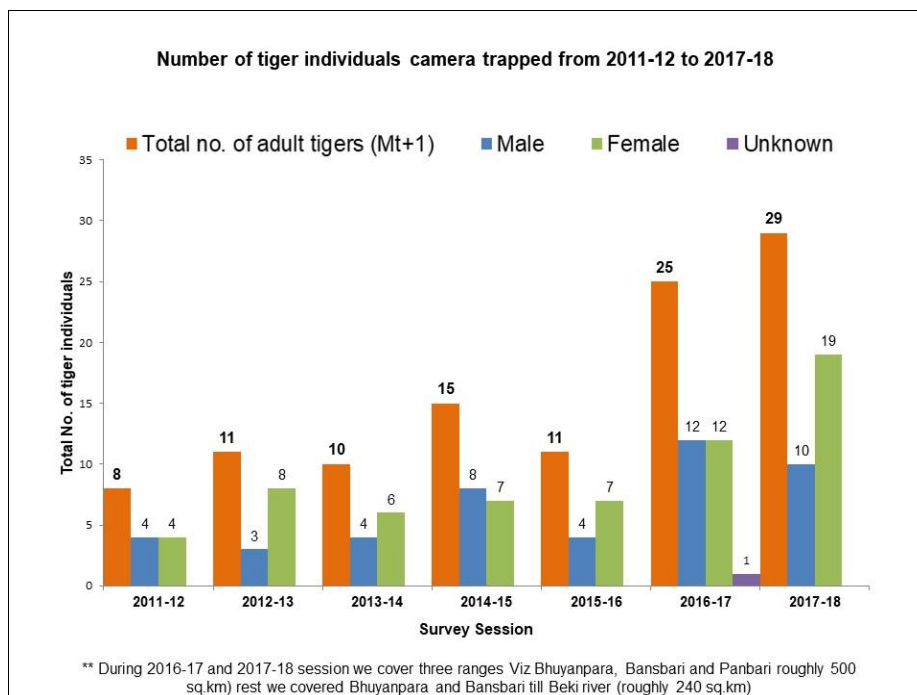
3.3.2. Present status of Tigers in Manas National Park: -

The camera trapping in MNP is being conducted as a part of Phase-IV Tiger Estimation exercise of Government of India, in collaboration with the National Tiger Conservation Authority (NTCA), Wildlife Institute of India (WII) and Assam Forest Department, and conservation partners.

- a) **2010-11:** - The camera trapping exercise was conducted within Bansbari, Bhuyanpara & Panbari Ranges of MNP, covering 480 sq. km. area. Camera traps were put in 120 locations across the three ranges between November 2011 and May 2012. We used combinations of CUDEBACK (Non Typical, Wisconsin), TRAILMASTER (Goodson and associates, Kansas), PANTHERA Camera Trap V3 (Panthera, USA), CEDT (Indian Institute of Science, Bangalore) camera traps for the exercise. A pair of camera traps was put in each 4 sq. km. grid cell size, with distance between each camera varying from minimum of 1.75 km to 2.15 km. The camera traps were deployed in best possible locations within each grid to ensure coverage of the entire sampling area, avoiding gaps large enough so as to satisfy the assumption that no animal had a zero probability of being photographed. The survey was, therefore, designed to cover the study area evenly to maximize the chance of photographing all animals present in the area (Karanth & Nichols, 1998). The time delay between photographs was set to the minimum in respective cameras. We kept all the cameras operational for 24 hours a day, except in cases of malfunction or damage caused by elephants. All camera units were mounted on trees, on poles or in steel cages made specifically for the cameras. The cameras were placed 3-4 m apart on either side of a path or trail, with the sensor set at 20-40 cm from the ground. We set the sensitivity of camera to high for maximizing capture of wildlife in the area. The

cameras were checked on daily basis by a team of researchers at MNP. Although the same camera locations were maintained throughout the study duration, we shifted the cameras 100-200 m from the original location whenever a sign of trap shyness was observed. We identified the photo captured individual tigers by its stripe pattern. Every photo captured tiger was given a unique identification number (e.g. MT1M, MT2F etc) after carefully examining the position and shape of stripes on the flanks, limbs, forequarters and sometimes even tail (Schaller, 1967; Karanth, 1995; Franklin et al., 1999).

- b) **2011-12:** Similar methodology was followed as described above.
- c) **2012-13:** Similar methodology was followed as described above. However, Panbari range could not be sampled due to disturbance and logistical constraints.
- d) **2013-2014:** During this camera Trap study, a pair of camera traps was placed in each 2.04 km² grid (1.43 km x 1.43 km) grid cell size. The camera traps were deployed in best possible locations within each grid to ensure coverage of the entire sampling area, avoiding gaps large enough to satisfy the assumption that no animal had a zero probability of being photographed. Camera trap points were selected based on cues such as presence of earlier tiger sign (scats, scrapes, scent deposits, tracks) and intersections of trails. For the convenient of our study we divided the study area into two blocks viz- entire Bhuyanpara Range and some parts of Bansbari range in first block (approximately 209 Km²) and Rest of the Bansbari till the Beki river into second block (approximately 92 Km²). In each block, double-sided camera-trap was operated for 25 days in each grid. After 25 days, we moved one of the double sided cameras to another location within the same grid in such a way that, if we divide the grid into equal halves, it represent in equal manner. The single sided cameras were keeping operated for 5 days. The distance between two adjacent single sided trap stations for single sided camera was between 0.5 -0.8 km. The same procedure was repeated in the second block.



3.4. Density estimates for Tigers based on Camera trapping:-

- a) 2010-11: 9 unique individually identified tigers comprising of 5 females and 4 males were photo-captured, during the 4389 camera trap night survey period, resulting in population estimate of 11 (SE 4.91). The density estimated was 0.8 (SE±0.27).
- b) 2011-12: 18 individually identified tigers comprising of 6 males and 9 females (3 unidentified) were photo captured, during the 6480 camera-trap night survey period. A total of 184 pictures of tigers were collected during the survey. The exercise also photo captured 4 cubs during the sampling period.
- c) 2012-13: 11 individually identified tigers comprising of 8 females and 3 males (1 unidentified) were photo captured during the 4920 camera trap night survey period. 3 new individuals were photo-captured which were not captured during 2011-12 sampling. Besides tiger, the camera traps were also able to photo capture all the major predator and prey species present in Manas, which indicates the healthy ecosystem of the area. Other species photo captured includes leopard, clouded leopard, dhole, leopard cat, jungle cat, sloth bear, Asiatic black bear, elephant, sambar, gaur, water buffalo, wild pig, barking deer and rhino.
- d) 2013-14: 11 individuals (10 adults and 1 cub) (9 having both flanks, 9 having left flanks and 11 having right flanks) were captured. Right flank photographs were considered for interim individual ID. Among the 11 adult individuals, 4 males and 7 females were identified. In addition, a cub was also photo-captured during the study. Along with the tigers, photographs of Clouded leopard and Common Leopard as well as several other species of animals of the park were also recorded.
- e) 2014-15: 15 individuals (14 adults and 1 cub) were photo-captured. Among the 14 adult individuals, 8 males and 7 females were identified. In addition, a cub was also photo-captured during the study.
- f) 2015-16: 11 individuals were photo-captured, out of which 4 males and 7 females were identified.
- g) 2016-17: A total of 25 individuals were identified from the camera trap photo-captures. Among the 25 adult individuals, 12 males and 12 females were identified, while one individual was unknown.
- h) 2017-18: A total of 29 individuals were identified from the camera trap photo-captures. Among the 29 adult individuals, 10 males and 19 females were identified. In addition, a cub was also photo-captured during the study.

Sampling session	No. of adult individual tiger captured (Mt+1)	Tiger Density $\pm$ SE (per 100 sq. km.)	Area Sampled (sq. km.)
2012-13	11	1.2 $\pm$ 0.3	321
2013-14	11	1.82 $\pm$ 2.11	321
2014-15	15	1.5 $\pm$ 0.4	321
2015-16	11	1.7 $\pm$ 0.5	321
2016-17	25	3.05 $\pm$ 0.72	420
2017-18	30	Results awaited-	420
2018-19	25	2.98 $\pm$ 0.60	420

*** From the session 2016-17 to 2018-19, sampling done in the entire MNP

Table 3.2: Details of individual and sex identity of 34 tiger scat samples from MNP (Borthakur et.al., 2013).

Sl. No.	Individual ID	Sex ID	sample	Location (beat/Range)
1	MNP-01	female	982	chourang beat, panbari
2	MNP-01	female	993	chourang beat, panbari
3	MNP-02	female	987	chourang beat, panbari
4	MNP-02	female	992	lakhijhara beat, panbari
5	MNP-02	female	1020	bhatghali beat, bansbari
6	MNP-02	female	1028	kapur pora beat, bansbari
7	MNP-03	female	990	chourang beat, panbari
8	MNP-03	female	1037	kanchanbari beat, bhuyanpara
9	MNP-04	male	996	lakhijhara beat, panbari
10	MNP-05	male	1025	uchila beat, bansbari
11	MNP-05	male	1074	tangunmara beat, bhuyanpara
12	MNP-06	unknown	1033	kokilabari beat, bhuyanpara
13	MNP-06	unknown	1095	semajora beat, bhuyanpara
14	MNP-07	male	1034	digihari beat, bhuyanpara
15	MNP-08	male	1044	daimary beat, bhuyanpara
16	MNP-09	male	1045	digihari beat, bhuyanpara
17	MNP-10	female	1050	koroibari beat, bhuyanpara
18	MNP-10	female	1068	makhibaha beat, bhuyanpara
19	MNP-11	female	1051	agrarang forest camp beat, bhuyanpara
20	MNP-12	unknown	1052	koroibari beat, bhuyanpara
21	MNP-13	female	1054	sataropa beat, bhuyanpara
22	MNP-14	female	1058	kalapani beat, bhuyanpara
23	MNP-14	female	1062	panda camp beat, bhuyanpara
24	MNP-14	female	1099	makhibaha beat, bhuyanpara
25	MNP-15	unknown	1069	semajora beat, bhuyanpara
26	MNP-15	unknown	1101	semajora beat, bhuyanpara
27	MNP-16	male	1075	semajora beat, bhuyanpara
28	MNP-17	male	1077	semajora beat, bhuyanpara
29	MNP-18	male	1081	tangunmara beat, bhuyanpara
30	MNP-19	female	1084	makhibaha beat, bhuyanpara
31	MNP-20	male	1086	purana sikaganda beat, bhuyanpara
32	MNP-21	female	1088	makhibaha beat, bhuyanpara
33	MNP-22	female	1091	kalapani beat, bhuyanpara
34	MNP-23	female	1102	semajora beat, bhuyanpara

3.6. Prey Estimation: - Estimation of prey density was undertaken through Line Transect survey during the period January to April 2013. A total of 24 random transects were surveyed, each with 3 – 5 temporal replicates. Transects were walked by a team of 1 or 2 researchers once between 5:30 – 6:30 am and once between 3:30 – 4:30 pm when the activity of the animals is highest. Each transect was approximately 2 km in length except those which could not be extended because of dense vegetation or difficult terrain. In each walk, a single observer platform was used; data on prey species encounter were collected. The sighting distance of the object from the observer, animal sighting single and cluster size were recorded. The distance was measured using a laser range finder (Bushnell Yardage Pro) and

the angles were measured using a compass (Suunto MC-2). All the data were analysed using Program DISTANCE.

A total of 144 animal detections (n) were recorded from an effort of 280.26 km walked during the sampling period (Table 4). Elephants were detected highest number of times (n=131), followed by Capped Langur (n=78), Gaur (n=67), Hog deer (n=44), Wild boar (n=38), Water buffalo (n=23), Rhesus Macaque (n=21), Barking deer (n=16), Indian Peafowl (n=11), Sambar (n=9), Golden Langur (n=7), Rhino (n=5), Red Jungle fowl (Galliformes) (n=3) and Cattle (n=1). Detections of wild ungulate species comprising of sambar, barking deer, hog deer, wild boar, Indian gaur and water buffalo were pooled and their group density was estimated ($D_g = 11.03 \pm 2.45$). Density of cervids (barking deer, sambar and hog deer) pooled together and individual densities of barking deer ($D_i = 1.56 \pm 0.7$), hog deer ($D_i = 11.01 \pm 11.52$) and wild pig ($D_i = 5.03 \pm 3.41$) were estimated ($D_i = 4.23 \pm 1.12$). The density of gaur and sambar with their detections pooled together was also estimated ($D_i = 7.27 \pm 2.88$). All the densities were estimated using Program DISTANCE 6.0. Species specific density estimation of the sambar was not done as they did not meet the required number of detection enough for robust analysis (Anderson *et al.*, 1979, Burnham *et al.*, 1993).

Table 3.4 : Summary of major tiger prey density groups in Manas National Park:-

Prey Species	Dg $\pm$ SE	GS $\pm$ SE	Di $\pm$ SE (%CV)	N	GOF-p[<i>df</i>]	Best fit detection function	AIC	P
Gaur and Sambar	1.64 $\pm$ 0.44	4.42 $\pm$ 1.27	7.27 $\pm$ 2.88 (39.62)	7	0.85 [3]	Uniform Cosine	82.48	0.57
Barking Deer	1.09 $\pm$ 0.47	1.43 $\pm$ 0.17	1.56 $\pm$ 0.7 (44.89)	2	0.67	Uniform Cosine	32.92	0.61
Hog Deer	7.03 $\pm$ 7.34	1.56 $\pm$ 0.12	11.01 $\pm$ 11.52 (104.75)	11	0.78 [2]	Hazard Rate Cosine	65.68	0.34
Wild Pig	3.88 $\pm$ 2.56	1.29 $\pm$ 0.19	5.03 $\pm$ 3.41 (67.73)	5	0.72 [1]	Hazard Rate Cosine	56.03	1.23
Cervids	3.2 $\pm$ 0.83	1.32 $\pm$ 0.77	4.23 $\pm$ 1.12 (26.6)	4	0.47 [2]	Uniform Cosine	93.84	0.44
Wild Ungulates	7.17 $\pm$ 1.5	1.53 $\pm$ 0.11	11.03 $\pm$ 2.45 (22.21)	11	0.15 [1]	Half Normal Cosine	194.94	0.33

Key :- Estimated density of groups (Dg; no. of groups (clusters)/km²) with associated standard error (SE);

mean group/cluster size (GS) with associated SE; density of individuals;

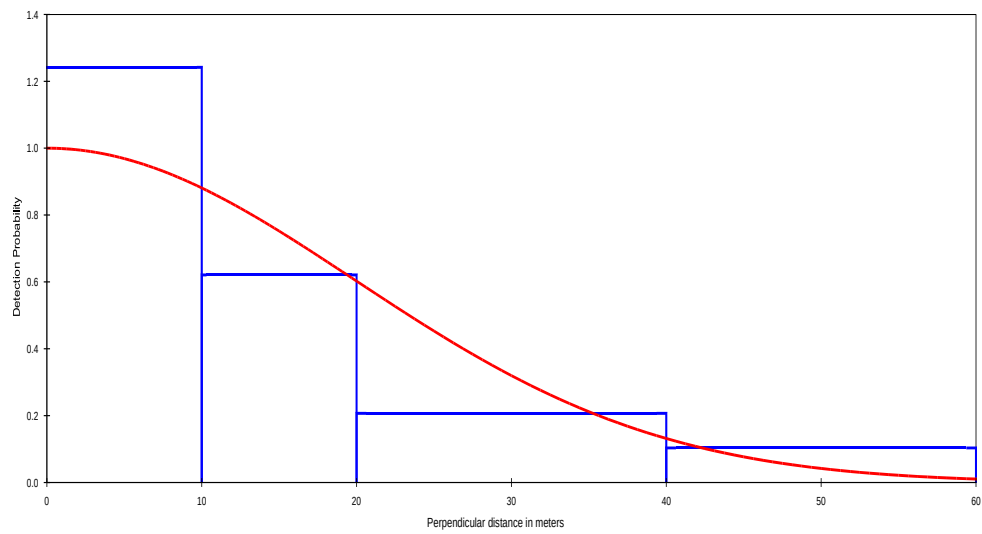
(Di; no. of individuals/km²) with associated SE and percent co-efficient of variation (%CV);

Estimated number of animals in the specified area (N); the probability of chi-square goodness of fit (GOF-p) and degrees of freedom [*df*];

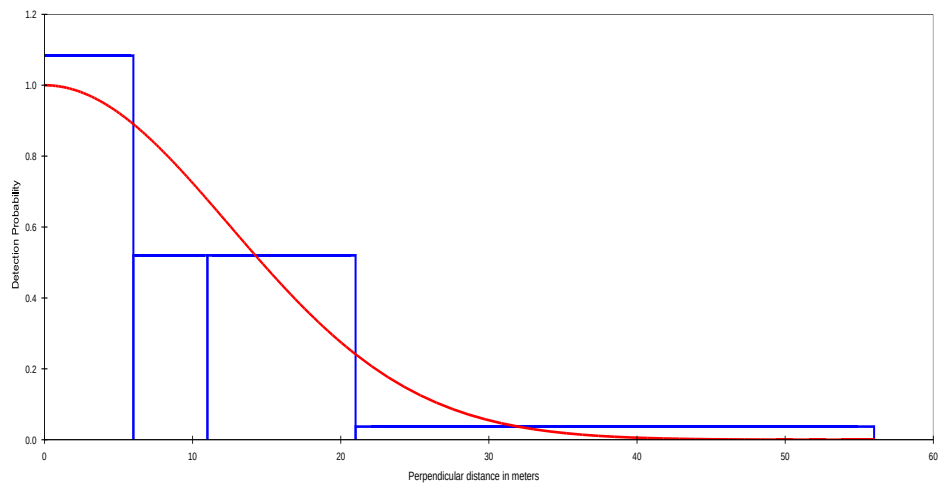
Best fit model; Akaike information criterion (AIC) value and the detection probability (p).

Detection Probability Graphs: -

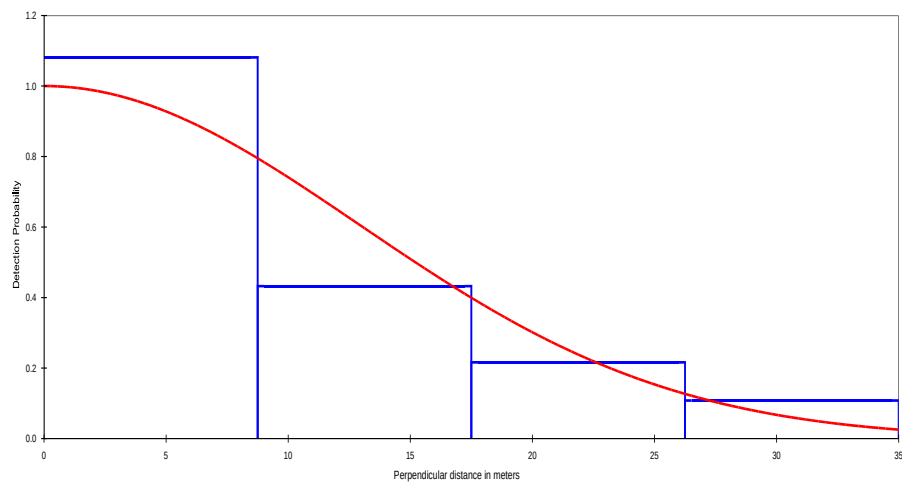
1. Barking Deer-



2. Hog Deer-



3. Wild Pig-



3.7. Prey-Predator Relationships: -

Predator-prey relationship maintains the dynamics and health of the Manas wildlife ecosystem, and any serious disturbance may cause either population explosions or crashes of any ungulate species, which is unnatural. The Manas ecosystem supports the tiger as the main predator, and the leopard, wild dog and clouded leopards as co-predators. These predators rank as such in the predation hierarchy, and have a distinct niche of their own. This relationship is yet to achieve the balanced demographic status after a period of serious loss of the prey individuals of different species during the period of the political unrest.

After the devastation of wildlife populations, natural revival of the populations took place with the help of protection measures; predators and prey started multiplying in the safer conditions. However, as observed in the results of 2010-11 scientific studies leopard numbers were higher than tiger numbers. This could be indicative of a relatively unhealthy ecosystem where the space of the natural top predator (the tiger) has been taken over by the more opportunistic and smaller predator species (leopards and wild dogs).

Tigers, generally, prey upon large sized ungulates, and travel over a long distance in their home ranges, away from habitations. While tigers kill a wide range of ungulate species in the Core Zone, sometimes even an adult gaur or a Rhesus macaque, or even a python with a freshly swallowed ungulate, the hog deer and wild pig form the most of its annual consumption.

Leopards generally have smaller and almost stable home ranges close to habitations. There seems to be no competition between the tiger and leopard, and they follow the tactics of mutual avoidance. Leopards are, however, sometimes also known to operate close to the movements of tigers in the Core Zone. They generally kill small sized preys, including domestic dogs, goats and birds, though they prey on hog deer, wild pig and sambar as well. The kills of leopards are also sometimes usurped by tigers in the Core Zone. In Manas, after the devastation of the ethnic violence which reduced the wildlife populations to alarmingly less numbers, leopards opportunistically filled more space in the highest trophic level of the ecosystem, as is evident from the higher density of leopards from tigers.

Wild dogs in the Core Zone are more transients, and travel frequently in packs over long distances. Though their home ranges overlap with those of tigers and leopards, their presence is so fleeting that they seldom come into conflict with the other two predators. The average pack size of the wild dog in the protected area is 5-10 animals. They also kill large preys. The other lesser predators such as clouded leopards and jackals prey upon small herbivores, rodents and birds.

In this predator-prey relationship, the prey species also have their defence mechanism against the predators to avoid being killed. The defence may include alarm calls, large aggregations, and taking shelter in refuge covers etc.

b) Assessment of Prey-Predator Biomass: -

The assessment of prey-predator biomass is very important to gauge the health of the wildlife ecosystem. For an appraisal of the available predator-prey biomass, the following average values were used:

Biomass of prey species: -

Sl. No.	Species	Density (per km ²)	Average Body Weight (kg)	Average Biomass (per km ²)
1	Barking Deer	1.88	20	37.60
2	Hog Deer	6.3	40	252
3	Sambar	1.07	150	160.63
4	Wild Pig	4.47	80	357.60
5	Wild Buffalo	0.44	800	355
6	Gaur	0.75	900	682.50
Total biomass per km²				1845.33

Biomass of major predators: -

Sl. No.	Species	Density (per km ²)	Average Body Weight (kg)	Average Biomass (per 100 km ²)
1	Tiger	1.9	180	342
2	Leopard	8.40	58	487.20
Total biomass per 100 km²				829.20

Table 9: Preferred Prey Biomass: -

Sl. No.	Species	*Body Weight (kg)	Biomass (per km ²)
1	Hog deer	30	18960
2	Sambar	112.5	120.38
3	Wild Pig	60	268.2
4	Gaur	300	506.25
5	Wild Buffalo	300	264



3.8. Assessment of Threats: -

The main threats to the tiger and its co-predator are-

- Lower availability of prey.
- Increased dependence on the domesticated cattle in the fringe village area, which lead to the conflicting situation with the populace of the villages.
- Half eaten domesticated cattle may be poisoned by the villager in retaliation which may lead to the loss of predator population.
- Invasion by the domesticated cattle may lead to the abrupt utilization food & habitat resource leading to the lesser utilization by the wild prey population resulting low prey abundance.
- The rate of increase of predator population may be less due to low availability of prey population.
- Habitat loss due to reasons like encroachment.
- Poaching due to increased demand in wildlife trade.

Plate 1: Some Individual Tigers of Manas National Park:-

Individual Tigers of Manas NP, Session 2014 [Plate 1]

MNP_001_F



MNP_002_M



MNP_003_F



MNP_004_M



MNP_005_F



MNP_006_M



MNP_007_F



MNP_008_F



MNP_009_F



MNP_010_M



MNP_011_F



CHAPTER FOUR

HISTORY OF PAST MANAGEMENT AND PRACTICES

4.1. Conservation History: -

Although the past history of Manas National Park, before the declaration of Proposed Reserved Forest in 1905 remains largely undated; the clusters of Mango tree on the eastern part of the park indicate that there were likely to be some settlements in a few localities. A pond like depression known as ‘Bangale hat-dhowa’ in the central part of the park also indicates human settlement in areas prior to establishment of the protected area. The literal meaning of ‘Bangale hat-dhowa’ is ‘where the aliens washed their hands’ and these aliens were the Mughals (Deb Roy 1994). However, malaria had prevented colonization of the terai area like Manas and other foothills in the northeast India. Yet tribes like Bodos who developed some immunity to the disease, had few settlements near the forest. With the initiation of anti-malaria programmes, including the control of mosquitoes by using DDT had resulted subsequent increase in human migration in the foothills. Fortunately, the area in which the National Park has been constituted was declared as Reserve Forests as early as in the year 1905, with the initiative of Major Gordon. The British rulers recorded that the jungle and grassland infested area of the Eastern Doors of Assam were suitable for rhino conservation. In 1905, the conservation history unfolds with the creation of a Proposed Reserved Forest called the North Kamrup Reserved Forest. In 1908, the Proposed North Kamrup Reserved Forests were declared a protected area closed to hunting and killing of wildlife. Further in 1924, the area of the Protected Area was increased to 360 square kilometres.

Amalgamating the entire North Kamrup Reserved Forests and parts of Manas RF upto Sukhanjan on the west, an area of 360 sq. km. was declared as Sanctuary in 1928, by which hunting, shooting or trapping were altogether prohibited except under Special permits to approved sportsman. Through further additions to its area in 1951 and 1955, the geographical area of the Manas Game Sanctuary became 391 sq. kms.

The shooting, trapping and fishing were closed practically from 1st October 1907 by an order. In 1917, Manas was declared as a ‘protected region’ in which hunting, shooting, trapping was altogether prohibited except under special permit and the same notification was re-issued in 1928 declaring as the Sanctuary. Since then the management of the Sanctuary gained momentum gradually in the positive direction till the insurgency of the recent past which caused colossal loss to the Park. After the settlement of Bodo ethnic problem, infrastructure reconstruction measures have been taken with topmost priority and are already showing results in positive direction.

4.1.1. Past system of Management: -

Till 1st October, 1907 the area of Manas was managed for extraction of forest produce to earn revenue and very little attention was paid to wildlife. With the declaration of Sanctuary, importance in protection of wildlife started gaining momentum gradually. The Government of Assam created a separate Division for Wildlife in 1967 with its headquarter at Guwahati. This Division was bifurcated into two Divisions in 1970 by a Govt. Notification No. FOR 363/66/125, dated: 17-07-1970: Western Assam Wildlife Division, and Eastern

Assam Wildlife Division. The management of Manas Wildlife Sanctuary came under Divisional Forest Officer, Western Assam Wildlife Division. The Western Assam Wildlife Division was shifted on 1st Nov 1971 to Rangia and then to Barpeta Road, Assam in 1975.

The reserve has an essential wilderness zone in the form of the Manas National Park, the core zone of the tiger reserve. Normal forestry operations were carried out in the core area prior to its designation as a sanctuary, but these were confined mostly to the southern belt. Traditional hunting practices persisted but without any noticeable adverse effects on wildlife populations. Hunting ceased with the establishment of the area as a sanctuary and negligible logging was permitted since 1950. The last timber operation took place in 1964. Much stone was extracted from the area during the construction of the National Highway in 1963-1964. Plantations were established along the southern border to provide a buffer against agricultural encroachment but this work ceased in 1977. Grazing by livestock was phased out from 1963 to 1965. No exploitation is allowed in the park but tourists may visit the Mathanguri-Bansbari area. Such restrictions do not apply to the surrounding buffer zone of the tiger reserve, which is managed on a multiple-use basis. Here residents are allowed to selectively remove timber, collect firewood, cultivate land and graze their domestic livestock. They benefit from inoculation of their cattle, to prevent diseases being transmitted to the wildlife, but this is offset by damage to their crops by elephants, wild boar and deer (Anon, 1974; Deb Roy). Under the management plan for the tiger reserve, controlled burning continues as the most important management practice, thus maintaining the composition of different habitats (Deb Roy, 1990).

However, some revenue earning practices continued, like issuance of cattle grazing permit and timber operations especially in the RFs, like Kahitama, Koklabari and Panbari, which were not included in the Sanctuary. But these practices were also discontinued in a phased manner and were finally put to an end with the declaration of these areas as a National Park in 1990 under Wildlife (Protection) Act, 1972.

The management of buffer area of the Manas National Park (Manas Tiger Reserve) was undertaken as per prescribed Working Plans of the respective Forest Divisions in the past. Due to absence of approved Working Plans and due to the disturbance caused by Bodo insurgency, the working of forest was badly affected in the recent past. Removal of timber based on silviculture principles, thinning and cultural operations for aiding natural regeneration, plantation on the degraded and open blank areas, allowing removal of minor forest produce by the local people for their household uses are the main management interventions.

- i) **Period (1973-1979):** - The summaries of management plan (1973-1979) are as follows:- The sanctum sanctorum of the project area lies in the central portion which was considered as wilderness zone and was under strict control from all biotic and other interferences. In the rest of the areas where forest operations were permitted under working plan prescription complete prohibition of any killing, trapping or hunting of wildlife was enforced.
- ii) Tourists to view wildlife, scenic beauty and for angling will be allowed in the Bansbari to Mathanguri area in the wilderness zone.
- iii) Some pockets of suitable compartments were left untouched as habitat of animals in the areas where no forestry operations was allowed. Suitable prescriptions were introduced in the revised working plans.

- iv) Intensive patrolling for suitable protection of wild animals was carried out. Requirement of additional staff had been requested. Enforcement to be continued with the existing staff.
- v) Construction or improvement of roads in the wilderness zone or in the buffer areas was necessary.

b) Period (1989-2003): -

In 1989 the Bodo agitation started struggle for separate Bodoland State and rebels had destroyed infra-structure of the park, killed frontline staff, killed wildlife and it continued till formation of Bodoland Territorial Council (BTC) in 2003.

In the agitation almost all the anti-poaching camps, bridges, culverts and other facilities were destroyed completely. Bhuyanpara and Panbari Range headquarter were destroyed several times. During the period entire management system was thrown out of gear. The lawlessness situation prevailing at that time provided best opportunity for miscreants to take toll on the Park infrastructure and wildlife. Almost all the camps were abandoned, arms looted, bridges were burned down and wild animals as well as domestic elephants were killed. Good number of frontline staff lost their lives. Hapless wild animals were left prone at the mercy of poacher and thus Manas saw the annihilation of entire population of Great Indian One Horned Rhinoceros in its habitat. Some of the incidents occurred in the National Park during civil strife are summed as follows in chronological order which speaks volumes about deaths and destructions perpetrated on Manas:

Tears of Manas at a Glance (1989-98): -

- 16-02-1989: The Bodo extremists attacked Lafasari Beat located in the interior area under Panbari Range and all the three houses were burnt down. Late Akhshay Rajbangshi, Forest Guard and Late Atowa Munda, Mahut laid their lives due to severe injuries of bullets and arrows. Sri Bhupen Nath, Forest Guard, wounded seriously by arrow managed to reach Gabharukhunda and then to Mathanguri. He was saved somehow.
- 17-02-1989: The armed extremists attacked Panbari Range Office at about 9:30 pm. About 500 men ransacked the office complex with guns, bows and arrows. One section of A.F.P.F. (Assam Forest Protection Force) and Forest staffs took shelter in a bunker and exchanged fire with the extremists. Firing continued till next morning while a Magistrate with a Company of APBN (Assam Police Battalion) arrived on 18-02-1989 and rescued the staffs. Entire Range complex was set on fire after being looted by the extremists.
- 02-03-1989: Bhalaguri Beat under Bansbari Range was burnt down partly by the extremist.
- 05-03-1989: Kahitama and Bhalaguri Beat under Bansbari Range were burnt down and properties looted by the extremist.
- 08-03-1989: Gabharukhunda Beat located at Indo-Bhutan boundary area under Panbari Range was destroyed by the extremist.
- 26-04-1989: Bhalaguri Beat under Bansbari Range was destroyed and personal property of staff looted.

- 03-04-1989: Rupahi Beat was burnt down and property looted.
- 04-04-1989: Doimari Beat under Bhuyanpara Range was attacked, set on fire and Rabang sub-beat under Bansbari Range was also burnt down on the same day. Both the two camps are located at Indo-Bhutan boundary area. Properties looted by the extremist. Sri Dinesh Lahkar, Forest Guard, was shot dead near Makhibaha Beat.
- 08-04-1989: Kapurpura House Beat along with the anti-poaching camp under Bansbari Range and Doimari Beat under Bhuyanpara Range were burnt down and properties looted by extremist.
- 30-04-1989: Extremist destroyed Khoirbari Beat under Bhuyanpara Range.
- 01-05-1989: Digjari Beat under Bhuyanpara Range was set on fire and destroyed which was damaged partly on 02-04-1989 by the extremist.
- 30-06-1989: Palsiguri Beat under Bansbari Range and Sikhilaihar Beat, Badaribeel Beat, Sukanjani Beat and Lakhijhora Beat under Panbari Range were burnt down and properties looted by the extremist.
- 01-07-1989: Photika bridge was destroyed, cut into three pieces, piles, deckings removed. On the same day Bhalaguri Beat was set on fire and the Beat house partly destroyed.
- 06-07-1989: The extremist damaged Sukanjan bridge in Panbari Range. On the same day Kahibari bridge under Bansbari Range was cut into two pieces and removed the deckings and piles.
- 26-07-1989: Katajhar Beat under Bansbari Range destroyed.
- 01-08-1989: Koroibari Beat under Bhuyanpara Range destroyed.
- 03-08-1989: Rupahi Beat under Bhuyanpara Range attacked and destroyed.
- 23-08-1989: Bhuyanpara Range complex was attacked; all the houses were burnt down, Govt. and personal properties looted. 12 numbers rifles and 12 nos. Guns with one V.H.F. set looted. Late Dilip Bezbaruah, Forester Grade-I, was shot dead by the extremists in the incident.
- 12-09-1989: Rabang Beat under Bansbari Range attacked and destroyed.
- 12-10-1989: Sidajhar Beat under Bansbari Range destroyed.
- 12-11-1989: Garuchara Beat under Bansbari Range destroyed.
- 16-01-1990: Gabharukhunda Beat under Panbari Range destroyed.
- 12-02-1990: Alabari Beat under Bhuyanpara Range destroyed.
- 15-08-1990: Koroibari Beat under Bhuyanpara Range was burnt down and properties looted.

- 19-08-1990: Kokilabari Gate under Bhuyanpara Range was destroyed and removed by the extremist.
- 20-08-1990: Syamajhora Beat under Bhuyanpara Range was destroyed for the first time.
- 23-08-1990: Bhuyanpara Range complex ransacked looted and razed to the ground for the second time. Altogether 17 buildings were destroyed. One Game Watcher and a casual worker were killed in the attack.
- 07-10-1992: Semajhora Beat under Bhuyanpara Range abandoned after being fired indiscriminately.
- 08-10-1992: Extremists ambushed patrolling party of Uchila moving towards Latajhar in between the stretch of Uchila and Chorphuli. Late Manomahan Nath, Game Watcher, lost his life on the spot due to multiple bullet injury. Late Suren Basumatary, Mahoot, was recovered in sub-conscious state with bullet injuries on his head on 09-10-1992 and expired later on 11-10-1992 at Guwahati Medical College Hospital. The departmental elephant "Premlal" also laid his life due to severe bullet injuries.
- 10-10-1992: Extremists burnt down Semajhora Beat Office under Bhuyanpara Range and destroyed for the second time.
- 07-11-1992: Semajhora Beat was destroyed for the third time. Kaljhar Beat was burnt down and property looted by the extremist on the same day.
- 19-10-1992: Kuhighat Beat under Panbari Range was abandoned after repeated threats.
- 03-03-1992: Extremists attacked Bansbari Range Office complex. Sri A.K. Brahma, Range Officer, Bansbari Range, was wounded seriously. Nine Rhino horns (4.627 kg), 4 nos. 0.315 rifles, 5 nos. DBBL guns, 3 nos. SBBL guns (all unserviceable) and cash amounting Rs. 2,20,000.00 were looted.
- 09-09-1993: Pahumara bridge under Bhuyanpara Range burnt down and destroyed.
- 20-09-1993: Makhibaha Beat staff threatened and looted. Some infrastructure destroyed.
- 21-09-1993: Extremists raided and looted one walkie-talkie from Giati Beat (Buraburijhar) under Bansbari Range.
- 09-10-1992: Semajhora Beat under Bhuyanpara Range destroyed which was reconstructed in September 1990.
- 11-11-1993: Gyati Bridge along Buraburijhar-Uchila road under Bansbari Range was burnt down.
- 28-04-1994: Extremists snatched away five 0.315 Rifles and 57 rounds of ammunitions from Katajhar Beat of Bansbari Range.
- 30-06-1996: Late Barek Haque Khandakar, Boatman, was shot by the extremist while on duty on elephant back near Kasimdoha under Bansbari Range and shifted to

the Guwahati Medical College Hospital in a serious condition and later died on the same day.

- 06-08-1997: Late Ibrahim Ali Khan, Range Officer, Panbari Range, was kidnapped on 04-06-1997 and later shot dead on 06-08-1997.
- 18-09-1997: Kokilabari Beat under Bhuyanpara Range was attacked and looted 7 Rifles along with 72 rounds of ammunitions and a VHF (wireless) set.
- 21-09-1997: Kokilabari Beat under Bhuyanpara Range was attacked again and partly burnt down.
- 24-09-1997: A gang of miscreants entered the Bhuyanpara Range complex and destroyed and looted Range properties.
- 20-12-1998: Kahitama Beat under Bansbari Range attacked. Looted 13 nos. 0.303 Rifles along with 212 rounds of ammunitions and 6 nos. 0.315 Rifles along with 30 rounds of live ammunitions, one wireless Base set and Rs.55, 000.00. Late Bimal Chandra Kalita, Forest Guard, laid his life in the encounter with extremists. Havildar Late Bentik Sangma, AFPF and Constable Late Chandra Kishore Kunwar of AFPF (Assam Forest Protection Force) died after multiple bullet injuries while fighting with the extremists valiantly.
- 23-09-1997: Iron sheets of temporary structures and properties of Bhuyanpara Range taken away forcibly by the extremists.
- 02-03-1998: Forest staff of Kokilabari Beat under Bhuyanpara Range threatened and compelled to spend the night in the jungle.
- 02-05-1998: Panbari Range complex attacked and looted accessories of wireless sets.
- 07-05-1998: BSF personnel camping at Panbari market detected and recovered 12 numbers of hand made guns kept hidden by extremists from Kuhighat area of Panbari RF.
- 31-01-1999: Bhutan vehicle was obstructed by armed miscreants on Bansbari-Mathanguri road near Mora Giati rivar and looted.
- 24-05-1999: Uchila Beat (chang bungalow) under Bansbari Range burnt down and destroyed completely.
- 02/02-05-2014: Narayanguri riot incidence.
- 23-10-2014: Sidajhar, under Kahitama beat; arms incidence

With the signing of peace agreement by the Government of India, Government of Assam and Bodoland Liberation Tigers (representing Bodos) in 2003 and the subsequent formation of the Bodoland Territorial Council (BTC), the normalcy returned in the area. Because of political will of the council, the PA is heading fast to regain its old glory as the Park is being restored. The 'in danger' tagged to Manas World Heritage Site in 1992 because of destruction and loss caused to it, was shed off in June, 2011 at the World Heitage Committee Session held in Paris. Reconstruction and activation of anti-poaching camps and

reopening of patrolling paths have occupied the top priority. Manas was placed in the category of “poor category” according to the earlier assessment by Management Effectiveness Evaluation (MEE) in accordance with the mandates of National Tiger Conservation Authority. But now due to improved situation in its management Manas has been categorised as “Good Tiger Reserve”.



4.1.2. Silvicultural systems and tending operations: -

Timber operations were carried out in the nearby areas existing in the form of reserve forests, namely Koklabari RF, Kahitama RF and Panbari RF contiguous to the erstwhile sanctuary area and despite abundance of wildlife in till the mid eighties as per Working Plan prescriptions. As per records, the Kahitama RF was worked for Simul, which was required for match factory owned by WIMCO at Dhubri. Some miscellaneous coupes were also sold in Koklabari RF.

Similar practices were followed as per prescriptions of approved Working Plans in 19 (nineteen) Reserve Forests controlled by 5 (five) Territorial Divisions, encompassing as ‘buffer area’ of Manas Tiger Reserve, and located on the east and west flanks of the Manas National Park.

- a) Even Aged and un-even aged silvicultural systems: - There is no record maintaining legal felling, firewood coupes and plantation age classes, distribution in periodic compartments, blocks and their juxtaposition.
- b) Bamboo working: - The area being almost devoid of any bamboo barring except a very few clumps, as such there is no record of harvesting bamboo at any point of time from the Park. The buffer area also lacks prominent bamboo bearing area.
- c) Firewood harvest and collection: - No firewood harvest was allowed from the National Park. There is huge demand for firewood from fringe villages but there is equally available firewood grown in the homesteads (called ‘Bari’). Fringe villagers do collect trees which float down in the form of ‘drift wood’ along the flood waters of

Manas river during monsoon outside the park. The fringe villagers do indulge in occasional illegal collection of firewood from the park.

4.1.3. Non wood forest produce (NWFP) collection: -

Collection of Non Wood Forest Produce in the PA is prohibited. Neither there is any record of collection of NWFP in the distant past. However, due to tradition and close proximity to the forest areas, occasional collection of thatch, medicinal plants, wild vegetables and fruits, and fishing and hunting of wild animals for meat by ethnic tribe cannot be ruled out. Though illegal, due to tradition and culture collection of 'Lati Sag' (*Trichosanthes dioica*) and other medicinal plants by Bodo tribe takes place occasionally in the month of March-April, taking advantage of long porous south boundary. Some herbs such as Mati-Galdab or Khera dapni (*Pygmeopremna herbace*) are much in demand by the locals for its medicinal properties and grows post-fire in grassland areas only and is therefore restricted to Protected Areas such as Manas.

4.1.4. Leases: -

The Central Seed Farm was established in 1971 in Kokilabari prior to Wildlife (Protection) Act, 1972 came into existence with allotment of 5000 acres from the first addition to North Kamrup Reserved Forest. However, only 2220 acres of land was reclaimed on the eastern side of the river Angulichinga. Further, the remaining area was not allotted due to certain objections raised by the authority of Manas Tiger Project. The deed was executed much later i.e. on 20-5-1981 for a period of 30 years commencing from 17-11-1971 and ending on 16-4-2001. According to the lease deed the lessee would have to pay a rental charge @ Rs. 6/- per acre per annum. The area so leased, shall continue to be treated as part of North Kamrup Reserve Forest. The lessee would have to hand over the area to the lessor after expiry of the lease period and gift machinery possessed by the farm free of charge, if the lessor undertakes to run the said farm. The property such as building and installed machinery and equipments of the lessee at the expiry of the term shall be sold to the lessor at depreciated book value. Importantly the farm has so far not paid any rental charge to the State Government.

4.2. Habitat management: -

The habitat management in the core area of the Manas Tiger Reserve is the grassland management, artificial management of saltlicks and water hole management prevailed from the past.

4.2.1. Grassland Management: -

The management of the grassland is done mainly to create habitat for wildlife and to prevent the occupation of the grassland areas by the much faster advancing woodland species like *Bombax ceiba*, *Dillenia pentagyna*, *Leea crispa* which may otherwise reduce the grassland areas the main habitat of the prey species of tiger. The management of grassland in Assam also started after 1972 and Prof Paul Lyhausen (IUCN cat specialist) had bitterly criticized the burning practice in Manas Tiger Reserve during his visit in 1977 (Deb Roy, 1986). In early eighties the grassland burning was used to take place haphazardly.

Hence a comprehensive and detailed burning regime may be developed including well established permanent fire lines. The short grassland in dry, well drained and upland should be burnt just at the onset of dry season and should be completed before 15th January of every year. No burning should be carried out in pygmy hog, bengal florican and hispid hare habitats after mid January.

In past the fire has been as a major tool for managing grassland in Manas Tiger Reserve. The main focus of grassland management was to create habitat for wildlife particularly herbivores. In early seventies the grassland burning was used to take place haphazardly. Prof Paul Lyhausen (IUCN cat specialist) had bitterly criticized the burning practice in Manas Tiger Reserve during his visit in 1977 (Deb Roy, 1986). In early parts of eighties, control burning was initiated, however it could not continue due to prolong civil unrest in the area.

As grassland were not managed properly over long period of time during the civil unrest, it has been converted to mixed moist deciduous forest and also occupied by invasive plant species. Henceforth, presently grassland management is key component of habitat management in the core area of MTR.

At present key interventions under grassland management are control burning, eradication of invasive plant species and control of illegal grazing.

- Control burning-Every year grassland burning is being carried out from November to March. Burning of short grass patches is usually carried out before 15th of January as short grasses are habitats of pygmy hog, Bengal florican and hispid hare. The existing roads, streams, nala acts are natural fire line in the grassland. The control burning creates patch mosaic habitat in the grassland.
- Eradication of invasive plant: Time to time initiative have been taken to eradicate invasive plant species manually like *Chromolaena odorata*, *Leea*.
- Control of illegal grazing: Besides burning another major issue of grassland management is livestock grazing, that has to controlled and stopped eventually in grassland, especially in the southern boundary of the Manas NP. The buffalo khutis located around southern boundary of Manas NP, is creating serious problem for the park. In no case the buffalo should be allowed inside the park. Further, organised thatch collection must be stopped. Buffalo khutis located around southern boundary of Manas NP have been removed and entry of livestock in core area is minimized.

The patch-mosaic burning technique has been widely used throughout the world for grassland management and it is same as traditional burning, where patches are kept unburnt. Burning of tall grass patches is essential to improve the grassland as feeding grounds to ungulates. As these patches also provide breeding and escape cover to pygmy hog, hispid hare, large number of birds, herpetofauna, few patches of such grasslands should be left unburnt so that feeding ground, cover for escape for breeding are simultaneously available (Lahkar, 2008).

4.2.2. Salt lick management:

Artificial saltlicks were created at Pahufield (deer field at Bansbari Range), Tangonmara (Bhuyanpara Range), mainly to enable citing and to supplement the mineral requirement of the wild fauna. Natural saltlicks are available in Manas. One of the most important saltlicks is located at Doimari at the Indo- Bhutan international boundary.

4.2.3. Waterhole management:

Needless to mention that the existing natural water bodies are managed, maintained and protected well. There are natural water holes located at Daulabeel, Makhibaha, Garuchara, and numerous ponds in the Kanchanbari grassland, Chorfuli, Buraburhi-jhar and Moinapukhuri area. These water holes are closely monitored and managed annually as per requirement. Removal of water hyacinth, other aquatic weeds and mud is carried out

according to need. However, there is urgent need to create waterholes especially in the bhabar tract where water scarcity is visible during winter and dry season.

4.3. Principles of Wildlife Conservation and Management: -

Under principles of wildlife conservation and management includes following interventions in core areas of Manas are planned-

- Habitat restoration and Management
 - Preserving and increasing the diversity and interspersions of habitat.
 - Protecting the habitat against factors causing degradation.
 - Making habitat conditions suitable for target species
- Maintenance of Grasslands
- Soil and Moisture Conservation
- Mitigation of Human-Wildlife Conflict
- Research, Monitoring and Capacity building and training
- Tiger population dynamics using mark-recapture & genetics techniques.
- Law enforcement mechanisms including protection and intelligence gathering
- Eco-development and alternative livelihood support
- Promoting sustainable ecotourism
- Reintroduction of heritage attributes species like rhino, swamp deer and pygmy hog etc.
- Combating Encroachment
- Absolute Protection of Core Area: The core area enjoys absolute protection and commercial felling and commercial exploitation is not undertaken.
- Strict Protection of the Habitat: Tiger and its biotope will be kept free from any sort of interference from unregulated forest exploitation. Restricted tourism is allowed in the core area.
- Improvement of Habitat: There has been a strong recommendation from UNESCO 2005, 2008, 2011 mission for development and implementation of an invasive species management for Manas NP. These invasive species would be eradicated in phased manner and the areas should be regenerated with palatable grasses. In the existing grassland where annual fire is prevalent, leading to coarser and unpalatable grass, rotational burning in alternate years will be adopted. Uncontrolled fires should be checked through cleaning of fire lines.
- Development of Waterhole.
- Creation and maintenance of saltlicks.

4.4. Protection and Intelligence gathering: -

Wildlife protection strategies consist of anti-poaching activities, anti-depredation squad, countering the threat of poachers keeping the Park free from habitat destruction and encroachment. Illegal cutting of trees, illegal removal of firewood and NWFP, poaching of Wild animals, boulder collection, illegal grazing, and encroachment are the main illegal activities in MTR. Wild animals in MTR are vulnerable to poaching. Currently rhino, elephants, tiger, deer, gaur are most susceptible to poaching. Occasional illegal fishing takes place in Beki, Hakua, Pahumara rivers and other nallahs and streams inside the park.

Illegal felling of tree takes place in buffer area and is a serious concern in MTR. Thatch is collected by fringe villagers for roofing and walls. Grasslands of Manas are important for many avifauna including bengal florican, a rare and endangered species.

Regular patrolling is organised to protect the wild fauna. Firearms like Rifles and DBBL guns are used for self protection during patrolling. Patrolling is done regularly on foot, on bicycle and by vehicle. Patrolling is done on elephant back during monsoon in inaccessible areas.



Wireless networks have been installed in most of the Range and in some Beat Offices. Walkie Talkie is used by Patrolling teams. Few Beats are provided with Departmental elephants for intensive patrolling.

Since recent past numbers of local NGOs such as Manas Maozigendri Ecotourism Society (MMES) have been formed in fringe villages of Manas. The members of these local NGOs are involved in protecting forest and wildlife along with MTR personnel as service provider.

4.5. Tourism and Interpretation:-

- a) Tourism statistics:- The biodiversity and the outstanding scenic beauty of the Manas National Park, particularly at Mathanguri, where the river Manas enters the Park from the Bhutan Hills displaying a picturesque view with the backdrop of tree covered hills and gradual slopes from the foothill of Bhutan to the plains of Assam on the right bank of river attracts people from far and wide. Annually 5000 - 6000 tourists visit core of Manas TR.

Table 4.1: Summary of Tourist visitors in Manas National Park: -

Years	Number of Visitors		Total Visitors	Total Revenue (In Rs.)
	India	Foreign		
2000-01	1005		1005	
2001-02	3219	11	3230	231441.00
2002-03	300	21	321	166510.00
2003-04	215	88	303	327200.00
2004-05	13648	234	13882	981995.00
2005-06	22029	289	24885	2494432.00
2006-07	1689	69	11829	1398650.00
2007-08	2127	239	9785	64370.00
2008-09	9597	139	17913	334135.00
2009-10	503	503	10237	1747745.00
2010-11	4793	129	16996	1591778.00
2011-12	13167	177	24207	2374655.00
2012-13	5214	91	18419	2488065.00
2013-14	22840	325	23165	3093075.00
2014-15	9786	475	10261	3347583.00
2015-16	40559	614	41173	7369007.00
2016-17	36201	351	36552	7624053.00
2017-18	37592	480	38072	8130830.00
2018-19	42340	650	42990	10663500.00

Wildlife tourism in Manas is a semblance of conservation education and entertainment with the active participation of local people. The underlying principle is that the tourism should be ecologically and socio-culturally sustainable.

- b) Wildlife and nature tourism:- The richness and grandeur of Manas National Park attract tourists from all over the world mainly for nature and wildlife tourism. The main tourist attracting sites inside Manas NP are Mathanguri, Doimari, Kuribeel, Uchila, Gabharukunda, Makhibaha, Kokilabari etc.
- c) Day Visitors:- Day visitors are generally local people, with school children coming in groups. Most day visitors go upto Mathanguri, Doimari and Kokilabari.
- d) Tariffs and Regulations:- Following regulations are in vogue.

Table 4.2: Tariffs for Tourists/ Visitors to Manas National Park (As per order by Governor Notification No. FRW.73 2008/239, Dated Dispur the 31st Oct/2015

Sl. No.	Item	Existing Rate in Rupees		Revise Rate in Rupees	
		Indian	Foreigner	Indian	Foreigner
1	Entry fee per person day	50.00	500.00	100.00	650.00
2	Fee for elephant seat per trip	450.00	1,000.00	750.00	1,250.00
3 a	Toll for road per trip per day	300.00	300.00	300.00	300.00
3 b	Toll for river cruise per trip per day	300.00	300.00	1,000.00	1,000.00
4	Camera Charges:-				
4 a	Mobile and Smart Phone			FREE	FREE
4 b	Still Photography	50.00	50.00	100.00	200.00
4 c	Movie/Video Camera	500.00	1,000.00	1,000.00	1,000.00
4 d	Still photography (Professional)	500.00	2,000.00	1,000.00	3,000.00
4 e	Movie/ Video Camera (Professional)	5,000.00	20,000.00	10,000.00	30,000.00
5.	Film/Documentary shooting per day				
5 a	Feature Film	5,000.00	25,000.00	1,00,000.00	2,00,000.00
5 b	Documentary Film	5,000.00	25,000.00	15,000.00	75,000.00
5 c	Security money for feature film	5,000.00	25,000.00	1,00,000.00	2,00,000.00
5 d	Security money for documentary film per day	5,000.00	25,000.00	15,000.00	75,000.00

e) Other regulations within the National Park: -

- No entry after sunset and before sunrise. Night driving is prohibited in the Reserve.
- Pets, transistors, tape-recorders, stereos are not permitted.
- No arms and ammunitions are allowed.
- Carelessly throwing and leaving trash litter is strictly prohibited.
- Kindling fire in the forest is prohibited.
- Fast driving (>20 km/hr.) and blowing of horn is strictly prohibited.
- Shouting, teasing or chasing of animals are prohibited.
- Staying in rest houses without reservation is prohibited.
- Hunting and fishing are strictly prohibited.
- Use of flash camera to take a snap of wild animals is not allowed.

f) Closed period: Park usually remains closed for tourists from 1st July to 30th September.

4.5.2. Tourism Infrastructure: -

- a) Roads: - Very few roads are open for tourism. Some of these routes are Bansbari-Mathanguri, Kokilabari-Doimari, Bhuyanpara-Doimari and Panbari-Gabharukunda. Development of tourism has both negative as well as positive impact on wildlife management.
- b) Accommodation:- There are ten double bedded rooms at Mathanguri forest inspection bungalow and a dormitory that can accommodate students and trainees, including government officials. There are few lodges privately owned located outside just adjacent to the National Park.

4.5.3. Interpretation: -

There is only one Nature Interpretation Centres (NIC), at Bansbari which was built in 1995-96. However to control law and order situation during the civil unrest, Indian Army and paramilitary force took over for 6 years. As a result of that, Nature Interpretation Centres was damaged and it needs renovation and reconstruction immediately. A visitor book is maintained at Mathanguri Forest IB to get the visitor's feed back and to assess the number of visitors. Time to time, conservation partners organizes nature camps for school children, nature guide trainings for local unemployed in around Manas.

4.6. Research and Monitoring: -

Manas Tiger Reserve is developing into an excellent research centre due to its rich flora and fauna and diverse habitat. In mid eighties, before the civil agitation, study initiated

by the Botanical Survey of India (BSI) and the Bombay Natural History Society (BNHS) on Bengal Florican was the beginning of the scientific research in the NP. Two doctorate degrees have been awarded in one for research on Golden langur and the other for research on mammalian fauna of Manas National Park in late nineties.

In 1995, Pygmy Hog Conservation Programme started under an MoU between Govt. of Assam, Govt. of India, Pigs, Peccaries and Hippo Specialist Group of IUCN and the Durrell Wildlife Trust, UK. Since inception of the programme, regular studies have been carried out on Pygmy hog (*Porcula salvania*) and grassland ecology in the park.

The Manas National Park has been a living laboratory for academicians of numbers of Indian University. A significant number of PhDs has been awarded in post agitation period for Manas which are as follows-

1. Pranjal Bezbarua (2007): Study of plant diversity status in Manas Biosphere Reserve with special reference to community structure, Gauhati University.
2. Bibhuti P Lahkar (2008): Ecology and Management of Grassland with special reference to Grass and Bird Communities in Manas National Park, Assam, Gauhati University.
3. Jyoti P Das (2011): Habitat utilization pattern and habitat suitability modeling of Asian elephant *Elephas maximus* in Manas National Park, India, North Orissa University.
4. Naba K Nath (2011): Study on Human-Elephant Conflict in Manas Tiger Reserve, Assam: Magnitude, Spatial Distribution and Mitigation Methods, North Orissa University.
5. Ghosh, S. (2014) Habitat suitability analysis for Tigers (*Panthera tigris*) in the Indo-Bhutan Manas Tiger Conservation Landscape. Aberystwyth University, UK.

Under World Heritage Biodiversity Programme, ATREE (an NGO) is conducting research on vegetation succession especially on grassland. Aaranyak, a scientific and industrial research organization has been involved in carried out number research works. Some of the key are: Manas Tiger Reserve Information System- a GIS based database, monitoring of elephant population using dung count, human-elephant conflict monitoring, monitoring of Bengal florican, swamp deer, hog deer and hispid hare. Aaranyak and WWF-India are involved in carrying out monitoring and habitat utilization pattern of translocated rhinos using GPS based radio telemetry. Aaranyak, WWF-India, and ATREE in collaboration with park authorities have been regularly conducting the monitoring of tiger and its prey in the park since 2008.

4.7. Training: -

The Manas National Park offers ample scope for on the job training in wildlife conservation and related issues. The field personnel of the park have been involved and

associated with the wildlife conservation since long. Workshops and training programmes on various techniques and issues are conducted regularly as part of capacity building. Trainings are imparted in modern techniques in wildlife management. It includes wide range of subjects like dealing with legal aspects, law enforcement, arms training, patrolling and antipoaching techniques, use of GPS, compass, range finder, camera traps, modern techniques in animal population monitoring and estimation. Exposure trips for the frontline staffs are also being conducted regularly.

4.8. Estimation of Wild Animals: -

This is one of the most important exercises carried out every year in the month of March/April in the Tiger Reserve. Needless to add, such information is essential to monitor changes in the population trends over time or among habitats, and evaluate the success of wildlife management programmes.

A series of rapid surveys and populations estimation of wild animals (including the flagship Tigers and elephants) have been carried out recently in the Park. The Details of each of these estimations have also been discussed in Chapter Three of this document and subsequent chapters.

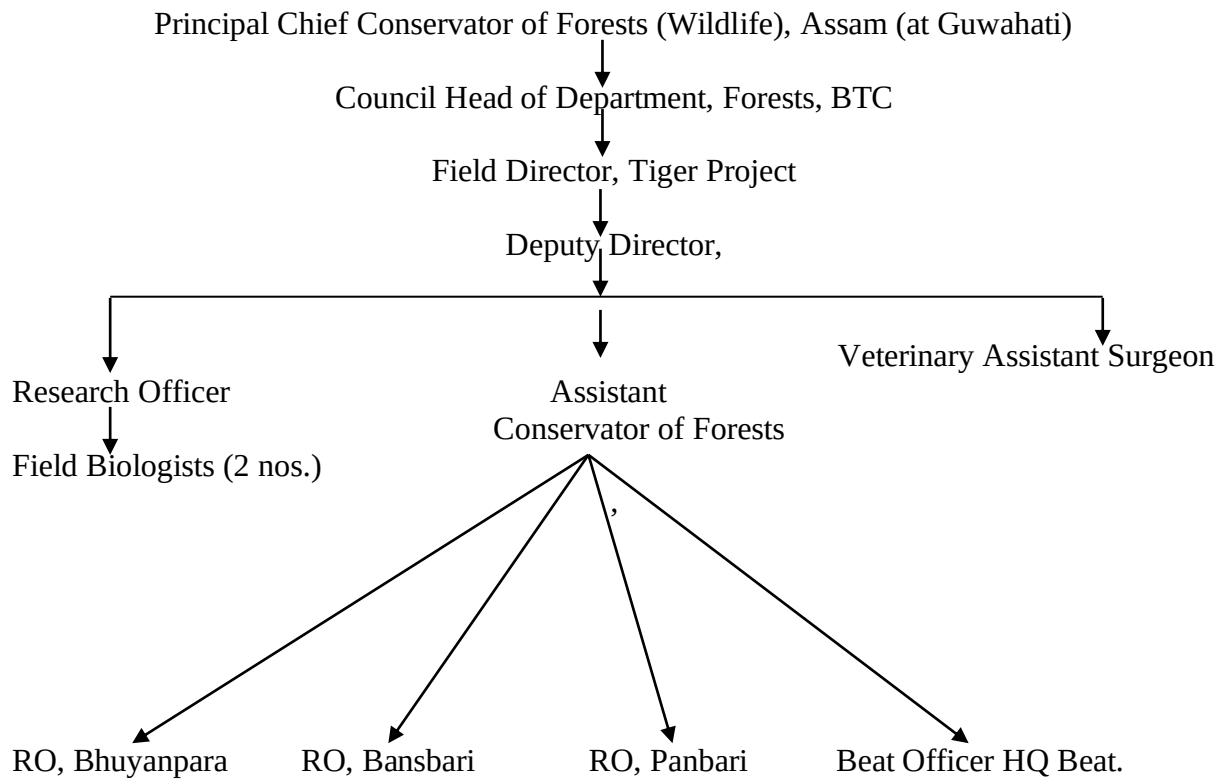
4.9. Relocation of Villages: -

It is essential to have a minimum inviolate area (forming the core of the Tiger Reserve) capable of supporting 20 breeding tigresses. On an average, a tigress requires 40-60 km² of territory for successful breeding. Pressure of human habitation is detrimental in sustaining high density breeding tiger populations. Taking advantage of ensuing peak of civil agitation an area of 16.30 sq. km. of Panbari RF was encroached in 1996. The encroachment was a loosely aggregated group initially and this type of illegal settlements do not qualify for relocation package. However, these settlements need to be re-habilitated from the core area of a tiger reserve. The relocation site should be so chosen so as not to compromise the conservation value of the Tiger Reserve i.e. it should be as far away from the core as possible and not located in connecting habitat corridors.

As per estimation carried out in 2008 there were 912 households living in 32 numbers of villages. Initial proposal for relocation of 100 numbers of families from these villages was submitted during 2008-09 as per norms circulated by the NTCA, i.e. Rs.10,00,000.00 per family. Accordingly, Rs. 645.0945 lakhs were sanctioned by the Government of India (NTCA) during 2009-2010. Unfortunately, families could not be relocated due to political uncertainty in the processes. As the relocation process has been delayed, the sanctioned amount from NTCA has been adjusted in the APO of 2012-13 year.

4.10. Administration and Organization: -

The core area of Manas Tiger Reserve, Manas National Park is under the administrative control of Field Director, Manas Tiger Project with headquarter at Barpeta Road, Assam. There are 3 (three) Ranges namely- Bhuyanpara, Bansbari and Panbari Range. The entire National Park was divided into 53 well demarcated blocks which are managed and protected by Beats or Sub Beats. The boundaries of these Beats and Sub Beats are demarcated by natural features like rivers, streams and nallahs mostly. The list of Blocks, the administrative structure and controls in terms of function and hierarchy is also place as Annexure.



4.11. Past History of Management in Barnadi Wildlife Sanctuary: -

- 1942: - Declared as Bornadi Reserve Forest (area 26.22 sq.km.).
- 1958-1973: Islam Plan: - The compact evergreen areas were placed under the evergreen working circle. The prescriptions for the working circle were. Selection cum improvement felling was introduced with a prescription for minimum exploitable girth limit for various commercial timber trees. Rotation period fixed for Khokan and Hollock was 80 years, for Mekai 100 years and 160 years for others. The felling cycle fixed was 20 years. Prescriptions were made for taking up area under assisted natural regeneration.
- 1971: - Reappearance of Pigmy Hog and Hispid Hare.
- 1975-80: - P.C. Das Plan. As per this plan the area was recommended to be managed under Irregular shelter wood system. The rotation prescribed was 120 years with a felling cycle of 13 years. Savannah and blank areas were covered under the Afforestation working circle. The available records indicate that plantation of *Tectona grandis*, *Bridelia retusa*, *Bombax Malabarica*, *Gmelina arborea*, *Phoebe goalparensis* and *Eucalyptus* spp. were raised in the area. The importance of the area was realized after the sudden reappearance of Pigmy Hog and Hispid Hare in the year 1971.
- 1980: - The area was declared as a Wildlife sanctuary (area 26.22 sq. km).

Table 4.2. List of Range, Beats and forest camps under Barnadi Wildlife Sanctuary

Sl. No.	Name Range	Name of Camp	Remarks
1	Barnadi Range	Nalapara AP camp	Functioning
2		Bamuninala AP camp	Functioning
3		Bogamati AP camp	Functioning
4		Ghopakhana AP camp	Functioning
5		Bamuninala Camp	Functioning
6		Alongjhar camp	Functioning

Table 4.3: List of villages in the fringes of Barnadi Wildlife Sanctuary

Sl. No.	Name of village	Human Population	Cattle Population
1	Rajagarh No. 1	253	255
2	Rajagarh No.2	1165	1600
3	Rajagarh No. 3	360	740
4	Rajagarh No.4	673	800
5	Dharamajuli Khoiragrant	870	880
6	Attreeghat Khoiragrant	420	550

7	Khoirajhar	190	550
8	Dharamajuli Tea Estate	550	1200
9	Suklai No.1	350	650
10	Suklai No.2	370	700
11	Suklai No.3	400	800
12	Barengajuli No.1	1150	2000
13	Barengajuli No.2	1900	2500
14	Barengajuli No.3	1500	2000
15	Tankibasti No.3	1800	2200
16	Tankibasti No.1	900	1500
17	Tankibasti No.2	700	1200
18	Badlapara Tea Estate	2000	2000
19	N.K. Suklai	400	600
20	N.K. Suklai Bagar	300	400
21	Neuli No. 2	250	400
22	Neuli No. 3	220	400
23	Neuli No.1	200	350

CHAPTER FIVE

LAND USE PATTERNS AND CONSERVATION MANAGEMENT ISSUES

5.1. Land use Classification: -

A broad scale habitat zonation of Manas National Park was attempted using Landsat satellite data between the years 2006-2010. Details of the categories have already been provided under Chapter Two. In brief, the landuse pattern of the Manas National Park, the core zone of the Manas Tiger Reserve is as follows-

Land Use Class	2006 (area in sq. km.)
Woodland	233.21
Dry Grassland	161.97
Swampy Grassland	44.37
Water Body	4.99
River Sand	35.97
Others	20.47

Landscape metrics of the various landscape element types in Manas National Park: -

- a) Woodland (semi evergreen and moist deciduous): The area under this LSE type is 233.31 sq. km. This LSE type is distributed mostly in northern part of the Park and in the extreme south-west of the Park.
- b) Dry grassland: The area under this LSE type is 161.98 sq. km. This LSE type is distributed in northeastern part of the Park and in the southern boundary of the Park touching villages.
- c) Swampy grassland: The area under this LSE type is 44.49 sq. km. This LSE type is scattered all over the Park.
- d) River sand: The area under this LSE type is 35.82 sq. km. This LSE type is mainly concentrated around dried river Manas.
- e) Waterbodies: The area under this LSE type is 3.94 sq. km.
- f) Others: The area under this LSE type is 20. 47 sq. km. This LSE is mainly encroachment and agricultural cultivation in Panbari and Betbari respectively.

5.2. Socio-economic Profile of Villages: - There are 62 thickly populated villages on the southern boundary of Manas National Park. The inhabitants of fringe villages belong to

different ethnic composition including: Bodo (70%), Bengali (7%), Assamese (5%), Adivasi (5%), and others (13%) includes Muslim, Rabha, Garo, Nepali and Rasbongsi. The native communities of the reserve are socially, culturally and emotionally attached to the area. The livelihoods of the people of these villages are mainly of agriculture based and cattle rearing. The socio-economic conditions of the majority of villages mainly inhabited by tribal and other backward communities are very poor. As the existing wildlife laws strictly prohibits access to the Park, and the scopes will have to be explored towards alternatives for cattle grazing, collection of fuel wood, fishing etc. Due to absence of buffer area on the southern front the wild animals cause significant damage to life and property of the people resulting in man-animal conflict.

Majority of the local people in the region are subsistence farmers and the prime crop cultivated is paddy (Summer & Winter). The farmer community is followed by the daily labours by 22.91%, Service holders by 6.39% (teachers, security personals, forest department employees, NGO workers), 0.53% farmers who also work as daily labours during non-cropping season and 0.36% were businessmen. The overall literacy rate in fringe villages is 20.04% which is much below the National Average of 52.21%.

In agrarian economy land is a complex issue and it is more so in the case of tribal area. Some of the existing alternative livelihood activities that the SHGs are involved in, includes Weaving, Farming, Piggery, Dairy Farm, Goatery, Poultry. Even though they are doing these activities but they are not working in a systematic way. Most of these activities they are involved as part of their daily life activities and in an inefficient, unscientific and non-commercial manner. Hence for these reasons they are not been able to get desired economic benefits. Besides, farming is the prime source of livelihood in these areas. Also most of the households in these areas rear poultry, goats and cows. However, all these existing livelihood activities are being carried out very casually, in unsystematic and unscientific way.

The land use pattern in the Zone of Influence can be broadly classified as under:-

Paddy cultivation	: -	70%
Homestead	: -	05%
Vegetables cultivations	: -	10%
Bamboo and tree groves	: -	05%
Fishery and water body	: -	05%
Fallow land for grazing	: -	05%

Live stocks are a part and parcel of families in a predominant agrarian economy. Livestock helps the communities in agriculture and provides meat and milk to meet basic needs. Tribal communities keep pigs and poultry.

The Zone of Influence or Eco-Sensitive Zones (ESZs) are areas notified by the Ministry of Environment, Forests and Climate Change (MoEFCC), Government of India around Protected Areas , National Parks and Wildlife Sanctuaries. The purpose of declaring the zone is to create some kind of “shock absorbers” to the protected areas by regulating and managing the activities around such areas. They also act as a transition zone from areas of high protection to areas involving lesser protection.

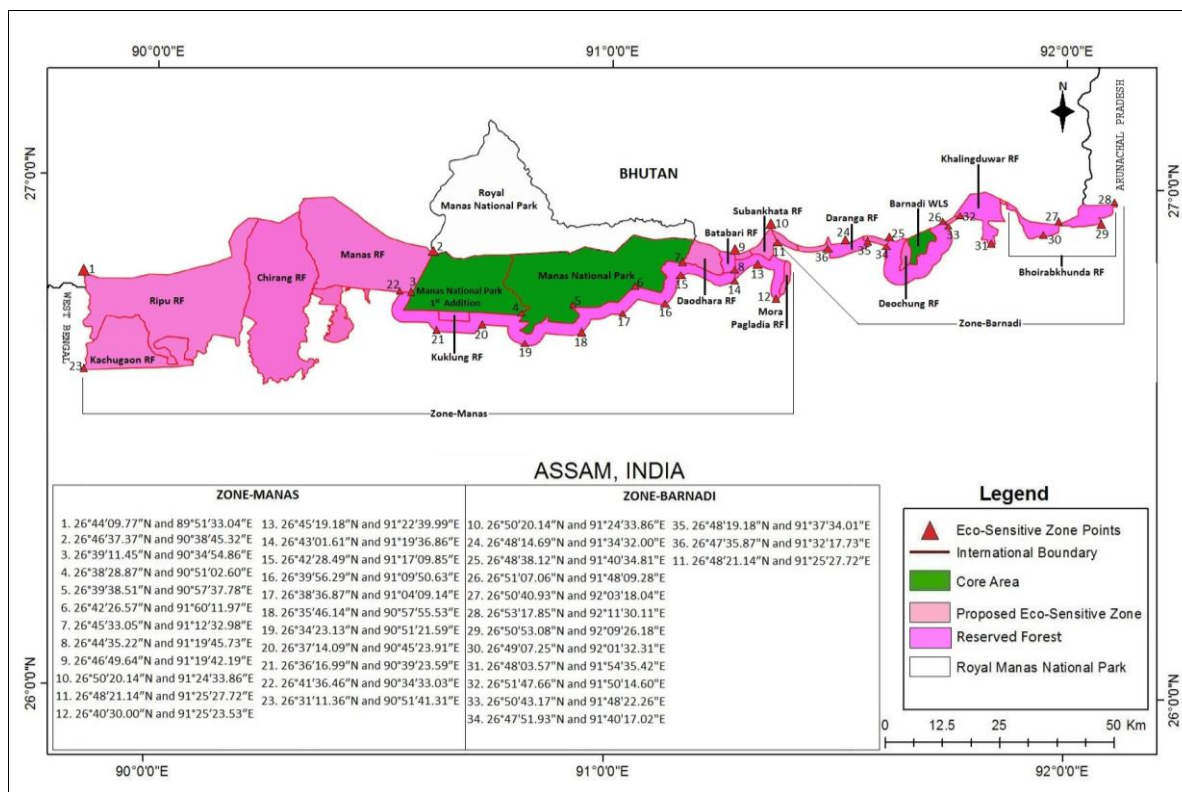


Figure 5.1: Map of proposed Eco Sensitive Zone around Manas Tiger Reserve

5.3. Resource Dependence of Villages: -

There are 62 thickly populated villages on the southern boundary of Manas National Park, and villagers' livelihood is heavily dependent on forest resources. Even though Manas is a National Park it has been facing tremendous pressures from communities living outside the forests. There are also pressures from external forces in the form of illegal extraction, poaching. Despite the ecological and economic importance of the forests of Manas, ecosystems have been subjected to great stress, and continue to face multiple threats.

In several parts of the National Park livestock quantities exceed the natural carrying capacity of the land. This leads to over usage of grasslands, and a reduction of productivity.

Once we get the desired witness of resource utilization pattern an effective management tool can be developed towards the conservation of Manas ecosystem. Previous data shows that the fringe villagers had an average income of 257/- per month, for which peoples had to look towards commercial sector of forest resources. A socioeconomic survey can contribute much in this regard; through which we can manage the livelihood of these peoples and play down the anthropogenic pressure from the forest. Various exercises can be used to formulate a sustainable margin between the human and wildlife in terms of utilization of forest resources, such as Participatory Forest Management where local groups will be equally responsible for jointly managing the forest area. This phase can answer to all the questions, then the preliminary problem analysis is complete and we can begin with the enumeration such as habitat analysis, restoration of damaged forest ecosystem and fragmented wildlife corridors. For this we should have to make an inventory of wildlife in the

periphery of human habitations with respect to some major species like Elephants, Leopards etc.

Monitoring activities should be included in the operational plan, and should be agreed during the preparation of the plan in the same way that objectives and activities are agreed. Monitoring is needed as a check that the operational plan is being implemented as planned and that it is having the desired results. The information from carrying out monitoring can then be used to make modifications to the operational plan if necessary. The participatory principles which are being applied in operational planning must also apply to monitoring - in other words, monitoring should involve all forest users or representatives of all stakeholder groups, because the only true aspects of conservation in a human and wildlife ingenerated ecosystem are proper management and Monitoring.

5.4. Human-Wildlife Conflicts: -

Growing human population, demands for cultivable lands and alteration of forest habitat to human habitation and cropland resulted serious human-wildlife conflict in around PA of Assam.

Occasionally the rhinos, elephants, deer and wild boars of the park stray out into the fringe areas and cause damage to the crops, killing livestock and including killing human being. Injury and death caused to human being by wild elephant, tiger and bear are not very common but in record. The total absence of provision to mitigate or for redressal of man-animal conflict is prominent. The south boundary abruptly encountering a sea of human being all along possesses serious threats to wild animals and causes conflict. The human wildlife conflict in the Manas National Park prevailed in the following direction-

- Human-elephant conflict: The human-elephant is most prominent type of conflicts around Manas. The intensity of the conflict is relatively more in the Panbari and Bhuyanpara area.
- Human carnivore conflict: The livestock killing takes place mostly inside the park. The leopard and tiger are responsible mainly for livestock predation.
- Human wild boar conflict: The human-wild boar conflict is another common type of conflict seen around. Reports regarding damage and loss of agricultural crops due to wild boar is the order of the day, and the conflict is acute.

Human elephant conflict refers to a range of direct and indirect negative interactions between people and elephants which potentially harm both. The most publicized are crop damage by elephants and injury or death to people. Human-elephant conflict is a closely related problem of elephant conservation scenario. The conflict problem is a cause for concern because it threatens to erode local support for conservation in areas where human life and property are at high risk of destruction by wild elephants. Depredation by wild elephants in Panbari, Bansbari and eastern portion of the Park is prevalent. This happens mostly in the winter season.

Crop damage incidents were mostly concentrated along the Park boundary areas and highest depredation occurred in the villages that are located adjacent to the Park. It was observed that as the distance increased the conflict gradually decreased and vice versa. During the study period it was found that within the distance class 0-500m of the Park boundary highly significantly more incidents of crop raiding occurred.

Crop raiding in the fringe areas around Manas National Park was found to be a seasonal phenomenon. Due to its large extent of cultivation in the study area Paddy was raided highly significantly more frequently than the other crops. In the study area both summer and winter paddy were cultivated however, the extent of cultivation of summer paddy was comparatively less.

A total of 26 different species of crops were recorded which were raided (consumed /trampled/damaged) by elephants in the affected villages around Manas National Park (Nath, 2011). All the house and property damages were reported to be caused by single bull elephants. Majority of the victims did not claim compensation for the losses occurred due to house and property damage.

5.5. Assessments of Inputs of Line Agencies/ Other Departments: -

Development programmes going on in districts are broadly of two types: Poverty alleviation programme and economic development programmes. Poverty alleviation programmes are for uplifting economic status of individual or communities living below poverty line. Development programmes are not directly focusing on individuals or communities but are benefiting indirectly by providing employment, developing infrastructure, improving agriculture production etc.

MNP is located within the jurisdiction of the Bodoland Territorial Council that came into being in 2003. As per agreement some 40 subjects were listed for transfer to the Council. But as on today 39 subjects stands transferred and Forest is one of them. The Council executes developmental programmes in its territory through various departments transferred to it and each headed by a designated “Council Head of Department” (CHD). The district administration has no role in these transferred subjects but executes schemes under Rural Development which too is funded by the Council.

5.5.1. Forestry: -

Forest, an important natural resource, plays very crucial role in the economic development of Bodoland Territorial Council as the Forests are located in the strategic locations of the Council. Out of 3540.63 sq. km. total area of the Council, 2473.45 sq. km. Forest area is located along the Indo-Bhutan international boundary. Forest department in the Council area suffered extensively in terms of destruction of infrastructure like, Range and Beat office buildings, staff quarters mainly in the interior forest areas during the last decade of agitation; therefore, the priority of the department is to reconstruct the and quarters of the

staff and the camps inside the forest areas for protection and conservation of forests. Altogether 352 buildings are required to be reconstructed. There are still a large number of offices and staff quarters yet to be constructed.

In addition to the above, the department has purchased more than 110 numbers of .315 rifles for use by patrolling parties in the protection of forests and wildlife. The department also has purchased 150 numbers of wireless sets to help mobilize staff in the protection of forests and wildlife; the base stations being set up in strategic locations for the purpose.

The forest department has created more than 1080 hectares' plantation during last few years. Besides the above, plantation is also being done by Eco Task Force in the Kokrajhar district (mainly in MTR). Every year, starting from 2008-09, the Task Force will raise 500 hectares' plantation (target).

Protection of forest is a serious problem in the Council. A large number post of frontline staff is lying vacant. In order to make up the shortage of staff, forest department is engaging 135 youths hiring them from NGOs for protection of forests and wildlife. Each hired youth is being paid nominal remuneration of Rs. 6500.00 per month (ninety percent of them deployed in MTR). With the deployment of these youths, the problem of illegal felling and smuggling of trees has been controlled to a considerable extent in Kachugaon Division (westernmost buffer flank of MTR).

5.5.2. Agriculture and rural development: -

Agriculture and Rural Department are transferred subjects of the Council. Some of the initiatives made by the Council are: -

- A. Production of quality certified HYV Sali paddy seeds at departmental Agricultural Farm at Kokilabari under Baksa District: To cater to the needs High Yielding Variety (HYV) Certified Sali Paddy Seeds for paddy growers of BTC as well as others, the Department of Agriculture of the Council has taken up a production plan for producing Certified HYV Sali Paddy Seeds of variety viz: Ranjit, Mashuri. The Agricultural Farm at Kokilabari is entrusted and engaged in "Seed Certification Program" since 2004-05. It has certified Ranjit and Mashuri Sali Paddy Seeds successfully since the time it became operational under BTC initiatives.
- B. Distribution of high yielding variety of paddy seeds: Under this program the Council has distributed 5140 quintals of high yielding paddy seeds free of cost through "Rice Minikit Program" during 2008-09.
- C. Steps for Self Employment and Income Generation of Educated Unemployed Farm Women: The Council also has initiated measures for self employment and income generation for educated and unemployed women farmers. This involves capacity building of Self Help Groups (SHGs) with the aim of establishing Small Scale Agro-Based Industries. So far, 1925 numbers of such SHGs have been trained up during 2008-09.

D. Establishment of Soil Testing Laboratory: A Soil Testing Laboratory at Kokrajhar has already been established which is helping the farming community in analyzing the soil samples at free of cost departmentally.

Other tangible activities under Agriculture Sector of the Council are distribution of tractors, power tillers, water lift pumps and distribution of improved agricultural implements. The Council has started construction of two numbers of 5000 MT cold storage at Patgaon (Kokrajhar district) and Rowta (Udalguri district). There are other initiative under Agriculture sector, like Horticulture Development Programme and Land and Water Management Scheme.

5.5.3. Integrated development: -

(i) Eco development: - The core area of the reserve is free of any human settlements. A total of 62 villages fall within the immediate vicinity of the park and considered as fringe villages for eco-development programme linked to the reserve. The inhabitants of fringe villages belong to different ethnic composition including: Bodo (70%), Bengali (7%), Assamese (5%), Adivasi (5%), and others (13%) includes Muslim, Rabha, Garo, Nepali, Rasbongsi. The native communities of the reserve are socially, culturally and emotionally attached to the area. They are dependent on the biological resources for use as medicine, food, fodder, fuel, timber, religious, fibre, agricultural tools, etc. Due to their traditions and ethno-specific practices, they are heavily dependent on various kinds of forest produce from neighbouring forests. It includes fodder (cattle grazing), timber, firewood, thatch, wild vegetables and fruits, fish and occasional wild-animal hunting for meat. Most of the villagers are poor, landless labourers or marginal agriculturist with very low agriculture production. Rice is the major crop, which contributes 75-90% of agriculture production; other agricultural crops include jute, mustard and vegetable. Location specific agriculture development initiatives are missing. Also, the efforts for possible development of fishery, piggery and dairy related income generating activities have not occurred in the area (Singh, 2002). As such, the buffer zone of the reserve is functioning as manipulation zones where the native communities are allowed to use natural resources and to carry out the developmental activities. Various activities such as eco-restoration, cultivation of medicinal plants, apiculture, animal husbandry, ecotourism, land stabilization, etc. are being initiated by the Biosphere Reserve Authorities, Research Organizations, and other agencies, etc.

The local communities residing in and around the buffer zone of Manas Tiger Reserve generally belong to Bodo, Adivasi, Bengali, Rabha-Hasang, Koch- Rajbongshi, Muslim and Nepalese. Due to their traditions and ethno-specific practices, they are heavily dependent on various kind of forest from neighbouring forests. It includes fodder, cattle (grazing), timber, firewood, thatch, wild vegetables and fruits, fish and occasional wild animal hunting for meat.

A major percentage of the total population belong to Bodo tribe who comprise 70% of the population in the individual villages which followed by other communities like Assamese, Bengali, Nepalese, Rabha-Hasang, Koch-Rajbongshi and a negligible number of Adivasis. Besides, minority community such as Muslims also inhabits the area.

The eco-development programmes in the area was a humble beginning of Welfare works in the fringe villages for seeking people co-operation in protection of flora and fauna of Tiger Reserve. The broad objective of this scheme are – a) to mitigate the pressure of the people on the natural resource of the reserve by creating alternate source of livelihood outside the reserve and other income generating activities which are not deleterious to Protected area value; b) to undertake welfare works in fringe villages for providing basic amenities to the people and collaboration of local people in conservation.

Logistic support agencies for demonstration projects, environmental education and training, research and monitoring related to local, regional and global issues of conservation and sustainable development: -

- Authorities of the MTR (Manas Biosphere Reserve) (State forest Department, Govt. of Assam) provide the basic support for organizing educational camps, seminars, technology transfer programmes, etc.
- The G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal- 263643, Almora, State of Uttaranchal, India, has been identified as Lead/ Coordinating Institution for Manas along with other Himalayan Biosphere Reserves i.e., Nanda Devi, Dibru-Saikhowa, Dehang-Debang and Kangchendzonga to facilitate the Research and Development activities and compile and disseminate the available information. The Institute after analysis of information identifies the gap areas for future action.
- Ministry of Environment & Forests, Government of India, under its Man & Biosphere Scheme, funds the projects in these Biosphere Reserves.
- Various Universities, Research Organizations and NGOs are executing R & D projects pertaining to biodiversity assessment and monitoring, ecorestoration, conservation and other related aspects with funding support from different national and international agencies.

(ii) Development through District Administration: -

MTR is located within the jurisdiction of the Bodoland Territorial Council came into being in 2003. As per agreement, some 39 subjects were transferred to the Council and Forest was one them. The Council executes developmental programmes in its territory through various departments transferred to it and each headed by a designated Council Head of Department.

The Ministry of P & R. D. Dept, Govt. of India and State Govt counterpart allocate fund under Community Development Fund, NSAP and Rural Development to the DRDAs of the BTC. The flagship programmes of rural development of Govt. of India are: NREGA (National Rural Guarantee Act), IAY (Indira Awas Yojana), SGSY (Swaenajoyanti Gram Swarozgar Yojana) and IWDP (Integrated Westland Development Programme). All the DRDAs of BTC districts like Kokrajhar, Chirang, Baksa and Udalguri receive Rural Development fund from the Central as well as the State Govt.

(iii) Catchment Area Treatment Plans: -

Tangible initiatives in the area in context of catchment area treatment plan are either missing or not loud in the area.

5.5.4. Tourism:- Manas is generally open to tourists from October to June. The entry to the Park is permitted from Bansbari gate on Bansbari- Mathanguri Road. Forest IB inside the park is situated at Mathanguri for which reservation is done by the office of the Field Director. It is located on an elevation on the bank of Manas river overlooking the Bhutan side of the park and presents a view of the spectacular landscape and forests. Due to insurgency in the area the park remained closed for the visitors between 1989 to 1994. The park was reopened to the visitors in 2008 with facility of catering. Prior to this there was no provision for caterings at Mathanguri IB, so one desiring to stay there had to carry the needful provisions for food etc. However, cooks and chefs are available for a small fee. Two lodges, one at Barpeta Road and the other at Bansbari near the park maintained by the tourism department provide comfortable accommodation. A dormitory is also available at Mathanguri which can accommodate twenty individuals.

There are other resorts owned privately and located at the fringe of the park. They offer host of facilities and services to the visitors at modest price.

The park provides boat rides (rafting) and elephant rides. Foreign visitors need a special permit to enter the park. Some 32,860 people visited the area in 1983-1984. Due to the Bodo agitation in Assam, the park was closed in 1989, but in 1996 an estimated 8,000 tourists visited the park (IUCN, 1997).

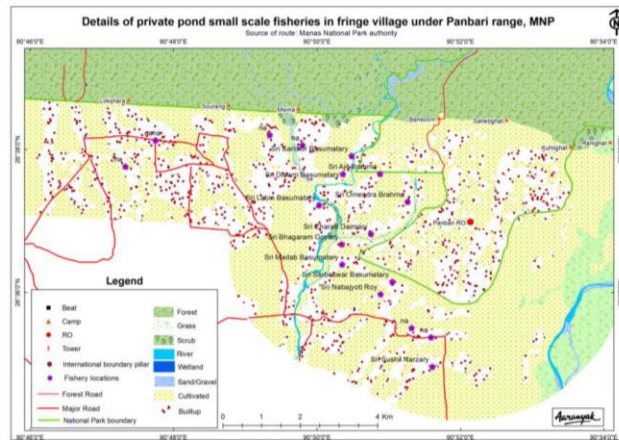
5.5.5. Fisheries:- Well organized for large scale production on a sustained long term based fishery is missing in the Manas Tiger Reserve (Manas Biosphere Reserve). However, there are several private owned small scale fisheries in the area (details of private owned small scale fisheries included in Appendix 40). As per Council, the mandates of the Fishery Department are as follows: -

1. Popularization of scientific fish farming.
2. Increase fish and quality seed production.
3. Support nutritional demand through protein rich fish.
4. Provide extension service to Fish Farmers/ Entrepreneurs.
5. Generate employment opportunities.
6. Culture base capture Fishery in Beels.

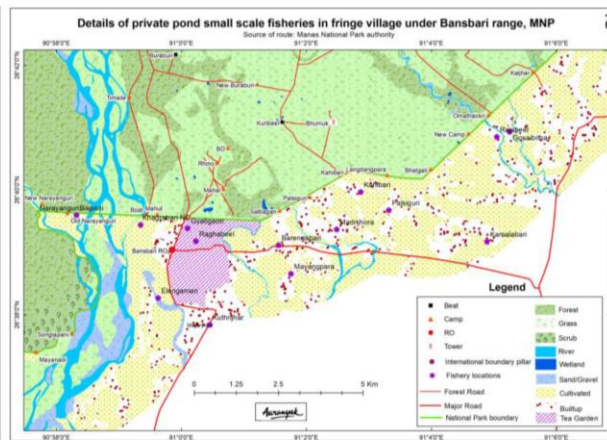
Besides, some of the initiatives undertaken by the department are summed up as follows: -

1. Development of Farmer's pond.
2. Development of Community Tank.
3. Pig-cum Fishery culture.
4. Paddy cum Fish culture.
5. Development of Derelict Water Bodies/Water logged areas.
6. Incentive to Fish Seed Grower.
7. Incentive to Fish Seed Traders.
8. Training to fish farmers.
9. Awareness camp.
10. Stocking of Fish Seeds in Public Water Bodies.
11. Kuchia culture etc.

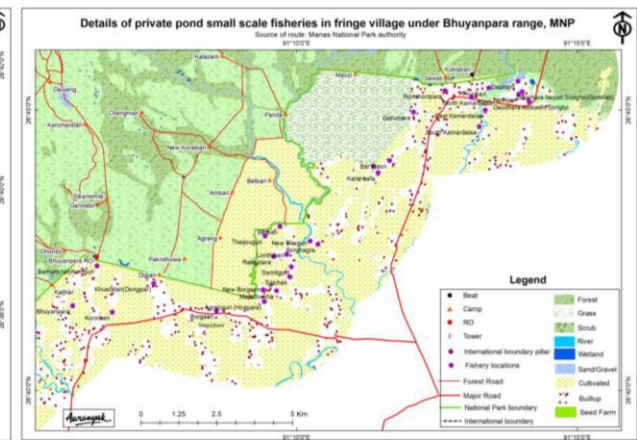
Map showing the details of private pond small scale fisheries in fringe villages under Manas National Park



Panbari Range



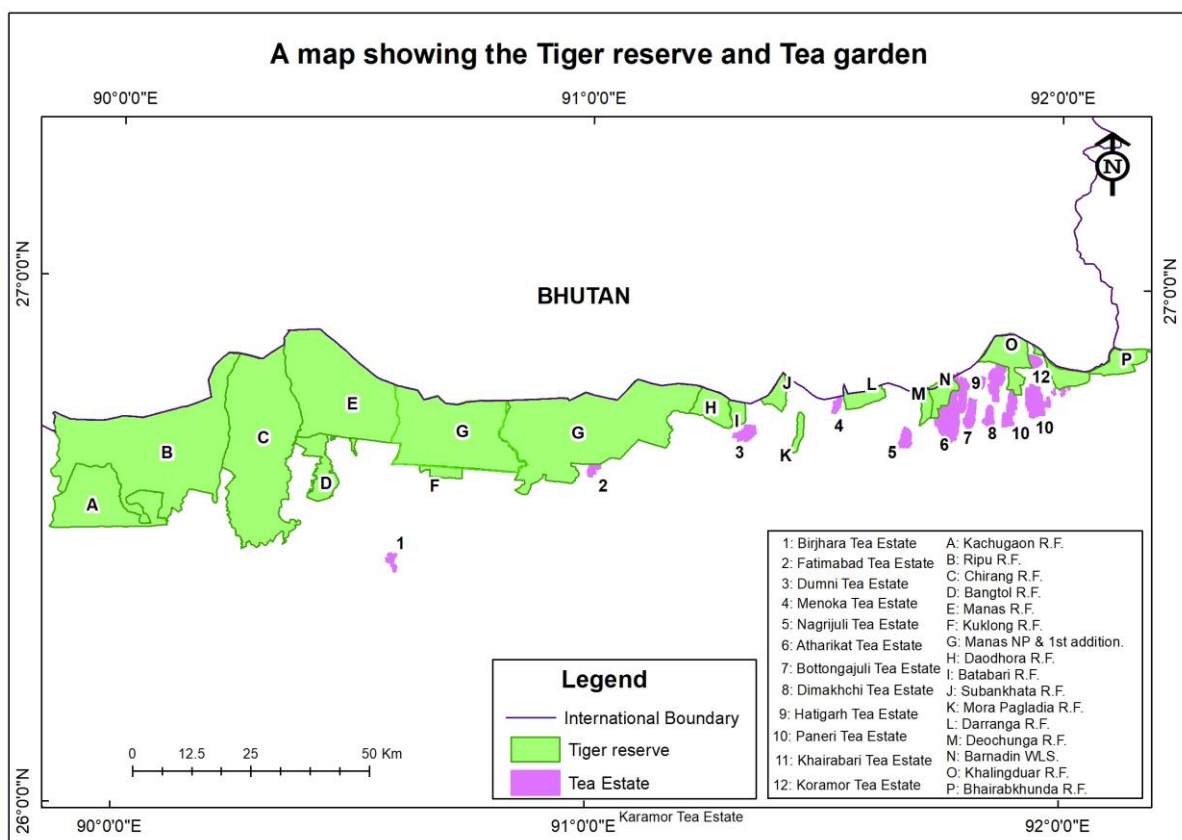
Bansbari Range



Bhuyanpara Range

5.5.6. Tea Plantations: - There are numerous Tea gardens located in the fringe of Manas Tiger Reserve. These are either just adjacent or in close proximity to the Tiger Reserve. The list of the Tea Gardens is given below: -

1. Fatemabad Tea Estate (adjacent to Manas National Park)
2. Dumni Tea Estate (near Batabari RF)
3. Menoka Tea Estate (near Darranga RF)
4. Nagrijuli Tea Estate (west of Barnadi WLS)
5. Atharikhat Tea Estate (south of Barnadi WLS)
6. Dimakuchi Tea Estate (south of Barnadi WLS)
7. Paneri Tea Estate (south of Khalingduar RF)
8. Bhutiachang Tea Estate (south of Khalingduar RF)
9. Hatigar Tea Estate (south of Khalingduar RF)
10. Khairabari Tea Estate (south of Khalingduar RF)
11. Koramor Tea Estate (adjacent to Khalingduar RF)
12. Chandana Tea Estate (Dhansiri).



5.5.7. Road/Rail transport: - Towards the south of the Tiger Reserve the NH-31 runs parallel from Srirampur on the west upto Rangia in the east. Further from Rangia the NH-51 connects Rowta, which may be considered the point to reach the eastern most tip of the

Manas Tiger Reserve (Manas Biosphere Reserve). The portion of NH-31 has been four laned as a part of East-West Corridor Project of National Highway Authority of India (NHAI). The NH-31 © passes through the forests in the west-east direction from Patgaon to Bongaigaon via Bishmuri, Karigaon, Garubhasha, and Sidli. In the similar way train line also runs parallel from Srirampur to Rowta. These two communication lines serve as backbone and a big boon to Manas. There are numerous crisscross road connections throughout the tiger reserve cutting across north and south connecting NH-31 and NH-51 at various points. Some of them are: -

1. Barpeta Road to Mathanguri-Panbang.
2. Bhabanipur to Salbari-Bhuyanpara.
3. Pathsala to Kokilabari-Nanglam.
4. Nalbari (Ganesh Mandir) to Dhomdhoma to Subankhata to Uttarkuchi.
5. Rangia to Darranga- Samdrup Jongkhar.
6. Baihata to Goreswar to Bogamati.
7. Mangldai to Tangla to Nunoi (Khalingduar).
8. Mangldai to Tangla to Barnadi.
9. Udalguri to Bhairabkunda.
10. Rowta to Bhairabkunda.
11. Bijni to Kuklung.
12. Kajalgaon to Bengtol-Santipur to Hatichar.
13. Kokrajhar to Sarbhang via Haltugaon- Bishmuri.
14. Kokrajhar to Hatichar (Gelekphu) via Karigaon-Samthaibari-Garubhasha-Runikhata.
15. Gossaigaon to Raimona (PWD).

5.5.8. Industry: -

There is no prominent industry in Manas Tiger Reserve. The Bodoland Territorial Autonomous Districts (BTAD) are considered as most industrially backward districts. There are no medium and large industries in the BTC areas, except Bongaigaon Refinery and Petro-Chemicals Ltd. at Dhaligaon under Chirang District. There are more than 1500 registered and unregistered small scale and cottage industries in the four districts of BTC and generated employment to 10000 persons directly and indirectly in the sector.

There is tremendous scope for development of small scale and cottage industries in the BTC areas based on locally available raw-materials and skills. The area possesses vast natural resources as such agricultural products- oil seeds, ginger, chillies, horticultural products- fruits, and vegetable, flowers, forest products- timber, bamboo, herbs, orchid, sand-gravel etc. for industrial input.

The cottage Industries Department has launched and implemented the following plan and programme for promotion and growth of small scale and cottage industries in the BTC areas.

The Industries Department is proposing to revamp the industry for utilization of available local resources and value addition thereof. It will create direct and indirect employment in the locality of Bijni.

5.5.9. Mining projects: -

There is no mining project in Manas National Park (Manas Tiger Reserve).

5.5.10. Thermal power plants: -

There is no thermal power plant in Manas National Park (Manas Tiger Reserve).

5.5.11. Hydro-electric projects: -

There is no hydro-electric project in Manas National Park (Manas Tiger Reserve).

5.5.12. Irrigation projects: -

Increase in agriculture production and productivity depends, to large extend, on the availability of water through the irrigation facility. The period of rainfall is restricted to only 4 (four) months in a year, June to September, when monsoon arrives. The remaining 8 (eight) months are dry. Even during monsoon, the rainfall is scanty and undependable in many parts of BTAD. Sometimes the monsoons are delayed considerably while sometimes they cease prematurely thus pushing large area into drought like situation.

So, for solving problem created by insufficient, uncertain and irregular rains the BTC has given great importance on proper development of irrigation facilities by constructing big and small irrigation structures across the rivers and streams running through the BTAD.

In the span of 4 (four) year, since 2005-06, the present BTC Government has invested Rs. 21.0950 Crores through Annual Operation Plan and successfully completed 288 nos. of Minor Irrigation Schemes bring 18,500 Hectors of land under Irrigation facilities.

The Champamati Irrigation Project (Major) and Sukla Irrigation Project (Medium) taken up under BTC special package 2005-06 for an amount of Rs. 43.85 crores and 8.12 Crore respectively is now on the verge of completion and about 26,663 Hectors (NIA) of land will be brought under Irrigation facility by the above 2 (two) schemes. Moreover, to bring entire crop land of BTAD under Irrigation system, the BTC authority is planning judiciously in a phased manner and accordingly 23 nos. of irrigation Schemes for Rs. 67.7019 Crores has been sanctioned under AIBP for the year 2008-09 to cover 12, 702 hectors of land under Irrigation facility. Presently about 15,000 families of BTAD have been benefited directly or indirectly by irrigation facility which has played a pivotal role in upliftment of rural economy.

5.5.13. Communication projects: - It is apparent that the Bodoland Territorial Council has laid emphasis on priority on the construction and improvement of road communication since its inception in 2003. The entire Manas Tiger Reserve falls within the Council area. The PWD is a transferred department/subject to the Council. The schemes are approved by the Council and works are executed through the Department under direct supervision of the Council. During the year 2008-09 the Department was allocated an amount of Rs.2850.00 lakhs under the Annual Operation Plan. Some of the major works are in completion stage and some are progressing as desired. Some of the agencies involved are NLCPR, DONER etc.

Some of the important roads of the Manas Tiger Reserve completed by the Council are as follows: -

1. North Kajalgaon- Dangtol Road	= 6.00 kms.
2. Kashikotra – Bamungaon Road	= 9.75 kms.
3. Dhamdhama – Tupalia Subankhata Road	= 18.00 kms.
4. Kalaigaon – Kundarbeel Road	= 10.30 kms.
5. Khourang – Mohanpur Road	= 6.45 kms.

(Source: Bodoland Territorial Council).

5.5. 14. Tribal affairs: -

The local communities residing in and around the Buffer zone of Manas Tiger Reserve generally belong to Bodo, Adivasi, Bengali, Rabha-Hasang, Koch- Rajbongshi, Muslim and Nepalese. A major percentage of the total population belong to Bodo tribe who comprise 47% to 65% of the population in the individual villages. Due to their traditions and ethno specific practices, they are heavily dependent on various kind of forest from neighbouring forests. It includes fodder, cattle (livestock grazing), timber, firewood, thatch, wild vegetables and fruits, fish and occasional wild animal hunting for meat.

5.5.15. Other sectors: -

Some of the sectors which have not been mentioned earlier but playing major role in the lives of the people living in the area are as follows: -

1. Handloom and Textiles.
2. Animal Husbandry and Veterinary.
3. Sericulture.
4. Health and Family Welfare.
5. Education.
6. Cultural Affairs.
7. Social Welfare.
8. Labour.
9. Diary.
10. Soil Conservation.
11. Market and Fairs.
12. Sports and Youth Welfare and,
13. WPT and BC Department.

5.5.16. Inter-agency programmes and problems: -

Manas Tiger Project Directorate works closely with different line agencies in various capacities. Authorities of Manas National Park, including 1st Addition to Manas National

Park, is prepared with a view to deal with the administrative situation arising in the jurisdiction extending over Chirang, Baksa and Barpeta districts. Cooperation and coordination will be maintained with the inter departmental officers, staff, civil administration, police & security personnel as well as other line departments like SSB, Army and other defence agencies. There is a close coordination with WCCB to deal with all wildlife related offences from Manas.

Biweekly meeting with law enforcement agencies at local level are held to discuss different issues. High level monthly meetings are also held separately to follow up on many other crimes related cases from the region.

Besides the above mentioned agencies, MNP also interact regularly with Physical health and Engineering (PHE), Medical and Public Work Department (PWD) as and when the need arises.

There exists a vast scope of working opportunity for each and every department in the area. Therefore, problems arising out of inter-agency programmes area is far less in the area.

PART B: THE PROPOSED MANAGEMENT

CHAPTER SIX

VISIONS, GOALS, OBJECTIVES AND PROBLEMS

6.1. Vision: -

The Park Management has set the following vision for the management of the Core Zone: -

“To protect and preserve the core landscape with outstanding beauty, diversity and ecological processes for posterity and provide the single largest contiguous natural habitat for tigers in the Eastern Himalayas”

6.2. Management Goals: -

- To maintain a viable population of tiger and its prey base in Manas landscape and preservation of bio-diversity of the Protected Area.
- To conserve and enhance the biodiversity of the Core, with special focus on the conservation of large mammals, along with low-impact, dispersed and diversified ecotourism ensuring maximum economic benefits for local communities.

6.3. Management Objectives: -

The Manas Tiger Reserve in its entirety was among the first nine Tiger Reserves to be included in Project Tiger in the year 1973. The management objectives of this protected area are very broadly based on the objectives as envisaged under para 4.1 and 4.2 of the Project Report submitted by Task Force of the Indian Board for Wildlife, Govt. of India. These broad objectives are as under: -

- To ensure the maintenance of a viable population of tiger for scientific, economic, aesthetic, cultural and ecological values.
- To preserve, for all times, areas of such biological importance as a national heritage for the benefit, education and enjoyment of the people.

Based on enhanced biodiversity values, additional opportunities as well as constraints, the specific objectives of the management of the Core Zone are as under: -

- To manage the over-all diversity of wildlife habitats, including grasslands/ meadows for supporting a good prey base for carnivores.
- To strengthen protection measures against all kinds of poaching, intrusion, illicit grazing and illicit collection of MFP.
- To increase tiger population during the plan period.
- To protect and preserve the unique population of flagship species such as Pygmy Hog, Golden Langurs, Wild Buffalo, Rhino, Hispid Hare and Bengal Florican among others.
- To ensure low impact and ecologically sustainable wildlife tourism for the enjoyment of visitors and conservation awareness.

- To develop technical skills of the select staff for the translocation of various wildlife species to other protected areas under active wildlife management.
- To conduct research and monitoring activities for the technical support of the Park Management.
- To reintroduce a small population of Great Horned Rhinoceros and Swamp deer.
- To manage stray, problematic and orphaned wildlife, specially tigers, leopards, bears and elephants and make efforts for their rehabilitation.

6.4. Problems in Achieving Objectives: -

The above objectives are examined against anticipated issues/problems, which may hinder partially or fully in achieving the objectives, these issues and problems anticipated are given as under: -

- a) Biotic pressure- There are 62 villages fringe villages (< 500 m distance from the Park) in the southern boundary, which have sizable population, which depends upon natural resources for their day to day need like fuel wood, food security, minor forest produce, thatch etc on the buffer zone and PA. The increasing population is putting more and more pressure on resources, causing degradation of forest and habitat.
- b) Grazing- Cattle population in the zone of influence surrounding the PA is very high, which pose a serious problem of grazing, resulting in invasion of weeds and destruction of grassland habitat.
- c) Invasion of weed- Manas National Park (MNP) is heavily invaded (IUCN, 2010) and the most important species are the perennial growing climber, *Mikania micrantha* (Asteraceae) ('Mikania') and *Chromolaena odorata* (formerly *Eupatorium odoratum*) (Asteraceae) ('Chromolaena'). Invasive alien plants (IAP) are posing a major threat to the core areas of Manas.
- d) Insufficient and over aged staff -There is an acute shortage of frontline and other trained staff to carryout day-to-day patrolling, habitat management, monitoring, research, eco-Tourism and eco-deployment works. The available staffs are getting aged and not properly trained for all the activities. The service condition inside PA is very hard, the staff and watchers have to stay in camps, away from their family and maintain double establishment for their family.
- e) Habitat loss/Destruction of forests/encroachments- The destruction of forests in some areas has lead to habitat loss and encroachment in the core of Manas. It is a serious and key threat to Manas.
- f) Poaching and illegal trade- Poaching of rhinos, tigers and elephants is major threats to Manas.
- g) Human-wildlife conflict- Straying elephant, wild pig, tiger and leopard etc. are likely causes of conflict in fringe villages of Manas National Park. In recent year, human wildlife conflict is major problem to the park.

6.5. Strengths-Weaknesses-Opportunities-Limitations (SWOT) Analysis: -

SWOT analysis is a strategic planning method employed to evaluate the strengths, weaknesses, opportunities, and threats involved in a project. The analysis involves specifying

the objectives of the project in question and identifying the internal and external factors that are favourable and unfavourable to achieve these objectives.

Strengths: -

- a. Only PA in India having six different conservation status viz. World Heritage Site, National Park, Tiger Reserve, Important Bird Area, Biosphere Reserve and Elephant Reserve.
- b. Manas is inhabited by more than 60 species that are either restricted range or now threatened due to population reduction in the recent years.
- c. Support from local government, the Bodoland Territorial Council is high to conserve the biodiversity of the Manas National Park.
- d. The top management officials are well trained and it helps in providing good leadership.
- e. Considerable number of frontline staff in park.
- f. Substantial number of camps and anti-poaching camps re established and good road connectivity.

Weaknesses: -

- a. Low animal population density such as tiger and its prey.
- b. Lack of mid level management staff.
- c. Poor publicity and marketing.
- d. Protection staffs are not trained.
- e. Degradation of habitat quality.
- f. Poor staff management.
- g. Security.
- h. Poor documentation.
- i. Insufficient accommodation.
- j. Habitat management/ Invasive species.
- k. Capacity building of frontline staff on aspects, like wildlife monitoring and habitat management, modern anti-poaching strategies, community interface, conflict resolution etc.
- l. Lack of the data base.
- m. Conservation Education, Nature Interpretation and Eco tourism related activities still need to be augmented.

Opportunities: -

- a. Donor interested to invest.
- b. NGOs & Institutes interested to support.
- c. Job opportunity for local volunteers.
- d. Management and local community aligning.

- e. Increased tourist interest.
- f. Reintroduction of rhino.
- g. Transboundary conservation.
- h. A rescue shelter for wild animals is required since quite a good number of injured or orphaned animals are received almost regularly which is still to be set up.
- i. Some effective barriers along the southern boundary of the Park need to be evolved to avoid severe human-wildlife conflict

Threats: -

- a. Insurgency
- b. Recovery of encroached land
- c. Checking poaching and illegal entry
- d. Difficult and inaccessible terrain during monsoon
- e. Community dependant on park resources, the entire southern boundary of the National Park is in the proximity of thickly populated villages of Bodo community. Traditionally they have tendency to go to the forest for purposes detrimental to the interest of the Park.

CHAPTER SEVEN

MANAGEMENT STRATEGIES AND ZONATIONS

7.1. Legal Status: -

The total area of the Manas Tiger Reserve is 2837.10 sq. km., and it incorporates 526.22 sq. km. of the Core Zone comprising of Manas National Park and Barnadi Wildlife Sanctuary. **(Appendix- 2 & 3)**. The entire core zone has the highest status of legal protection as it derives its legal sanctity/ inviolability from Section-35 and 38 V (2) and (4) (i) of the Wildlife (Protection) Act, 1972 (as amended upto 2006). The Critical Tiger Habitat which comprises of extended areas of Manas RF and Daodhara Reserved Forests (altogether 840.04 sq km) has been created as per provision envisaged under Section-38V (4) (i) of the Wildlife (Protection) Act, 1972.

7.2. Management Issues: -

The significance of the protected area, past experience and the stated objectives of wildlife management give rise to the following major management issues:

7.2.1. Tiger Conservation: -

The Tiger (*Panthera tigris*) is also an endangered species in all of its range-countries in the world. The conservation of this species has attracted international attention, and even after almost four decades of the launch of the Project Tiger, it still remains a burning issue in wildlife conservation. The Core Zone fosters a typical representative of tiger habitat with all the intrinsic attributes required for a viable population of the species. Besides, the protection and scientific management afforded to the species have also led to a steadily upward trend of population. The tiger being a “flagship” species of the Project Tiger in the Tiger Reserve, the protected area requires specific approaches to facilitate its safe dispersal in large forested area under a Core-Buffer strategy, ensuring the survival of strayed transients from the natal area and free-ranging individuals within the contiguous forest.

7.2.2. Other Flagship species conservation: -

7.2.2.1 Proposed Action Plan for conservation of Pygmy Hog and Hispid Hare: -

1. Annual census of endangered grassland species: - Since the grassland areas of Manas NP are well defined and can be covered by existing forest department staff, it is proposed to carry out the annual census of endangered grassland species especially Hog deer, Pygmy Hog, Hispid Hare, Swamp deer and Bengal Florican. Non-invasive methods such as the use of pellet-count survey for Hispid hare, sign survey for Pygmy hog besides using camera traps and finding out populations of both species using genetic studies by collecting pellets and droppings may be incorporated in regular count and monitoring of the target species.

2. Carry out intensive vegetation studies and mapping: - Research indicates that the Park has lost over 40% of its prime grassland habitat (short alluvial grasslands) due to natural succession promoted by annual burning and flooding. The extent of invasive species is also a critical factor that needs to be studied a spatio-temporal basis. The use of high resolution satellite data (<3 m) or other aerial photography (Drone) for intensive mapping of land-cover categories will help in understanding the dynamics within the landscape. Experimental permanent plot should also have embarked for understanding grassland-woodland dynamics. Apart from that, the role of hydrology effecting the vegetation structure should also be thoroughly investigated.

3. Undertake an early controlled Burning Plan: - The immediate threats to the relict populations of the Pygmy hog and Hispid hare can be alleviated by a change in the reserve's management practices, from uncontrolled dry season burning of its tall grassland habitat, to a system of carefully controlled rotational burning such that large areas of suitable habitat (providing optimal cover and food) are available throughout the year. Carry out mosaic burning based on prevailing climatic conditions repeatedly during the early period (November-January). A fire season can be declared during the critical months as per sections of Wildlife Protection Act (Feb-May) and levy penalty.

4. Carry out a systematic plan to remove invasive species and supplement with grass species- using manual uprooting of invasive and nursery for grass species.

5. Community awareness and involvement to reduce livestock grazing and thatch collection from these areas- Unregulated grazing and removal of minor forest produce is an important factor that impacts the quality of prime pygmy hog habitat. The need to control (if not eradicate completely) and monitor the extent shall be very crucial for future conservation. Initiatives shall be taken through Eco-Development Committees in the coming year.

6. Education and Capacity building of forest staff- The forest frontline staff must be trained and incentivised to carry out regular monitoring of the target species. Simple measures such as use of camera and GPS units for carrying out the monitoring will be the first step in this direction.

7. Undertake long-term research program- for examining the effects of each of the several disturbance factors operating on the remaining prime tall grassland habitat of these two highly endangered species (burning, grazing, thatch harvesting) are required to formulate appropriate long-term management plans considering the fact that Manas is the only protected area in the world where these two species have natural wild populations. Thus research into burning, for example, should investigate the effects of timing, frequency of burning and the soil water content of the grass vegetation so that optimal management plans can be developed later for individual areas within the National Park. DNA-Based sampling techniques should also be planned.

8. Reintroduction- From the present survey and anecdotal evidences shows that, the population of Pygmy hog is steadily declining. Number of drivers including- spread of invasive plants such as *Chromolaena odorata*, *Mikania micrantha* and invasion of successional woody plants, which are now becoming a big threat in many grassland areas of Manas. On the basis of detailed assessment, reintroduction should carry out in selected sites in MNP. Rigorous monitoring of released populations along with biological and behavioural studies should also carried out for understanding its ecology.

9. A captive breeding program for the Hispid hare- needs to be initiated like that of the Pygmy Hog to provide a nucleus of animals for reintroduction in the wild.

7.2.3. Habitat degradation and encroachment: - Approximately 17 sq. km. of the core area habitat has been impacted due to several natural and anthropogenic causes. Village relocation, systematic habitat improvement as per zone and theme plans will need to be undertaken in the near future.

7.2.4. Transboundary protection: - The core area of MTR is contiguous with large tracts of forests in Bhutan, namely the Royal Manas National Park and Khaling Wildlife Sanctuary. Recent camera-trap evidence also indicates the trans-boundary movement of tigers.

7.3. Management vis-à-vis Relevant Guidelines: -

It shall be ensured that the Tiger Conservation Plan provides site-specific habitat inputs for a viable population of tigers, co-predators and prey, without distorting the natural prey-predator ecological cycle in the habitat. Besides, the Tiger Conservation Plan should also conform to the guidelines issued by the National Tiger Conservation Authority, New Delhi, and should also be in consonance with the following Acts/ Directives: -

- Wildlife (Protection) Act, 1972
- The Biodiversity Act, 2002
- Forest (Conservation) Act, 1980
- Indian Forest Act, 1927
- Environment (Protection) Act, 2006
- Directives received from the Hon'ble Apex Court, from time to time on the subject.

The Tiger Conservation Plan has also taken into consideration the mitigation of weaknesses of the Core i.e. critical core, large volume of tourism and stranglehold of resorts, degrading grasslands and conflicts as mentioned in the Management Effectiveness Evaluation (MEE) of Tiger Reserves in India Process and Outcomes (2010-11).

7.4. Zone & Theme Approaches to Management Strategies: -

The zone and theme approaches have been adopted in the proposed management strategies of the Core Zone. A zone shall be defined as an area of special management category with its own specific objectives. Sometimes separate zones have to be created so that compatible and related management objectives will be prescribed for different zones. A zone plan is self contained that identifies problems, develop strategies, and also relates realistically to the surrounding areas of the other zones. A theme plan has to link all

concerned zones for application of its prescriptions. In this way, several objectives and different problems created by a combination of factors are tackled by a theme strategy under which measures shall be applied for the entire area.

7.5. Zone Plans: -

The following zones have been identified/visualized for management in the Core Zone (Fig 14). Detailed zone plans would also be discussed in the following chapters of this document.

7.5.1. Tiger Preservation Zone: - Main objective of constituting this zone is to preserve constituent forests in as near natural conditions as possible by providing complete protection against all the forms of biotic interference and maintaining natural course of ecological succession. Most of the National Park area has been brought under the zone. The Tiger (*Panthera tigris*) is also an endangered species in all of its range-countries in the world. The conservation of this species has attracted international attention, and even after almost four decades of the launch of the Project Tiger, it still remains a burning issue in wildlife conservation. The Core Zone fosters a typical representative of tiger habitat with all the intrinsic attributes required for a viable population of the species. Besides, the protection and scientific management afforded to the species have also led to a steadily upward trend of population. The tiger being a “flagship” species of the Project Tiger in the Tiger Reserve, the protected area requires specific approaches to facilitate its safe dispersal in large forested area under a Core-Buffer strategy, ensuring the survival of strayed transients from the natal area and free-ranging individuals within the contiguous forest.

a) General constitution: - All the blocks and compartments falling within the Manas National park and some parts of Barnadi Wildlife Sanctuary and RF are included in this zone. These areas extend over Bansbari, Bhuyanpara, Panbari, Daodahara, Rajaghar and Kuklung Ranges.

b) Objectives of management: -

- To preserve the entire zone in as near natural condition as possible.
- To maintain natural courses of ecological succession within the zone.

c) Strategies to be followed in this Zone: -

- Natural forests in this zone shall strictly be preserved.
- Only limited use for scientific and research purpose shall be allowed.
- Improvement and protection works shall be carried out for the purpose of, maintenance of roads and firelines, maintenance of artificial waterholes, Boundary demarcation shall be carried out and staff amenities shall be provided only to the extent required for protection of this zone, Soil-moisture conservation works for improvement and protection of habitat.

- Grazing and fire shall be strictly prohibited in this zone.
- No collection of NTFP will be permitted in this zone.

Fig 7.1 Range and Beat boundary map for Manas National Park (core area)

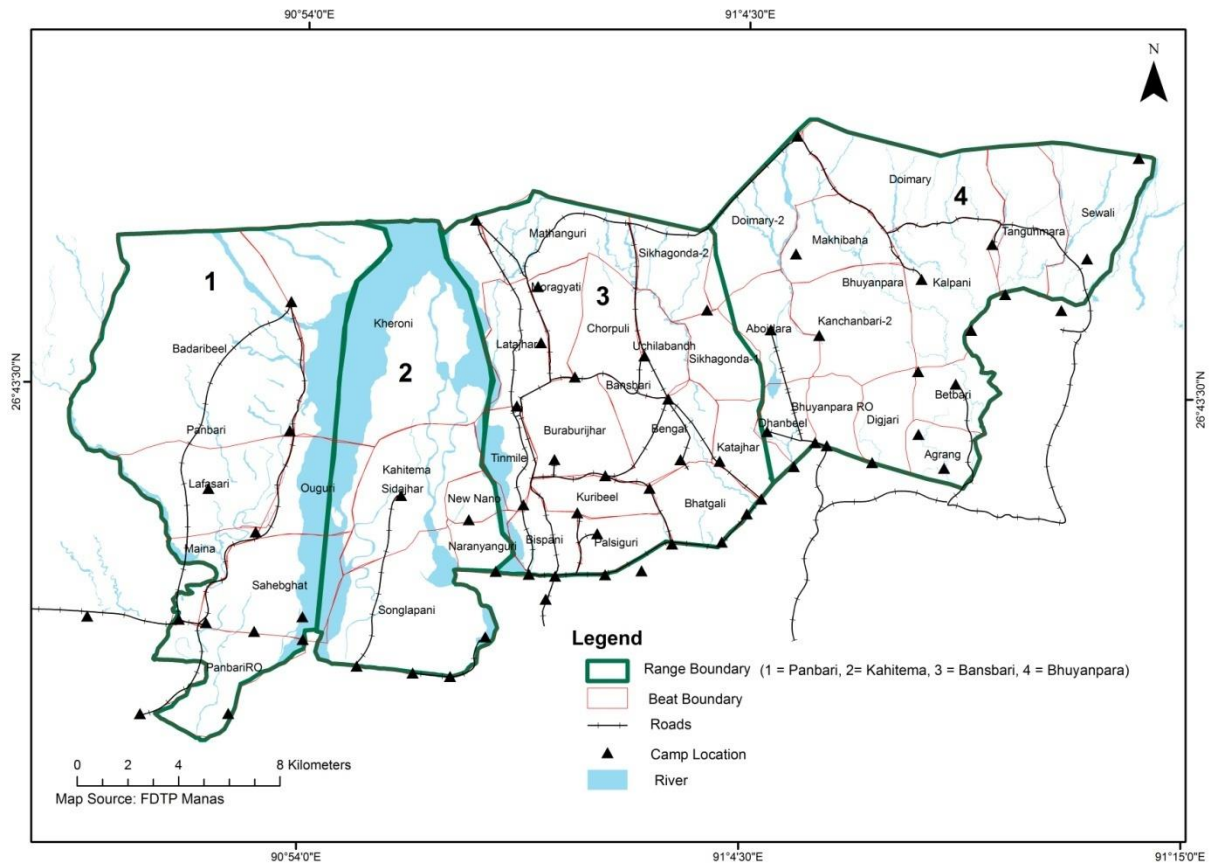
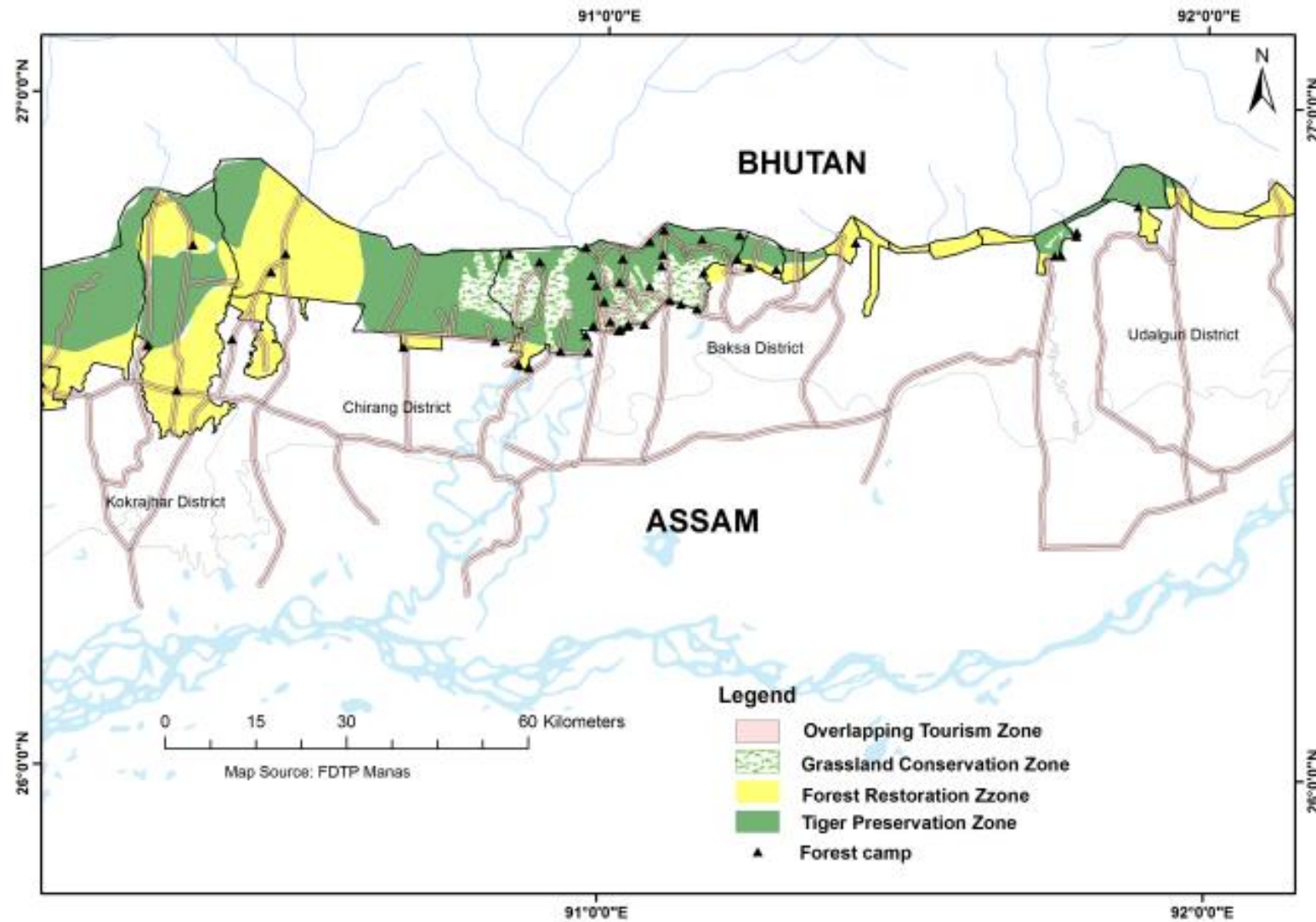


Fig 7.2 A pictorial depiction of Management zonations of Manas Tiger Reserve and Core areas



7.5.2. Grassland Conservation Zone: -

a) General constitution: - The grassland habitat forms the mainstay of all the ungulate species in the Core Zone of the Tiger Reserve. Although the carrying capacity as calculated for the National Park indicates that the current tiger densities are at much lower densities, the fact that grasslands have been reduced drastically over the last thirty years (Sarma et.al., 2008) calls for specific management interventions that are as follows:-

- To improve the present conditions of grasslands for increasing the population of prey base species.
- To arrest the succession in tall grassland areas and use fire and manual techniques (such as uprooting of trees) as a tool to prevent encroachment by woodland and invasive species.
- To create and improve grassland habitats, especially in the non-tourism forest ranges where animal density has been low.

A few blocks falling under Bansbari, Bhuyanpara, Panbari areas under Manas National Park and Barnadi Wildlife Sanctuary are included in this zone.

b) Objectives of management: -

- To maintain and manage prime tall and short grassland habitat so as to maximise their productivity and carrying capacity.
- To undertake wild animal (species-specific) management interventions for increasing prey base.

c) Strategies and management practices to be followed in this Zone: -

Based on the existing situations and current knowledge, the following broad prescriptions should be followed for the management of grasslands in the Core Zone depending upon financial allocations received from the state govt. and the National Tiger Conservation Authority, New Delhi. Needless to add, prime grasslands should be taken up on a priority basis: -

- a) **Burning:** - The Park Management should clearly identify and list out the pure patches of short (alluvial) and tall (dry) grasslands in the core area. Patch burning mosaics using fore lines should be encouraged. All burning should be carried out within Dec-January each year. Late burning, especially after March should not be encourage and fire prevention strategies should then be in place.
- b) **Weed Eradication:** -Weeds are obnoxious plant species, which are unpalatable and invade grasslands and compete with grasses resulting in the degradation of this habitat type. The main weed species in the grasslands of the Core Zone are *Mikania macrantha*, *Eupatorium* spp, etc. These species mushroom very rapidly and if not controlled in a systematic and phased manner, may pose a serious threat to grassland habitat. Weed eradication practice should be done preferably with the onset of the rains, taking advantage of the already wet and soft ground to manually uproot the species. The eradicated biomass should be dumped in heaps and burnt before the fire season. The management has to ensure that the next year a thorough weeding is also undertaken in the same areas for effective eradication. Considering the juxtaposition

of forest and grasslands, connectivity among grasslands should also be ensured by eradicating weed and unpalatable species.

- c) **Eradication of Woody Species:** -The management should identify such grasslands threatened by the invasion of gregarious woody species such as *Bombax ceiba*, and *Dillenia indica* etc. These woody species tend to encroach into the grasslands from the periphery and gradually grow in size and area, thereby not only reducing the extent of the grassland habitat but also creating obstruction to the foraging animal population. All these woody species and their associates have to be uprooted before the end of the monsoon. If the grassland is large, a few small grooves of tree should be retained to provide the much-needed shelter to the animals in the late morning and afterwards. Prominent grasslands should be first considered for this uprootal programme, followed by the adjoining large clearings.
- d) **Grazing management:** -Grass lands and grazing areas have virtually disappeared from revenue village lands and as a result, there is tremendous pressure in terms of free ranging cattle being let lose in grasslands in our Protected Areas. Eco-development activities combined with awareness, penalty measures will need to be adopted as per local conditions. At present more than 15 km of solar energised fencing has been placed all along the southern boundary to prevent straying of wild animals and vice versa. Community-owned and community managed fencing can be tried out in other areas.
- e) **Water development:** -Water development is a very important conservation input, and in the present context includes the distribution and quantity of water, not only in the dry regions, but also where it is plentiful. This includes, besides the construction of new water bodies, the maintenance of the old ones by deepening, desilting and reshaping them.
- Except in the pinch period which lasts from December to March, the availability of water in the Core Zone at present is satisfactory. Besides, the water table in the Bhabhar tract along the Indo-Bhutan Park boundary is anyways very low to harness ground water. Suitable rain water harvesting techniques shall be made mandatory while constructing new anti-poaching camps in this region.
- f) **Other relevant points:**

- Grassland areas shall be strictly preserved in their arrested successional stage using fire as a management tool.
- Intensive science-based research shall be carried out to undertake suitable management strategies to be adopted for obligate/ grassland specialist's species such as pygmy hog, bengal florican, hispid hare, swamp deer, one horned rhinoceros among others.

Improvement and protection works shall be carried out only for the purpose of, maintenance of roads and firelines, maintenance of artificial waterholes etc. Boundary demarcation shall be carried out and staff amenities shall be provided only to the extent required for protection of this zone. Grazing of livestock and collection of thatch and other minor forest produce shall be regulated and gradually reduced using suitable eco-development activities in the fringe areas.

d) Maintenance of Grasslands: - This operation is mainly applicable to Grassland conservation zone, however wherever grasslands are formed (due to sudden changes in river courses which is characteristic of the Bhabhar tract; erosion and accretion of land) naturally, the theme plan will be put into place to increase the herbivore prey base. As per this plan, Woody encroachments shall be cut back on a 3-years cycle. The grassland shall be protected against grazing and deliberate fire, controlled burning shall be carried out periodically. Monitoring of the area should be done regularly and removal of invasive alien species (weeds) through biological means can be attempted.

The grassland habitat forms the mainstay of all the ungulate species in the Core Zone of the Tiger Reserve. Although the carrying capacity as calculated for the National Park indicates that the current tiger densities are at much lower densities, the fact that grasslands have been reduced drastically over the last thirty years (Sarma et.al., 2008) calls for specific management interventions that are as follows:-

- c) To improve the present conditions of grasslands for increasing the population of prey base species.
- d) To arrest the succession in tall grassland areas and use fire and manual techniques (such as uprooting of trees) as a tool to prevent encroachment by woodland and invasive species.
- e) To create and improve grassland habitats, especially in the non-tourism forest ranges where animal density has been low.

7.5.3. Forest Restoration Zone: -

a) General constitution: - The main areas under this zone primarily lie in the buffer areas of Manas Tiger Reserve and have been therefore dealt with in detail under the buffer plan of this document. In case of the core area, the recently encroached areas of Manas National Park (under Panbari and Bhuyanpara Ranges) shall be targeted.

b) Objectives of management: -

- A time bound recovery of degraded/encroached forest areas.
 - To encourage evictions/village relocations as deemed necessary based on field conditions.
 - To undertake plantations and reclamations of the degraded habitat by using only the native species of floras.
- f) **Strategies to be followed in this Zone:** - The habitat has a long history of disturbance owing to insurgency and related problems. Many of the ranges require restoration of the protection infrastructure (patrolling camps, wireless control rooms etc.) hence the zone plan should include such areas for time bound recovery, while reflecting the needs in the APO of the Project Tiger.
- g) **Village relocation and combating encroachment:** - This theme shall be applicable to areas under Forest Restoration Zones. Any such area falling under Critical Tiger Habitat that is subjected to forest degradation/seasonal encroachment etc shall also be brought under this theme plan.

- h)** As per Wildlife (Protection) Act, 1972, as well as the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, require that rights of people (Scheduled Tribes and other traditional forest dwellers) recognized in forest areas within core/critical wildlife habitats of tiger reserves/protected areas may be modified and resettled for providing inviolate spaces to tiger/wild animals. This requires payment of compensation (rights settlement in addition to the relocation package offered under the CSS at present). Chapter IV of the Wildlife (Protection) Act, 1972 (Section 24) provides for acquisition of rights in or over the land declared by the State Government under Section 18 (for constituting a Sanctuary) or Section 35 (for constituting a National Park). Sub-section 2 of Section 24 of the Wildlife (Protection) Act, authorizes the Collector to acquire such land or rights. Therefore, payment of compensation for the immovable property of people forms part of modifying/settling their rights which is a statutory requirement. The ongoing study and the analysis of the available research data on tiger ecology indicate that the minimum population of tigresses in breeding age, which are needed to maintain a viable population of 80-100 tigers (in and around core) require an inviolate space of 800 -1200 sq km. Tiger being an “umbrella species”, this will also ensure viable populations of other wild animals (co-predators, prey) and forest, thereby ensuring the ecological viability of the entire area/habitat. Thus, it becomes an ecological imperative to keep the core areas of tiger reserves inviolate for the survival of source populations of tiger and other wild animals. The forest restoration zone has several villages (including forest villages) which are in line for relocation outside the reserve. The relocation proposals will be taken up only after settlement of Rights under Forest Rights Act. **Eco-development and alternative livelihood support:** - This shall be applicable to the forest restoration zone. Forest fringe villagers shall be trained and encouraged to take up alternative livelihood support solutions such as eco-guides, home stay tourism, women self help groups for production handicrafts, piggery, stall feeding of high yield milch cattle etc.

7.5.4. Overlapping Tourism Zone: -

a) General constitution: - As per NTCA guidelines, only 20% of the core zone shall be set aside for eco-tourism. It is therefore proposed to have an overlapping eco-tourism zone along some of the fair-weather roads as an eco-tourism zone inside the core area. The only exception to this will be the existing set-up at Mathanguri inside Manas National Park where a department run tourism complex has been existing prior to declaration under Project Tiger in 1973.

b) Objectives of Management: -

- To promote eco-tourism as an alternative livelihood support for forest fringe villagers.
 - To generate revenue which shall in turn be ploughed back into management of the Park as and when required.
 - To create awareness and a sense of pride among visitors to the Park using the principles of responsible tourism.
- d) Strategies to be followed in this Zone:** - Eco-tourism shall be regulated/implemented as per the guidelines of the NTCA and has been reflected in Chapter Eleven in detail.

7.5.5 Other flagship species conservation zone: The core zone is an important refuge for several rare and endemic species including the Pygmy Hog, Bengal Florican, Hispid Hare, Golden langurs, One horned rhinoceros among others. The management interventions required for such habitat specialists is a challenge which needs constant monitoring and scientific inputs.

7.6. Proposed Action Plan for conservation of Pygmy Hog and Hispid Hare: -

i. **Annual census of endangered grassland species:** - Since the grassland areas of Manas NP are well defined and can be covered by existing forest department staff, it is proposed to carry out the annual census of endangered grassland species especially Hog deer, Pygmy Hog, Hispid Hare, swamp deer and Bengal Florican. Non-invasive methods such as the use of pellet-count survey for Hispid hare, sign survey for Pygmy hog besides using camera traps and finding out populations of both species using genetic studies by collecting pellets and droppings may be incorporated in regular count and monitoring of the target species.

ii. **Carry out intensive vegetation studies and mapping:** - Research indicates that the Park has lost over 40% of its prime grassland habitat (short alluvial grasslands) due to natural succession promoted by annual burning and flooding. The extent of invasive species is also a critical factor that needs to be studied on a spatio-temporal basis. The use of high resolution satellite data (<3 m) or other aerial photography (Drone) for intensive mapping of land-cover categories will help in understanding the dynamics within the landscape. Experimental permanent plot should also have embarked for understanding grassland-woodland dynamics. Apart from that, the role of hydrology affecting the vegetation structure should also be thoroughly investigated.

iii. **Undertake an early controlled Burning Plan:** - The immediate threats to the relict populations of the Pygmy hog and Hispid hare can be alleviated by a change in the reserve's management practices, from uncontrolled dry season burning of its tall grassland habitat, to a system of carefully controlled rotational burning such that large areas of suitable habitat (providing optimal cover and food) are available throughout the year. Carry out mosaic burning based on prevailing climatic conditions repeatedly during the early period (November-January). A fire season can be declared during the critical months as per sections of Wildlife Protection Act (Feb-May) and levy penalty.

iv. **Carry out a systematic plan to remove invasive species** and supplement with grass species- using manual uprooting of invasive and nursery for grass species.

v. **Community awareness and involvement to reduce livestock grazing and thatch collection** from these areas- Unregulated grazing and removal of minor forest produce is an important factor that impacts the quality of prime pygmy hog habitat. The need to control (if not eradicate completely) and monitor the extent shall be very crucial for future conservation. Initiatives shall be taken through Eco-Development Committees in the coming year.

vi. **Education and Capacity building of forest staff-** The forest frontline staff must be trained and incentivised to carry out regular monitoring of the target species. Simple measures such as use of camera and GPS units for carrying out the monitoring will be the first step in this direction.

vii. **Undertake long-term research program-** for examining the effects of each of the several disturbance factors operating on the remaining prime tall grassland habitat of these two highly endangered species (burning, grazing, thatch harvesting) are required to formulate appropriate long-term management plans considering the fact that Manas is the only protected area in the world where these two species have natural wild populations. Thus research into burning, for example, should investigate the effects of timing, frequency of burning and the soil water content of the grass vegetation so that optimal management plans can be developed later for individual areas within the National Park. DNA-Based sampling techniques should also be planned.

viii. **Reintroduction-** From the present survey and anecdotal evidences shows that, the population of Pygmy hog is steadily declining. Number of drivers including- spread of invasive plants such as *Chromolaena odorata*, *Mikania micrantha* and invasion of successional woody plants, which are now becoming a big threat in many grassland areas of Manas. On the basis of detailed assessment, reintroduction should carry out in selected sites in MNP. Rigorous monitoring of released populations along with biological and behavioural studies should also carried out for understanding its ecology.

ix. **A captive breeding program for the Hispid hare-** needs to be initiated like that of the Pygmy Hog to provide a nucleus of animals for reintroduction in the wild.

RHINO CONSERVATION ZONE

7.7 Past History of Rhinos in Manas (Pre-2005): -

The Great One Horned Rhinoceros (*Rhinoceros unicornis*) had been historically found in the flood plain grasslands on the north-Bank of Brahmaputra, including areas within Manas National Park. Prior to 1989, about 100 rhinos had been estimated in the Park. Published information was rather scarce while sourcing for past history of rhino occurrence in Manas National Park. It is well known that Manas was declared reserved forests where 'Game' could be hunted for a price way back in 1905. A compilation of published literature is therefore limited to a report by Menon (1996) for WWF-TRAFFIC-India.

According to this report, the IUCN /SSC Asian Rhino Specialist Group (AsRSG) proclaimed that in 1989, there only remained three of the seven refuges for Rhino in India (Kaziranga, Manas and Orang) that were known to have a viable population of the species. Unfortunately, by 2001 it was confirmed that most of the 100 rhinos in Manas had been poached (Menon, 1996, Table 13.1).

Table 13.1: Population and poaching of native Rhinos in Manas National Park (upto 2001; source Vigne and Martin, 1994; Menon, 1996 and FDTP, Manas)

Year	Population	Poaching	Remarks
1962		1	
1963		1	
1965		1	
1966	15	0	Population estimation by E.P.Gee (Spillet, 1966)
1971		1	
1976	40	4	Population estimation by Laurie, 1978
1977	75	0	Population estimation by Deb Roy.
1978		1	

1981		2	
1982		1	
1983		3	
1984		4	
1985		1	
1986	75-80	1	Population estimation by Forest department
1987		7	
1988		1	
1989	85	6	Population estimation by Forest department
1990	85-100	2	Population estimation by Forest department
1991		3	
1992	80	11	Population estimation by Forest department
1993	60/30	22	Population estimation by Forest department
1995	30/120		Population estimation by Forest department
2001	-	1	Poaching as reported by Forest Department

7.8 Present Rhino Conservation status (Post-2005): -

At the Centenary celebration of Kaziranga and Manas National Park in 2005, it was decided to reintroduce Rhinos to areas where it had been exterminated as per a multi-stakeholder plan which is popularly known as IRV-2020 (India Rhino Vision-2020).

The Indian Rhino Vision 2020 as conceived is a joint conservation initiative of the Assam Forest Department, WWF India and International Rhino Foundation, supported by the Bodoland Territorial Council, United States Fish and Wildlife Service, Wildlife Areas Welfare and Development Trust and other partner organizations. Under this programme, wild-to-wild translocation of rhinos to Manas from two other rhino bearing protected areas in Assam was initiated in 2008 with 2 rhinos. As of 2012, this had increased to a cumulative total of 18 rhinos. In parallel, 9 rescued rhinos from other areas were also rehabilitated in Manas (Table 13.2).



Table 13.2: Population Status of Rhino Wild-to-Wild Translocation & Rescue-and-Rehabilitation in Manas National Park

Wild-to-Wild Translocation		Rescue-and-Rehabilitation	
Year	No. of Rhinos	Year	No. of Rhinos
2008	2	2006	1
2010	2	2007	2
2011	4	2008	1
2012	10	2012	2
-	-	2013	1
-	-	2014	3
-	-	2018	3
-	-	2019	4
Total =	18	Total =	17

Unfortunately, a number of rhino poaching incidents occurred during the last two years in the region as a whole. Both the World Heritage Sites namely, Kaziranga National Park and Manas National Park were affected by the sudden spurt in poaching. In Manas, a total of 8 rhinos have succumbed to poaching till date (as on 30.11.2014). On the other hand, the translocated rhinos also gave birth to 11 rhino calves in the new habitat (Table 13.3). Currently there are 31 Rhinos in the Park (Table 13.4).

Table 13.3: Mortality and Birth of Wild-to Wild Translocation & Rescue-and-Rehabilitation of Rhino in Manas National Park

Year	No. of Rhino Death	Cause of Death	No. of Rhino Birth
2008	1	Natural	-
2011	1	Poaching	-
2012	1	Poaching	1
2013	5	Poaching	9
2014	1	Poaching	1
2015	1	Natural	3
2016	2	Poaching	-
	2	Natural	
2017	-	-	3
2018	1	Natural	3
2019	1	Natural	1
Total =	16		21

Table 13.4: Current distribution of Rhino population in Manas National Park

Rhino distribution status as on 23.11.2014						
Sl. No.	Name	Sex	Age	Reintroduction type	Collar	Ranging area
1	Rhino-3	Female	Adult	Wild		Bansbari
2	Rhino-6	Female	Adult	Wild		Bansbari

3	Rhino-9	Female	Adult	Wild		Bansbari
4	Rhino-11	Female	Adult	Wild	Working	Bansbari
5	Rhino-13	Female	Adult	Wild	Working	Bansbari
6	Rhino-15	Female	Adult	Wild	Working	Bhuyanpara
7	Ganga	Female	Adult	captive-bred		Bansbari
8	Jamuna	Female	Adult	captive-bred		Bansbari
9	Mainao	Female	Adult	captive-bred		Bansbari/Bhuyanpara
10	Rhino-4	Female	Adult	Wild		Bansbari
11	Rhino-7	Male	Adult	Wild		Bansbari
12	Rhino-18	Male	Adult	Wild		Bansbari
13	Rhino-19 (Raja)	Male	Adult	captive-bred	working	Bansbari
14	Rhino-20 (Maju)	Male	Adult	captive-bred		Bansbari
15	Rhino-6-calf	unsexed	SA	Wild		Bansbari
16	Rhino-21	Male	SA	captive-bred	Boma	Bansbari
17	Rhino-22	Male	SA	captive-bred	Boma	Bansbari
18	Rhino-23	Male	SA	captive-bred	Boma	Bansbari
19	Rhino-3-calf	unsexed	calf	wild		Bansbari
20	Rhino-8-calf	unsexed	calf	wild		Bansbari
21	Rhino-9-calf	unsexed	calf	wild		Bansbari
22	Rhino-10-calf	male	calf	wild		Bhuyanpara
23	Rhino-13-calf	unsexed	calf	wild		Bansbari
24	Rhino-15-calf	unsexed	calf	wild		Bansbari
25	Ganga-calf	Female	calf	wild		Bansbari
26	Jamuna-calf	Female	calf	wild		Bansbari
27	Mainao-calf	Female	calf	wild		Bansbari
28	Rhino-14	Male	calf	wild		Bansbari
29	Dwimalu	Male	calf	captive-bred	Boma	Bansbari
30	Purabi	Female	calf	captive-bred	Boma	Bansbari

Date of birth of each Calf with name of Mother:-

Sl. No.	Name of the mother	Sex	Date of Birth/First Detection	Place of Birth
01	Rhino-10	US	26/09/2012	Chengamarjahr
02	Rhino-17	US	20/03/2013	Narenguri area
03	Rhino- 8	US	23/3/2013	Sourfuli

04	Ganga (Rehabilitates Female Rhino)	Female	05/04/2013	Rhino camp
05	Rhino- 6	US	14/05/2013	Kuribeel area
06	Mainao (Rehabilitates Female Rhino)	Male	02/06/2013	Rupahi
07	Jamuna (Rehabilitates Female Rhino)	US	04/07/2013	Mahal area
08	Rhino- 13	US	27/09/2013	2 nd Gate
09	Rhino- 15	US	02/11/2013	Kuchiabil
10	Rhino- 3	US	27/09/2013 confirmed on 12/11/2013	Sourfuli
11	Rhino- 9	US	04/03/2014	Sourfuli with photographs
12	Ganga	Male	18/06/2015	Rhino camp
13	Maino	US	30/07/2015	Rupahi
14	Rhino- 6	US	04/12/2015	Rupahi
15	Jamuna	US	03/09/2017	Mahal
16	Rhino-15	US	18/09/2017	Abaidhara
17	Ganga	US	15/11/2017	Mahal
18	Rhino-13	US	28/04/2018	Buraburijhar
19	Rhino-9	US	28/04/2018	Sourfuli
20	Rhino-6	US	15/10/2018	Rupahi
21	Mainao-(A)	US	02/04/2019	(Detected during rhino census at Chengamri area (Bhuyanpara) sighted by Sande Daimary

7.9 Plan Objectives: -

The main objective of this plan is to maintain a viable population of Rhinos in Manas landscape by maintaining a harmonious relation with indigenous people without causing any damage to the PA resources. They can be broadly described as follows: -

- **To conserve Greater one horned Rhino as the flagship species in Manas by managing habitat and other ecological attributes for the propagation of prey species in a balanced ecosystem.**
- **To strengthen anti-poaching strategies and capacity building for forest frontline staff and developing an intelligence network.**

- To assess and summarize the conservation activities including research and monitoring aspects, community engagement etc since rhino reintroduction in Manas in 2008, and provide a road map for the next ten years.

7.10 Habitat Management strategies:

7.10.1 Improving Habitat quality: -

Rhinos are graziers and therefore eat a variety of grasses and forbs. Past observation (under IRV-2020 annual monitoring) indicate that Bansbari and Bhuyanpara ranges of Manas NP bear sufficient fodder plant species generally eaten by the rhinos in all the habitats. The common fodder species available and generally grazed and browsed by the rhinos are *Paspalum orbiculare*, *Paspalum conjugatum*, *Pogonotherum crinitum*, *Echinochola colonum*, *Panicum spp.*, *Leersia hexendra*, *Dol*, *Cynodon dactylon*, *Limnophylla sessileflora*, *Hydrophylla zeylanica*, *Vallisneria spiralis*, *Azolla pinnata*, *Monochoria hastata*, *Eichornia crassipes*, *Cyperus spp.*, *Themeda villosa*, *Arundinicia sp.*, *Saccharum spontaneum*, *Phragmites karka*, *Alpinia nigra*, *Lasia spinosa* and several species of undergrowths etc. Rhino also generally grazed new shoots sprouted of tall grasses after burning. However, the grazing pressure by livestock is medium to very high, especially along the Southern boundary of the Park. Rhinos were also found to feed on algae species, *Bihalangani* (*Amphineuronopulentum*), *Dhekia* (*Diplaziumesculentum*) and other varieties of ferns, herbs, shrubs and creepers specially during the late or retreating monsoon (August –September). The Rhinos were also seen to eat the seeds of *Oxy* (*Dillenia pentagyna*) during July – August and also on the young and new leaves during March - April.

Fig 13.2: Location of Rhino Dung (blue) and waterhole (green) locations in Manas National Park (Data source: Deba Dutta pers observ.)

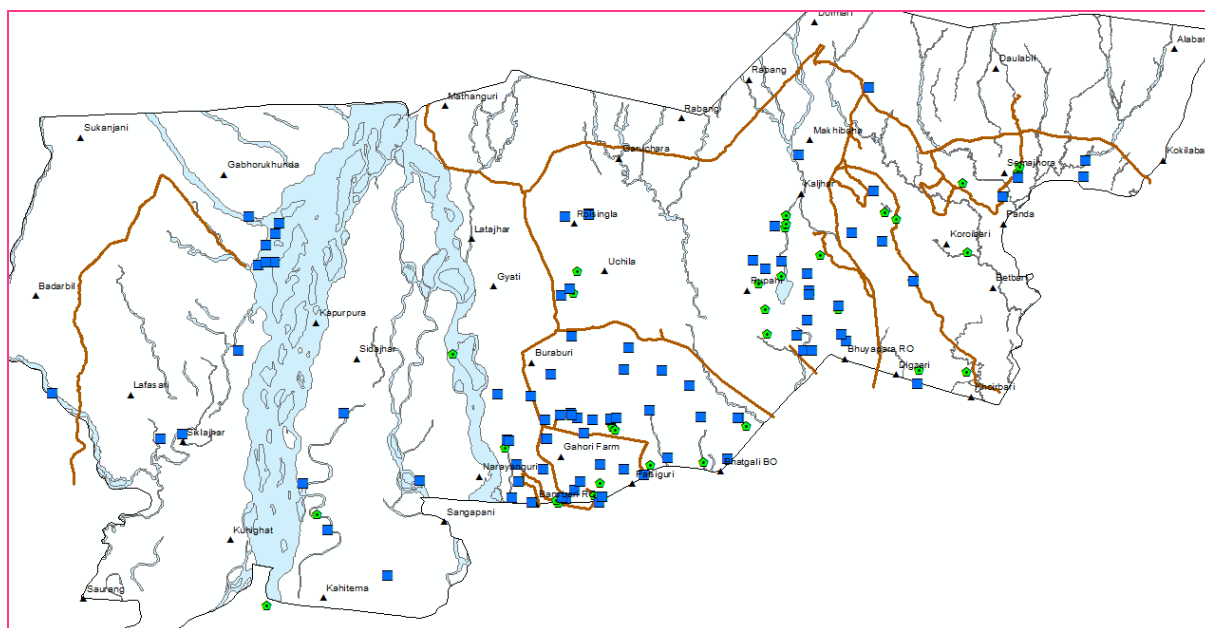


Fig 13.3: Habitat use by reintroduced rhinos in Manas National Park (as recorded between April 2008-March 2010)

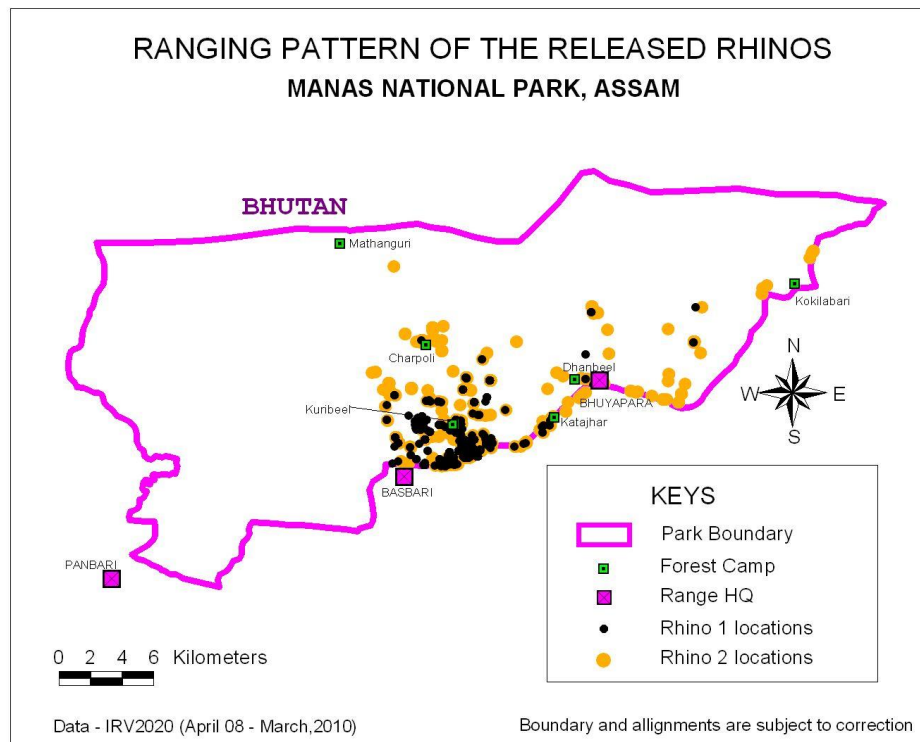
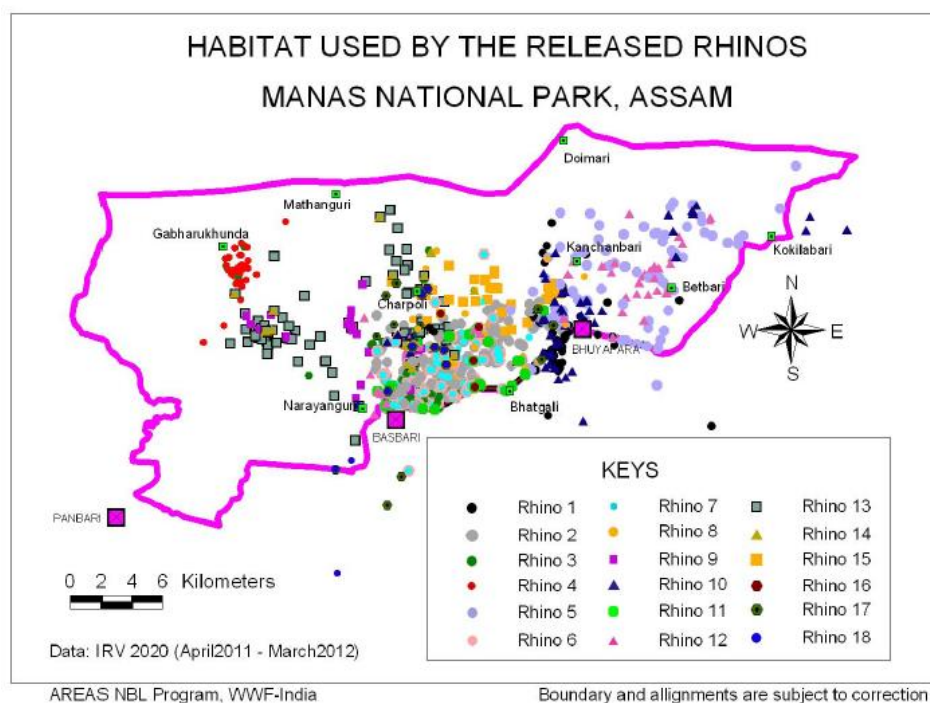


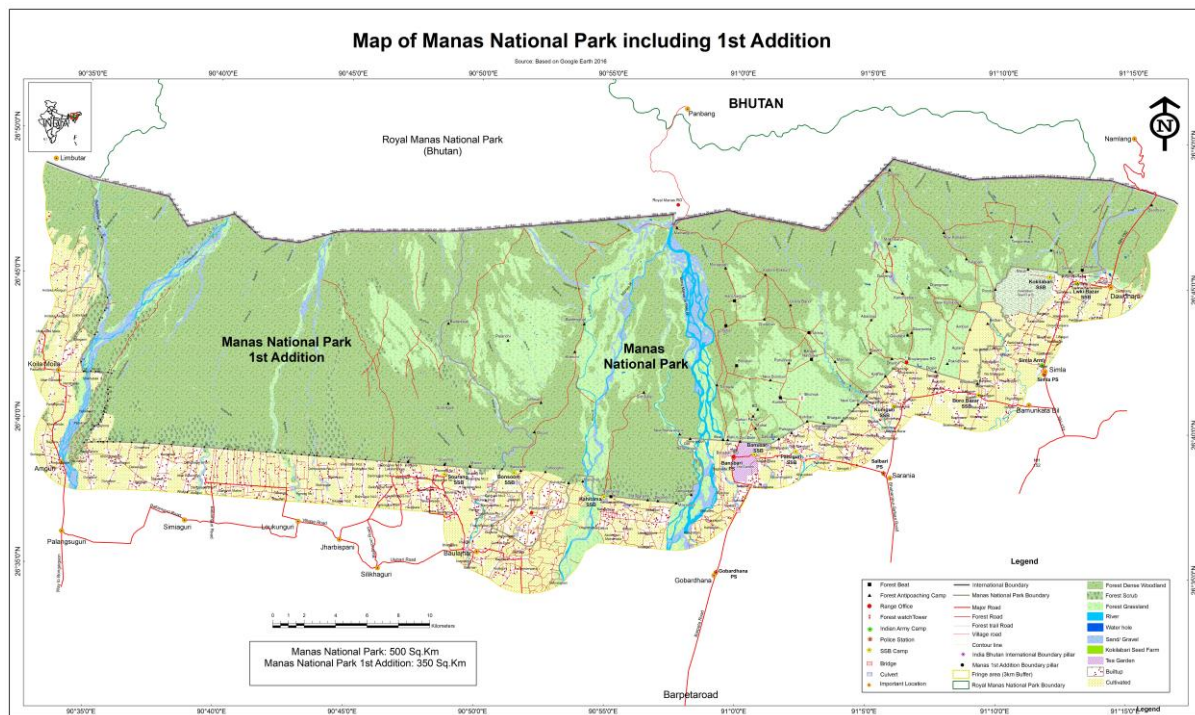
Fig 13.4: Habitat use by reintroduced rhinos in Manas National Park (as recorded between April 2011-March 2012)



7.11 Expansion of Rhino to transboundary habitats: -

The first addition to Manas NP extends from the Indo-Bhutan boundary on the north to the Manas road on the south. The eastern side is bounded by the river Sukanjan which is the western boundary of Manas NP and extends to the Sukanteklai river on the west. Beyond the western boundary there lies the remaining part of the Manas (Pt.) RF which stretches to the Chirang RF, Ripu RF and then to Buxa Tiger Reserve of West Bengal. Excluding the southern side of the proposed NP, the other three sides have contiguous forest areas both in Bhutan and India. The total area of the MNP is 350 sq km (Fig 13.8).

Fig 13.8: Map of Manas National Park with 1st addition



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7.12 Theme plans: -

Management strategies, which are common to two or more Zones, will be discussed under Theme plan. The following themes have been identified under various zones.

7.12.1 Habitat (including water) restoration and management: - This theme plan shall be applicable to Forest restoration zone, Grassland conservation zone and overlapping Eco-tourism zone. Habitat improvement works in the Reserve will be based on following considerations: -

- Preserving and increasing the diversity and interspersions of habitat.
- Protecting the habitat against factors causing degradation.
- Making habitat conditions suitable for target species.
- Raising local, palatable and nutritive fodder grasses, shrubs and fruit trees for increasing the quality of degraded habitats.

Based on the above considerations following habitat improvement works are proposed.

a) **Indigenous tree Plantations:** - Plantations as per prescription of the Working Plan shall be carried out under the forest restoration zone. Due to heavy biotic pressure, certain areas (Subankhata, Daodhara, Barnadi, Chirang and Manas RF etc) have become degraded. These areas will be taken up for reforestation with suitable (fodder and fruit bearing) indigenous species. Plantation will be raised in lines 2 m apart. Sowing will be done in alternate lines. Transplanting will be done in alternate lines at 2 m spacing. Choice of species will be made depending on the site conditions. Bamboos should be planted in grooves scattered uniformly over the plantation area.

b) **Maintenance of Salt licks:** - Natural salt licks present currently in all zones shall be left in natural conditions without any artificial interference. Artificial salt licks will not be used in tourism zone for enhancing visitor experience.

d) **Maintenance of Artificial and natural waterholes:** - This operation is applicable to all the Management Zones. A vast area of MTR lies in the *Bhabar* tract. During winter and summer (December to May) there is acute shortage of water in the National Park. So the existing artificial water holes shall be maintained. In this regard, select natural and artificially created water bodies shall be de-silted manually. Manual uprooting of aquatic weeds such as *Eichornia* species shall be carried out using community-led initiatives. Creation of artificial waterholes shall also be explored in certain areas under core and buffer areas.

e) **Soil and moisture conservation:** - This operation is applicable to Forest restoration Zone, Grassland conservation zone and overlapping eco-tourism zone. Bank erosion of numerous rivers and streams is a major problem in Manas Tiger Reserve. This causes huge damage to the habitat. This also leads to breakage of forest lands, uprooting of big trees and damage to plantations. It should be noted that occasional shifting of rivers/streams courses is a natural phenomenon in the *Shiwalik-Bhabhar* tract. This can't be completely stopped. However, some temporary measures for bank protection in the forest through concrete embankments, Gabions, spurs and porcupines (made of bamboo) shall be undertaken to protect forest villages, roads and forest establishments. Shifting of establishment shall be more economical in some cases than the river protection measures. Similarly, bank protection and river training works will be undertaken in consultation with the Irrigation Department and Soil Conservation Department. No big projects of irrigation department will be initiated inside the core of TR.

7.12.2 Wildlife monitoring theme plan: -

This shall be applicable to all zones. Manas National Park has drawn up a significant tiger database since 2005. The use of camera trapping and fecal genetics has yielded highly positive results since 2010. In addition to that, as MTR share boundary with Royal Manas National Park in Bhutan. There are evidences of tiger movement across the landscape. To study movement and behavior of tiger in the landscape GPS based radio telemetry shall be used as a long-term conservation measure. There is also need to further extend the camera-trapping to the other areas of the critical tiger habitat in the first instance.

7.12.3. Protection theme plan: -

This shall be applicable to all zones and suitable training and infrastructure (including creation of anti-poaching camps, patrolling paths etc.) shall be undertaken under this theme.

7.12.4. Vehicle movement: Private vehicle movement inside the core is restricted. Tourists plying on tourist zone shall only use Gypsy vehicles which are registered with forest department. All vehicles entering into the park shall have to register at the entry point. Vehicle numbers, occupant's details would be recorded. Camera traps would be installed at key points to keep a tab on the vehicular movement. Appropriate apps would be explored to check if those can be used to monitor tourist vehicles. Numbers of vehicles allowed inside core area would be decided based on the real carrying capacity, described later in separate chapter. This is to be noted that the road from 2nd gate, Bansbari to Panbang in Bhutan is open year the round for daily needs of people in Panbang Civil Sub-Division. Private vehicle plying inside core area upto Mathanguri is now under control and restricted. Only private LMV vehicles with BIS 4 - 6 shall be allowed.

7.12.5. Disaster management: -

7.12.5.1 Hazards & Vulnerability Scenario

- **Prevalent Hazards in the department** – This Manas National Park being under Wildlife Wing is directly not dealing with public to look after them as in case of Territorial Forest Divisions where there are recognized forest villagers and these villages come under the control of the concerned Territorial DFOs.

In case of Manas National Park, the Park authority is mainly concerned in dealing with the following in respect of prevalent hazards, vulnerability and risk factors –

- a) This Division is controlling and managing a Protected Area i.e Manas National Park which is part of Manas Tiger Reserve under Wildlife (Protection) Act, 1972 (53 of 1972). It is the core area of Manas Tiger Reserve (1973), Manas Biosphere Reserve (1989), and Chirang-Ripu Elephant Reserve (2003). The Manas National Park was declared as National Park vide Govt. Notification No. FRW.55/86/64, dtd. 07/09/1990 comprising Manas Wildlife Sanctuary, Panbari RF, Kokilabari RF and Kahitama RF with total area of 500 Sq.km. Later on 1st Addition to Manas National Park with an area of 350 sq. km. was added from Manas RF under Chirang Division. Now total area of Manas National Park has become 850 Sq.km.
- b) Besides protection of Park area, it has to look after the surrounding forest fringe areas where time to time depredation of wild elephants etc. take place besides stray animals coming out to outside the Park area in human habitation areas.
- c) There is always pressure on the Park Area and on beels, rivers, streams etc. from local people of fringe villages in the form of firewood collection, tree felling, smuggling, fishing and poaching etc. despite of all measure taken for protection.
- d) During Winter and Summer season, when rainfall is too less or do not take place for a longer period, the forest floor with dry leaves become quite vulnerable to fire which is made by human beings. The grasses and other shrubby, bushy jungle also become dry and become quite vulnerable to fire and this is nothing but man made hazards.
- e) As such risk factor of human life i.e. field staff and other NGO workers who are engaged in day to day protection related duties bear physical and life risk while on duty from man to man conflicts as well as man and wild animal conflicts. The field staff and officers are to encounter conflicts with people who enter the Park area with

various ill motives like tree felling, firewood collection, hunting/ poaching or for other purposes. However, situations are Tackled as and when situation arises.

- f) Time to time rescue of wildlife under various situations have to be done and after necessary treatment by the Veterinary Surgeon of the Department and upkeep released back to suitable forest habitat. In case of requirement of longer treatment, sent to the Field Veterinary Service Centre (Rescue Centre) at Choraikhola run by WTI where a Vety. doctor and Animal Keeper are stationed.
- g) Except two multi storeyed buildings at Barpeta Road HQ. rest of Govt. buildings are basically of Assam Type and hence the risk factor from earth quake is considered to be less in respect to human life risk.
- h) As such there is no hazardous buildings under this Division. Hence, vulnerability in regards of buildings are quite negligible and no threat is there to human life from these buildings.
- i) No such roads, bridges or culverts are considered vulnerable to disaster under this Division.
- j) Manas National Park suffered a number of man made disasters where lot of Govt. properties, infrastructure, arms, ammunitions, money, wireless sets, Rhino horns etc. were lost besides death of many forest personnel and departmental elephant on duty. Extremists not only attacked forest department but also forest fringe village killing public and destroying houses and properties creating a lot of problems to the department.

- **Likely geographical extent and magnitude/severity :-** The geographical extent of disaster management by this Manas Tiger Project Division is basically in and around the Manas National Park. But, this Division will have to extent cooperation and assistance in whole Kokrajhar district, Chirang district as well as nearby districts also sometimes in case of wildlife matters. Although the magnitude/severity is not so severe, but in no case the matter can be given less importance. Sometimes, the wildlife coming out from conventional forest areas create man animal conflicts, the wild animals cause injury to people, kill domestic animals or they got killed by people. Though in normal situation, these area is manageable, but in case of heavy natural and man made calamities, the extent and magnitude/severity will be quite high.

The risks and hazards those are likely to arise from different factors can be attributed to following-

- a) **Flood :-** Flood in Manas National Park including 1st Addition is sometimes experienced severe since number of rivers of bigger sizes are flowing through the park area and during rainy and monsoon period floods occur and large areas are inundated inside and outside the park area creating havoc. The animals can take shelter during heavy rainy season and flood adverse affect to the wildlife and human being cannot be ruled out.

Occuring flood in every year is common and causing damage to properties, crops, erosion, damage to road communication etc. also take place.

- b) **Earth Quake :-** Earth quake of moderate intensity take place every year but as such no damage known to happen so far. The major jolt was felt on last 18.09.2011 with epicenter in Sikkim where lot of damages to life and properties caused. However, taking place of major earth quake cannot be ruled out since this region comes under Zone-V of Seismic zone.
- c) **Storms & Cyclones :-** Occasional but probability is there always especially during last March to June every year. However, storms come sometimes in other months also. Storm can damage a lot to trees by uprooting, breaking of branches, damaging flowers and fruits etc. Wildlife also get affected. The people out side the Protected Area also get affected adversely and have to bear losses of various kinds.
- d) **Fire Damage :-** The fire damage is rare or very less in towns and villages. Accordingly less impact in towns and villages. But it is a common Hazard to forest especially during dry and summer season if proper measure for prevention like constant watch, pressing, weeding etc. cannot be done. The control burning also need to be carried out in time along with weeding, jungle clearing, watching, suppressing weeds, fire line cutting etc. If funds are not obtained in time, the magnitude of hazards remain high. Many times creeping or ground fire take place caused by graziers, encroachers, firewood cutters/timber smugglers, poachers or other unauthorised intruders in the Park area.
- e) **Landslide :-** Problem of landslide is as such not found under Manas National Park area since there is no hilly tract in the Park.
- f) **Man made Hazards :-** Man made hazards occurred in Kokrajhar district as well as in other districts of BTC in recent years in the form ethnic violence. Ethnic violence took place in Kokrajhar and Chirang district in 1994, 1996, 1998, 2012 and in 2014 and many people died belonging to Bodo, Adivasi and Muslim communities. Along with killings lot of damages to houses and properties also took place due to burning/torching, looting, theft etc. by miscreants taking the chances of the volatile situation. Although the forest department is directly not affected, but the situation remains quite un-conducive for staying in assigned headquarters like Ranges, Beats, Camps etc. and carry out normal protection and field duties by field staff in forest areas for threat perception. In such cases, the miscreants, poachers, hunters etc. do take chances for doing illegal activities.
- g) **Seasonality of Hazards :-** Seasonality of certain probable hazards are as follows which are applicable to all Divisions in the district.
 1. Storms & Cyclone: Mainly Last March to June.
 2. Drought: Mainly March to May & sometimes in August-September.
 3. Earth Quake: No specific time or warning. Probability is there during the whole year.
 4. Sun stroke: April to September.
 5. Fire: December to March.
 6. Chemicals: Less chances in Protected Area. But contamination in water system is quite high in water bodies especially outside Park area
 7. Accidents: Any time may happen.

8. Epidemic: June to August more probability is there. FMD i.e. Foot & Mouth Disease of domestic cattle are risky to spread to wild animals especially ungulates like deer etc. Cattle vaccination programmes are required around the Park Area to check such hazards.

9. Lightening: April to August/September during rains.

- **Magnitude of likely losses due to disasters :-** The magnitude of likely losses due to disasters is already discussed in above point No. 2 of the Chapter. The risks are mainly the man animal conflicts, wildlife related problems and their rescue and rehabilitation, fire hazards, killing/poaching probabilities of wildlife and man made hazards. The rescued wildlife are released back to wild habitat as soon as possible after careful medical examination, treatment and upkeep by departmental veterinarian or sent to Charaikhola Rescue centre if better treatment and observation is required till the animal become fit for release back. However, all precautions are taken to deal with the anticipated risks and hazards. The risk to human life is considered to be less at present since situation has improved. But precautions and alertness is always required from poachers, smugglers and wildlife while on duty as well as in protection camps.

- **Overview of specific tasks undertaken by the Deptt. During previous disasters (Consider last 50 years : Both Natural & Man-made Disasters) :-** As such no systematic record available regarding tasks undertaken by the Department during previous disasters both natural and man-made. Further no Disaster Management Plan also prepared for this Manas Tiger Project (Manas National Park). However, since the creation of the Division, important Acts are being implemented by the Department under the jurisdiction and these are as follows :-

* The Assam Forest Manual containing “The Assam Forest Regulation, 1891 with Acts, Rules & Notifications as amended upto date.

* The Wildlife (Protection) Act, 1972 (53 of 1972) and as amended upto date.

* The Forest (Conservation) Act, 1980 (69 of 1980)

* The Environment (Protection) Act, 1986 (29 of 1986)

* The Water Prevention and Control of Pollution Act, 1974 (6 of 1974)

* The Air (Prevention and Control of Pollution) Act, 1981 (14 of 1981)

* The Disaster Management Act, 2005 (No. 53 of 2005)

The draft plan for Eco-Sensitive Zone (CESZ) for Manas National Park including Barnadi Wildlife Sanctuary is prepared and submitted to the Committee of Eco-Sensitive Zone for issuing Notification by Govt. to protect the ecologically fragile and sensitive areas surrounding the Park & Sanctuary Area.

Besides the regular departmental staff employed for protection purpose, some local youths as Service Providers (NGO volunteers) also engaged for protection purpose to assist the regular departmental staff and AFPP personnel. Besides them, there are Fixed Pay Employees, Vanmazdoor (Casual Worker), Home Guards etc. hired for protection works.

Besides above, the active NGOs/Organisations working under Manas Tiger Project area - WWF-India, Aranyak, ATREE and WTI-India and hired Biologists (Botanist & Zoologist) to assist the Park authority.

7.12.5.2 Main Tasks of the Department. and possibilities of integration of related disaster management aspects in these (At State, District and Local Levels) :- The tasks for disaster management before, during and after/post disaster will be different depending upon situation and extent or severity of disaster or hazard. But the objective of the plan should be for prevention of disaster as much as possible. The measures for prevention of Disaster, Mitigation, Crisis Response Structure, Standard operating procedure etc. are described below.

- **Measures for prevention of Disaster :-**

1. Organizing Departmental meetings and orientation programmes among officers, staff, NGOs, public etc. to impart ideas and knowledge regarding Hazards and Disasters and their adverse and negative impacts.
2. Improvement of information, knowledge on hazards and disaster, causes, mitigation measures etc. and disseminating the same to other staff, NGO members, local public, JFC/EDC members etc. through awareness campaign, meeting, informal talk/discussion etc. In all these activities, Govt. officials, staff, NGOs, public, students etc. are to be involved.
3. Training, poster, media coverage etc. to be done during normal period.
4. Plantations- Normal weeding, cleaning, up-keep of plantations, watch & ward, beating up operation, fencing repairing etc. should be carried out normally.
5. All dried, unwanted weeds, grasses, thatches etc. to be pressed and controlled burned well ahead during dry and summer period to avoid severe forest fire.
6. For animals rescued and kept for short period for treatment etc. Sufficient care should be taken without any lapse/negligence. The Veterinary Doctor need to be always available and the responsible officers should be informed well at the time of leaving station. Govt. Veterinary Doctors are also to be kept in touch always to take their service as and when required.
7. This maintains only few trekking paths, patrolling paths etc. which are not problematic from disaster point of view except sudden attack by wildlife, smugglers, poachers or extremists while staff are on duty. However, the roads, bridges and culverts etc. surrounding the PA, need attention by the concerned line departments/agencies entrusted to. However, liaison is to be maintained by the department.
8. Time to time warning, dissemination of information, mock practices etc. will have to be done to inform all concerned.

- **Mitigation Measures Proposed :-** At the time of actual disaster and crisis, the integration of related disaster management aspects under Manas National Park will be to utilize the optimum resources available as well as from other sources-may be as man power or other non man power resources. The following mitigation measures are proposed to be adopted as and when required.

1. In case of fire in forests the local staff will attend the problem immediately. The help from other Forest Divisions will also be taken or mobilized to the spot to tackle the situation.
 2. The Fire Brigade/ Fire Fighter Department will have to be informed immediately over telephone or otherwise through superior authorities/Police/Civil Administration via control room or any other means. Important contact nos/phone nos are given in this Disaster Management Plan covering as much as possible those may be required at the time of crisis as well as in normal time also.
 3. Nearest NGO members, EDC members, public will be called for assistance. Contact nos are already with the field staff. Help from SSB personnel deployed along boundaries of the park will also be explored and taken if required besides Civil Administration and Police.
 4. Matter will be reported to the higher authority for necessary assistance and recoupment.
 5. Advise and assistance from other higher authorities like Addl PCCF, BTC, Field Director, ManasTiger Project, Deputy Director, ACF, OSD, Dr. Prabhat Basumatary, MNP, Dr. Bhaskar Choudhury, WTI, Dr. Daoharu Baro, WTI, Choraikhola etc. will also be taken as and when necessary besides other higher authorities of Forest Department, Civil and Police Department depending upon the situation and spot of incidents.
 6. The departmental vehicles. Trucks, mini trucks or LMVs, Tractors, etc. can be put to service and sources with contact nos are given in the contact list.
 7. Control Room in the office of the FD, Manas Tiger Project with **Mobile No. 9435022920 (Sri Girin Barman, Beat Officer, HQ. Beat, Barpeta Road)** is for any time contact during day time in normal period. **Sri Abbas Ali Dwan, ACF will act as Nodal Officer** with contact **No. 7002654217 (M)**. However, contact may be done to any phone no given in this Disaster Management Plan especially Field Director, Dy Director, OSD, Range Officers etc. Attendance will be round the clock during and post crisis period.
 8. All Range Officers, Beat Officers, Camp in-charges, Foresters, Forest Guards etc. of the Park will be responsible for all types of precautionary and mitigation measures in their respective Range, Beat and Camp jurisdictions. Necessary assistance, communication, liaison with other Divisions, Police, Civil Administration, Line Departments, NGOs, concerned public, Eco Development Committees/JFMCs etc. will be done from Division level also. The liaison with higher authorities, Governments etc. will also be done from Division level. All necessary guidance, suggestions, information whatever possible will be provided accordingly.
- **Crisis Response Structure : For Manas National Park :**
 - (a) **Preparedness** – Setting up of Control Room and manning it for round the clock during crisis time. The Nodal Officers will remain available and can be contacted

to their respective contact numbers already given besides contacting the Officers or any staff whose contact numbers are given in this Disaster Management Plan.

- (b) Contact No. Beat Officer, HQ. & Control Room** -9435022920, **ACF, HQ.**- 7002654217, **Deputy Director**- 9435127370 & 9435311006, **Field Director**- 9435111172 & 9435599918 , **OSD, D.D. Boro** -9365980279 & 9435152364 & **Eco-Tourism Officer**, -9435195579 can be contacted at any time.
- (c) Pre Disaster (Pre/After Warning)** – Ensured to alert the personnel in command system for action from bottom to top level.
- (d) During Disaster** – Round the clock functioning of Control Room. Ensured proper information receipt and delivery of information, coordination with respective department, authority etc. Also to provide services if required.
- (e) Post Disaster** – Ensure proper assessment of damages, taking mitigation, restoration measures, bringing to safety, treatment of affected areas, persons, animals, live stocks, rehabilitation of damaged plantations, nurseries or any other as the case may be. Patrolling and proper watch and ward of affected areas, resources, assets etc. of the Division.
- **Standard Operating Procedure for Divisional Control Room : –**
 - (a) Operational Time** :–To start immediately on receiving warning/information on Emergency situation.
 - (b) Officer in-Charge of the Control Room** :- The ACF, HQ. will be over all in-Charge of Control Room to be assisted by the Beat Officer, HQ. Beat at Barpeta Road. The names & contact nos. of respective Forest personnel, Civil and Police Administration, Other Security Agencies, NGOs & Other Stake holders are given in the Annexure in detail.
 - (c) Assembly in Control Room** :-The Filed Director, Deputy Director, ACF, OSD, Eco-Tourism Officer, Range Officer, Foresters, Forest Guards, Sr. & Jr. Assistants. Other office staff will assemble in the Control Room as and when required or for duty.
 - (d) Control Room during Emergency period** :- The office chamber of the Beat Officer, HQ. Beat will be set up Control Room during Emergency period to be provided with existing Contact Numbers, Inverter, Walky-Talkie sets, GPS sets etc.
 - (e) Alert to all Field Staff** :- All Field Officers/staff like Range Officer, Beat Officers, Camp in-charges, Foresters, Forest Guards, Game Watchers, Fixed Pay Employees, Casual Workers, Mahuts, Grass Cutters, Bearers, AFPP, Home

Guards, Service Providers (NGO) and other working NGOs etc. will be alerted. The FDTP, Dy. Director and all subordinates, CHD, Forests, BTC, Civil Administration, Police, various security personnel, public, NGOs etc. will be alerted as required when warning or information is obtained.

(f) **Maintaining of Records :-** i) A Register will be maintained for recording chronologically regarding sequence of events.

- i. Take necessary action as required.
- ii. Maintain contact with all concerned and disseminate information/news and coordinate.
- iii. Allot duties of staff and other stake holders.

CHAPTER EIGHT

RESEARCH, MONITORING AND TRAINING

8.1. Research Priorities: -

Manas Tiger Reserve is a part of significant conservation area in the region with contiguous habitat with forests of Bhutan in the north and Buxa Tiger Reserve in the West. It acts as a corridor for larger mammals, particularly elephants from West Bengal and Bhutan as well as residential elephants. In MTR landscape, which is contiguous to Bhutan Hills, with its rich species diversity, can serve as a benchmark ecosystem where extensive research works can be carried out in areas like ecology, ethno-medicine, biochemistry, etc. Research on natural and social aspect is essential for PA management. Management practices of Manas Tiger Reserve have vast scope of incorporation of research findings on aspects such as habitat of endangered and endemic species, annual movement elephants, socio-economic issues, etc. Wildlife management is a mix of field craft and science based on field research.

Research will be handled by consultants, research Organizations/Institutes, Universities, individual researchers and competent NGOs. Preferably, research will be carried out by departmental resources as long as they are available, otherwise help of local institutions and individual researchers who have worked in this area earlier would be taken. This would help to develop research interest and expertise among local students and researcher. With some financial arrangement in a post-project scenario, MTR would then have a sustainable arrangement for flow of information for management and eco-development.

Management of invasive species and manipulation of habitat constitute an integral part of habitat management. Invasion of weeds in the grasslands of Manas and gregarious tree species inside the Park is prominent. Suppression of different grass species by weeds like *Mikania*, *Eupatorium* and *Leucaena* is of recent origin. Apart from this *Simulium* and *Oxytropis* (*Dillenia pentagyna*) have invaded the grasslands of Panbari, Bansbari and Bhuyanpara Range areas in massive way. This southern belt forms important and crucial habitat of endangered and endemic species like pigmy hog, Bengal florican and hispid hare and ungulate species as well.

Priority Research Topics of Manas National Park: -

Field of Research	Proposed Research Topic
Biological	• Study on population dynamics of ungulates. • Study on population monitoring and movement of elephants across Bhutan border. • Study to identify actual tiger niche, their distribution, seasonal variability, food habit and population dynamics. • Study on inventory and status of insect fauna in the park. • Study on inventory and status of invertebrate species in the park. • Study on impact of invasive plant species on grassland habitat. • Study on inventory, status and distribution of Insect fauna in park. • Study on impact of cattle grazing in the National Park and mitigation measures. • Study on the bird community structure of the park. • Study of carnivore population using non-invasive techniques like

	genetics. • Study the movement and habitat utilization pattern of tiger and other co-predators using radio collar.

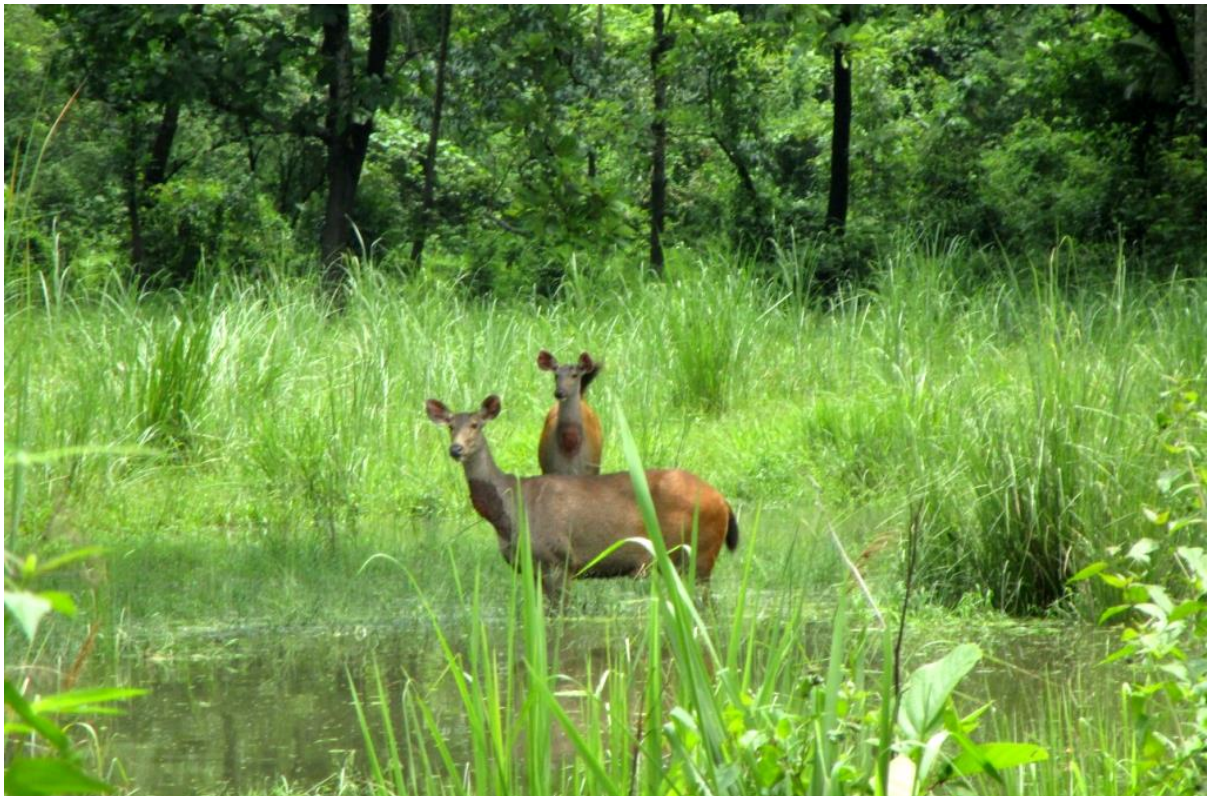
Proposed research topics: -

Field of Research	Proposed Research Topic
Ecological	• Study on river system and environmental impact assessment of boulder extraction from riverbeds. • Identification of fragile ecosystem and habitats/ niches and means for their conservation. • Study on effect of fire on flora and fauna, and mitigation measures. • Impact of habitat changes on population of wildlife. • Study on hydrobiology of Beki and Manas river system using GIS. • Study on wildlife health and diseases in the park. • Inventorization of the small mammals, herpetofauna and invertebrate groups in diverse habitats. • Long-term ecological study on globally threatened species and habitats. • Restoration of habitat
Socio-economic	• Study on NTFP and its impact on village economy. • Study on institution development, participation and empowerment of social organisation and financial sustainability of village Institutions. • Impact assessment of dependence of local people on the park. • Study on prospects and strategy for eco-tourism. • Study on key drivers of zoo-notic diseases in the park.

8.2. Research Projects: -

1. Study on population dynamics of ungulates: - After the civil unrest the population of herbivores and tigers have declined. However, since last three years monitoring Tiger population using of camera trap has been done which shows that Tiger population is rising in Manas. Ungulate population is important for supporting Tiger population. So, a detail scientific study of population dynamics of ungulates is planned in the coming years.
2. Study on movement of elephants across Bhutan border: - Elephants are long ranging animal. One large population of 3800-5800 elephants ranges along the Himalayan foothills from northern West Bengal, eastward through Assam touching southern Bhutan and Arunachal Pradesh and Manas National Park is perhaps the largest remaining safe home for elephants in entire Himalayan foothills in Assam. There has been no systematic scientific study on the movement of elephants across the Bhutan border. So, study is planned to know the movement of elephants across the border.
3. Study to identify actual Tiger niche, seasonal variability, and population dynamics: - Currently only population monitoring of tiger is being done using camera trap in Manas National Park. But in coming years a detail study is being planned to identify actual tiger niche, seasonal variability and population dynamics.

4. Study on Inventory and status of Insect in the Park: Insect is a very important and sensitive group. They are also one of the least studied groups. They can also be good indicators of the overall health of habitats. At present there is no proper information available on Insect found in Manas.
5. Study on impact of Invasive Species on grassland habitat: - Invasion of weeds and gregarious tree species in the grasslands of Manas is prominent. Suppression of different grass species by weeds like Mikaenia, Eupatorium and Leea is of recent origin. Hence a detail scientific research on grassland habitat will be undertaken to know the impacts of invasive species on grassland ecosystem.
6. Study on Inventory, status and distribution of Herpeto fauna in Manas: - Little information is available on amphibians, snakes and lizards of Manas. There is no such systematic and scientific surveys carried out in Manas in the recent past. Hence this proposed study is targeted to know about the herpeto fauna of Manas.
7. Study on Impact of grazing by livestock in Manas National Park and mitigation measures: - There are 62 fringe villages along the southern boundary of Manas National Park and there has been tremendous pressure of livestock grazing from these villages. However, there is no information on the intensity and impact of livestock grazing. So, to know impact of livestock grazing and its mitigation measures a study is proposed in the coming years.



8.3. Monitoring Framework: -

Eco-system is a highly dynamic process. Monitoring of impacts of management interventions is necessary. It enables the management to analyze and evaluate the effect of changes. Continuous monitoring and recording of data are shall be done through an elaborate, systematic and management-oriented monitoring mechanism. The Park management shall

continue to ensure that the monitoring of biological resources form a basic routine activity in protected area management, and it is the principal way in which the management can identify trends or changes, and to gauge the effectiveness of its managerial inputs. Though it may sound an unplanned and subjective procedure, it is easy to collect useful biological information in a simple, systematic and scientific manner. The management shall strive to include a number of useful monitoring activities in the routine duties of the staff, as well as regular annual estimation of wildlife, counts and other activities. All such data shall be incorporated in the MIS in a routine manner.

8.3.1. Monitoring physical changes: - Monitoring of physical changes, mainly air and water qualities, is essential. Monitoring the water quality of streams and rivers passing through the Park particularly with reference to pesticides is very important. Tea garden in several fringe villages are known to use pesticides in their agricultural crops. All the tea gardens are present in the southern boundary of Manas. The gradient slope of Manas is towards south direction, and therefore there is unlikely of any pesticides affect within Manas.

8.3.2. Monitoring changes in vegetation: - Vegetation changes will be monitored in different vegetation types. Information will be collected every year for changes in pattern of succession, species composition, effect of grazing and fire on vegetation, etc. Some permanent plots shall be selected in the area. Study of density and frequency of species should be done by Point Centred Quarter (PCQ) method and ground cover by Area Sampling or point sampling method.

8.3.3. Monitoring Changes in wildlife population: - By regular recording of animal sighting: When staff goes for patrolling: A register will be maintained in each Beat and weekly data will be sent to Range Office in a following prescribed proforma and from there data will be sent to the office of the Field Director for consolidation and analysis to get information about seasonal movement, habitat utilization, etc. Introduce M-STrIPES patrolling in Manas from 2019 onwards.

8.3.4. Conducting periodical census operation:- This shall be carried out as per NTCA protocols and guidelines.

8.3.5. Monitoring wildlife health and diseases: - It shall be done regularly as there is danger of spread of epidemic through domestic cattle grazing in the Park. Water samples shall be checked regularly by setting up mobile field research laboratories. Survey of adjacent fringe villages shall be done to know about the spread of any epidemic. Vaccination of fringe cattle against F.M.D., Anthrax, H.S.B.Q, etc. shall be done at suitable intervals by veterinary unit.

8.3.6. Training needs assessment: - Training forms an important area for all levels in the administration which results in generation of better and innovative ideas leading to enhanced conservation and managerial measures. There is a lack of intensive training in almost all the strata which will address important practical and day-to-day issues facing the frontline men in particular. Training is essential to increase the managerial capability and technical skill of the staff. Present days PA planning and management is a highly technical science bringing together the theory of several diverse disciplines, i.e., ecology, forestry, geography, wildlife. Training shall be carried out in an organised and structured manner in order to achieve optimum result. It shall be organised for the different levels of staff. It shall address the specific needs, duties and responsibilities carried out by the staff. In order to increase the managerial capability of staff and managers following training are important.

- a) Formal Training Courses: - Formal training is generally conducted by recognised Institutes on national, international level. Wildlife Institute of India (WII), Dehra Dun organises a large number of training courses under Government of India assistance or with the collaboration of international organizations. It is proposed that every year one RO will be sent for 3 months' diploma course in WII. As and whenever needed RO and ACF will be sent to Eastern Ranger College for Refresher Courses.
- b) Nature and environmental education programme for local people: - Such education programme is aimed at enlisting support of local people mainly forest villagers, fringe villagers and tea garden labourers. To focus on the issues that are crucial with local people who live in and around the park, the nature and environmental education plan is to be based on the biological importance of the area.
- c) Study Tours:- Field study tours for staffs and officers of MTR are proposed. Such tours shall be organised within the state/ in other state as per requirement of target group.
- d) Training to tourist guides: - Guides working in Manas are doing hard work, however some of them do not have adequate skills to communicate with visitors. Skill up scaling and capacity building will enhance their performance.
- e) Workshop/Seminar: - A seminar is a good tool to obtain broad agreement with local people, other stakeholder groups, administrators, scientists and nature lovers on the issues related to management of Manas. Frequent meeting with the village heads/VCDC is needed occasional meeting with fringe villagers shall be conducted involving village institutions and NGOs to make them aware about this project and for reminding them their duties and responsibilities in respect of park's natural resource management.

Some of the topic for workshop and field study may be: -

1. Wildlife and its habitat monitoring.
2. Wildlife census and field techniques.
3. Anti poaching, legal proceeding and forensics.
4. Micro planning for development in surrounding villages.
5. Fire protection training.
6. EDC Account keeping.
7. Environmental Education and Awareness.
8. Endemic wildlife and its conservation.
9. Human-wildlife conflict mitigation measures.
10. Rescue and rehabilitation of wildlife.

Besides these types of workshop and field training, regular interactions/discussions between forest department and local community would also add to the understanding of new perspectives relating to wildlife management and strengthen community support.

8.4. Human Resource Development Plan: -

Along with monitoring and need-based training, HR measures shall include more activities directed towards better management and welfare of the staff.

Wildlife management is a specialized branch, which need special orientation, skill and knowledge. Training makes a technocrat and field staffs perfect in his profession. Exposure of good efforts done in the par excellence site develops a feeling of motivation to achieve the goal to the same degree or sometimes higher also. Not only this, tremendous degree of confidence is also developed if the initiative done is appreciated by others. Hence it is practicable to initiate effort to impart special training to all level of staff in various relevant fields.

8.4.1. Training programs:- These are already discussed in section 8.3.6

- a) Formal Training Courses: - Formal training is generally conducted by recognised Institutes on national, international level. Wildlife Institute of India (WII), Dehra Dun organises a large number of training courses under Government of India assistance or with the collaboration of international organizations. It is proposed that every year one RO will be sent for 3 months' diploma course in WII. As and whenever needed RO and ACF will be sent to Eastern Ranger College for Refresher Courses.
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10. Rescue and rehabilitation of wildlife.

Besides these types of workshop and field training, regular interactions/discussions between forest department and local community would also add to the understanding of new perspectives relating to wildlife management and strengthen community support.

8.4.2. Staff Amenities: - The staff amenities presently provided are far from satisfactory. A large number of the field staff is living deep in the forests. They keep their family either in adjoining town or with their parents for educating their children. This is also done to get medical facilities for their family. Thus they maintain double establishment. This causes financial hardships. Some of them are keeping their families at departmental quarters at Bansbari Range headquarters and Barpeta Road. These quarters are very old and lack basic amenities. Following basic amenities to staff are proposed: -

- a) Housing facility: - Because of lack of education and health facilities within the area, housing has to be seen from two different perspectives i.e. in situ housing at camp sites and housing for families at some stations where basic education and health facilities for kith and kin of staff are available. The buildings are to be maintained in such a way that they have water, toilets, non-leaking roofs, mosquito net protection, and white washed etc so they are liveable. It is proposed that building will be concrete structure with G.I. sheet roof. Annually three forest guard quarters and three forester quarters are required to be constructed.
- b) Field equipments: - Necessary camp and field equipments for the protection of staff shall be provided. The other necessary equipment helpful in carrying out field work e.g. water bottles, measuring tapes, compass, GPS, field forms and diaries, knives, khukri, small axe, fire arms, tiger tracers, plaster of paris etc shall be provided as and when needed.
- c) Uniforms and protective gears: - Timely supply of good quality uniforms as per provisions shall be ensured every year along with other items such as caps, belts, boots, hunter shoes, winter wears, raincoats etc. Protective gears like wooden canes, helmets etc shall also be provided specially to the personnel deputed on bordering areas.
- d) Provision of drinking water facility in staff locations: - A large number of staff locations in Manas suffer from drinking water scarcity. Within the terai area of the PA shallow tube well with high yield is possible while in the bhabar area such as Moragyati, Roisingla, Rabang, Doimari, Alabari, Sidajhar, Gabharukhunda, Badaribeel, Sukanjan, Saurang, Lakhijhora, etc. deep bore well or tapping of surface water is the only answer. The facility shall be provided in a phased manner within the first half of the plan period.
- e) Provision of medical facility: - Manas is a malaria prone area. Water born diseases are also prevalent. Health centers are far away from staff locations. Conveyance to reach them is not readily available. Preventive measures shall get priority. Free supply of malaria and other medicines shall be made. Forest villagers also suffer from malaria and gastrointestinal problems. Regular health camps shall be organized for health checkups of staff. This will ensure better health and will in turn result into better output from staff and will have great value. One mobile medical unit with medical officer for the park staff and forest villagers is proposed. In severe cases Range vehicle shall be used to shift patients to nearby hospitals.

- f) Insurance scheme for staff: - Possibilities of health insurance for staff and field assistants living in interior areas shall be explored with insurance company and take up the scheme. .
- g) Solar lights for staff compound: - In large number of staff locations electric supply is not available. Because of the remoteness of these camps, electrification is also not possible. Supply of solar lamps and lights at all these locations shall be taken up on priority. Where electrification is possible, electrification of staff locations shall be taken up on priority. Every year one or two beats shall be taken up for electrification.
- h) Safety and improvement of staff compound: - Staff locations shall be fenced by compound wall/power fence/barbed wire. The compounds shall be cleaned 3-4 times/year. Roads connecting staff locations shall be repaired and improved.
- i) Financial incentives for good works: - Staff shall be rewarded for performing good works by giving medal, certificate or some money with certificate to boost up their morale.

Following rewards shall be considered for introduction: -

- i) Best worker for wildlife protection.
- ii) Best worker for intelligence gathering.
- iii) Best worker for eco-development programme implementation.
- iv) Best worker against wildlife depredation.

On the other hand, staff may be penalized as per law for incompetence and non performance.

- j) Creation of Manas Staff Welfare Society: - It has been observed that forest frontline staff sometimes live with their families in the vicinity of forests and therefore their children are deprived of good school and college education. As a result of this, such children largely remain unemployed in the longer run. It has also been observed that staff sometime requires an immediate amount of financial assistance either for treatment of a medical emergency or an event in the family. It is due to these reasons that a Manas Staff Welfare Society is being proposed on a contributory basis. A fixed amount of monthly sum (from the salary) shall be deposited as a membership fee and all members will then be eligible to take a soft-loan from the society. Similarly, the eligible unemployed kin of field staff could be gainfully employed as nature guides, helpers etc through this society.

CHAPTER NINE

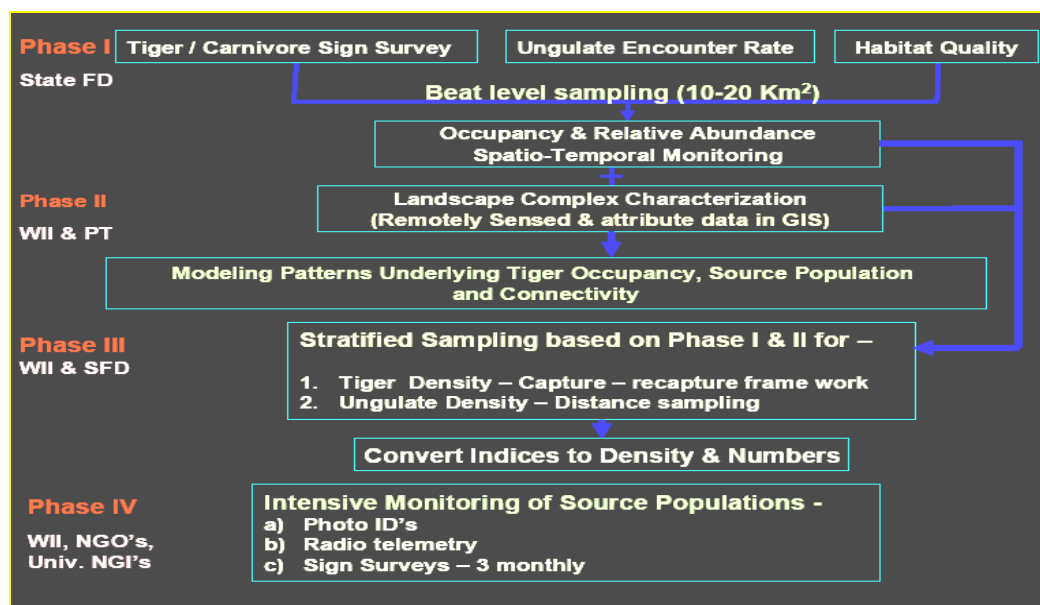
TIGER POPULATION AND HABITAT ASSESSMENT

9.1. Daily Monitoring and Forecasting: -

Day to day monitoring of wild life is one of the most important task of the camping staff. All the information is recorded in Camp register daily by patrolling party. For the impression of Pugmarks of Tiger, Panther and other carnivores, pressure impression pads (PIPs) must be laid out on the roads at distance of 500 meters. At the junction of the road impression pad may be laid on all roads just few feet away from the junction. Impression pad may be made on both side of the road crossing a river or nala. The width of PIPs should be almost the width of the road and length should cover two strides i.e. almost 4-5 meters. All the PIPs should be serially numbered. The PIPs should be monitored on the basis of day-to-day, at least twice in a week for Tiger evidences. Sign survey and individual tiger monitoring should remain a regular task for every guard.

9.2. Tiger Population Estimation and Monitoring Framework (Phase I, II, III and IV): -

For designing implementing and evaluating the success of any conservation program for an endangered species, it is imperative to monitor the status, distribution and trends in the population of the target species. The monitoring program should be transparent in approach and holistic, addressing an array of parameters related to the survival of the species by using the blend of the best available science and technology. Before 2004, in case of the tiger, the only form of countrywide monitoring was based on the pugmark system, which depends on identifying individual tiger by experts. The system generated a total count of tigers, but gave no indication of spatial occupancy, population extent and limits, connectivity between population, habitat and prey conditions. Realizing the shortfalls of the pugmark monitoring system, Project Tiger directorate evolved a program "Monitoring Tiger, co-predators, Prey and their Habitats" in collaboration with Wildlife Institute of India, Dehra Dun and State Forest Departments. This program is based on a four-stage approach (NTCA-WII, 2006).



a) Phase-I: Spatial mapping and monitoring of tigers, prey and habitat: -

For estimating the distribution, extent and relative abundances of tigers, other carnivores, and ungulates data will be collected in simple formats on carnivore signs and ungulate sightings and on indices of human disturbance and habitat parameters (NTCA-WII 2006). For this data collection beat/sub-beat will be taken as a unit. All the frontline staff involved must be trained in the data collection protocol. The detailed methodological approach for sampling carnivore signs, ungulate encounter rates, pellet/dung counts, habitat and anthropogenic pressures is as follows: -

1. Sampling for Tiger, Leopard, and Other Carnivore Sign Encounter Rate: -

To obtain data on the presence, absence and intensity of use of a beat by tigers and other carnivores, we shall quantify the relative abundance of tiger, leopard, and carnivore signs in an area. The following procedure needs to be followed for data collection: -

- A beat/sub-beat will be considered as a sampling unit.
- Areas within the beat/sub-beat that have the maximum potential for tiger occupancy will be intensively searched.
- Since tigers and leopards have a tendency of using dirt roads, trails, foot paths, river beds and nallahs, these landscape features within the beat/sub-beat need to be searched intensively (Figure 1).
- One to three persons who know the terrain and habitat features of the beat should conduct the search for tiger sign.
- There should be 3-5 separate searches (in different compartments within the beat and/or at different times 1-5 days apart) each search covering about 4-6 km distance in areas having the best potential for tiger presence. It is important to record the distance covered and the time spent during each search separately (in the data sheet-1) and accurately. If time is spent resting or in other activities while conducting the search, this duration should be reported separately. If possible the GPS coordinate of the beginning point of each search path should be recorded.
- The total minimum distance covered while searching for tiger and other carnivore sign should be 15 km per beat.
- Tiger and leopard signs should be classified into the following categories 1) Pugmark trails, 2) Scats (Old: dry with hair and bones visible; Fresh: dry but intact with shiny surface; Very Fresh: soft, moist, and smelly, 3) Scrapes, 4) Scent marks (spray, rolling), 5) Rake marks on tree trunks, 6) Actual sighting, 7) Roaring (vocalization), 8) Kills (Predation on wild prey).
- A brief description of the topography and forest type is to be recorded for each sign.
- In case of pugmark trails, each trail set is considered as one sign (not each pugmark as one sign). In case a tiger (or other carnivore) continues to walk along a dirt road for a long distance (say 1 km), then this should be considered as one sign, and a comment recorded in the remarks section of the data regarding distance covered by a pugmark trail of a single tiger.
- Tiger and leopard signs if encountered outside of the sampling route should also be recorded with GPS coordinates (if available) and with appropriate comments.

- Special emphasis should be given to sign of tigress & leopards with cubs, and any authentic evidence of tiger cubs (sightings of cubs, lactating tigress, tracks, etc.) obtained within the past twelve months should be mentioned in the data sheet.
- While sampling for tiger and leopard signs, record should also be kept for signs of any other carnivore that are encountered.
- The number of livestock that are killed by predators within the past three months needs to be recorded in the questionnaire following the data sheet.
- It is important to report data sincerely. It is likely that there may be reliable information that tiger/leopard is present in the beat being sampled, but no tiger/leopard signs are recorded during the intensive search survey. In such cases, mention should be made in the remarks column of the data sheets. However, failure in obtaining tiger sign from a beat/sub-beat is equally important as recording tiger/leopard signs and for appropriate analysis of this data the actual data should be reported.

2. Sampling for Ungulate Encounter Rates: - This protocol outlines a simple method for quantifying ungulate abundance in an area based on visual encounters while walking along fixed line transects. The following procedure needs to be followed for data collection: -

- A beat would be considered as the unit for sampling.
- After considering the shape, size, vegetation, and terrain type of the beat, a transect line of a minimum of 2 km and not exceeding 4 km will be marked for sampling.
- The transect line should traverse similar habitat (broad vegetation types) as far as possible. If the beat is composed of 2 or 3 distinct vegetation types eg. Mixed Teak Forest comprising 40% of the beat and the remaining 60% comprised of Miscellaneous forest with bamboo, then 2 separate line transects should be marked for sampling as shown in Figure. 2b.
- The line transect within a beat may be broken up into 2 or more segments so that each segment has a minimum length of 2 km and traverses' similar habitat.
- Care should be taken that a line transect is not located near a busy road nor should it run parallel to a river or other features of the landscape which may bias sighting of ungulates.
- For each transect the point of beginning and end point coordinates (Latitude and Longitude) should be recorded by a global positioning system.
- The broad forest type and terrain type that the transect traverses needs to be recorded.
- Each transect should be walked by 1 -2 persons during the early morning hours (6:30 AM to 8:30 AM). Preferably one of the persons walking should be a good field person who is able to spot wildlife.
- A record should be kept of all mammals and peafowl seen during the walk in the prescribed format (see data sheet). For each animal sighting the following needs to be recorded: 1) serial no of the sighting, 2) time of the sighting, 3) species (eg. sambar, chital, wild pig, peafowl, langur, etc.), 4) group size - number of animals of the same species in the group sighted, it is important to try to count the number of animals in the group as accurately as possible. Animals are considered to belong to two different

groups if the closest animals from the two groups are separated by a distance of over 30 m.

- If possible the number of young (fawns/calves less than 1 year of age) seen in the group should also be recorded.
- A broad habitat category (vegetation and terrain type) needs to be recorded for each sighting eg. S.No. 5, 12 chital (10 adults and 2 young) were seen at 6:40 am, in mixed teak forest, gently undulating terrain.
- Each line transect needs to be walked at least on three different mornings for estimating ungulate encounter rates.

To quantify the habitat parameters and determine relative abundance of ungulates sampling will be done along the same line transect on which ungulate encounter rates were estimated. For economy of time and effort it would be possible to first sample the line transects during early morning hours for ungulate encounter rate and then while returning along the same line, sample for vegetation and ungulate pellets. Sampling for vegetation, ungulate dung and human disturbance will be done only once on a transect.

- Again a beat will be the sampling unit, and sampling will be done along the established line transect.
- The beginning and end point coordinates of the line transect need to be recorded using a GPS unit.
- The same principal of laying line transects as explained in the section on ungulate encounter rates is applicable here (see Figure. 2).
- Vegetation would need to be sampled every 400 m along the transect.
- The vegetation would need to be quantified visually at the following categories for each plot:

a) 15 m. radius circular plot: -

- Broad vegetation type and associated terrain type eg. mixed teak forest on hilly terrain, sal forest on flat land, etc.
- Within a distance of approximately 15 m of the observer the five most dominant trees (over-story, all vegetation >6 fit heights, including bamboo) need to be listed in the order of dominance (abundance) (see Figure 4).
- The observer needs to list the 5 most dominant shrub species (middle story, vegetation >20cm and <6fit) in order of dominance (abundance) within 15m of the location. He needs to categorize shrub density (under-story vegetation) as absent, very low, low, medium, and dense. Shrubs will be assessed on five-point scale (0 to 4 i.e. absent to most abundant) for density estimation.
- If weeds are present, their abundance needs to be scored on 0 to 4 scale (0 being absent and 4 high abundance) and the three most common weeds seen in 15 m need to be listed in order of abundance.
- Within the same 15 m distance the observer needs to record number of signs of looping, wood cutting and presence/absence of human foot trail. Mention need to be made if people and or livestock are seen from the plot.

- The observer needs to visually quantify the canopy cover at the location. The observer should subjectively classify the proportion of the sky above him that is covered by canopy foliage and categorize it into <0.1, 0.1 -0.2, 0.2-0.4, 0.4-0.6, 0.6-0.8, > 0.8 canopy cover (see Figure.5).

A mention needs to be made in the data sheet regarding the number of permanent human settlements, human population, and livestock population present in the beat (to the best of his knowledge). A mention needs to be made based on the observer's knowledge if any non timber forest product is collected from the beat. If yes, which NTFP and to score the magnitude of collection on a 5-point scale (0- no collection 4-high rate of collection).

If the beat was burnt (natural or management practice), the proportion burnt in the past 3 years need to be mention in the data sheet.

b) 1 m radius circular plot: -

This plot should be laid 5m away from the centre of the 15m circular plat. The observer needs to use a 2m long stick to define an imaginary circle around him with the stick as the diameter. Within this circular plot (2 m diameter) the observer needs to (a) quantify the percent ground cover, i.e. the proportion of the ground covered by herbs, grasses, litter, and bare ground, (b) List the 3 most dominant grass species, and herb species in order of dominance.

3. Sampling for Ungulate Pellets: -

Ungulate abundance will also be indexed by enumerating their faecal pellets. This exercise will be done on the same line transect that has been sampled for ungulate encounter rate. To save time, this exercise could be done after the line transect has been sampled in the early morning for ungulate encounters.

- At every 400m along the transect (line of walk) the observer needs to sample an area of 2m by 20m, perpendicular to the transect for quantifying ungulate pellets. This is done by using the 2m long stick held at the centre horizontally in his hand and by walking slowly, 20m right and left of the transect alternately at every 400m (see Figure.7).
- All ungulate pellets encountered need to be recognized to ungulate species and recorded in appropriate columns of the attached data sheet.
- The number of pellets needs to be counted. In cases where the pellets occur in large heaps, then they should be categorized into the following categories: A (50-100), B (100-200) and C (>200).
- In areas where small livestock like sheep and goat are known to be grazed, it is possible that pellets of these can be confused with wild ungulates especially those of chital. In such areas, a mention needs to be made that goat or sheep graze the area.
- In the last row of the data sheet the observer needs to report if ungulate/animal listed in the data sheet occurs in the sampled beat to the best of his knowledge irrespective of whether its pellets/dung were recorded in the plots.

This spatial data generated will be used to model tiger occupancy detection probability of tiger signs, and relative sign density at high spatial resolution. The data will be

analysis in GIS domain and several spatial and attribute data like human density, livestock density, road network, topographical features, forest type and cover, meteorological data, poaching pressures and landscape characteristics will be use as covariates to model tiger occupancy and relative abundance in landscape and individual forest patches. Several corroborating variables like prey encounter rates, pellet group counts and habitat condition will help in ensuring quality data. National and international expert would act as observer while official in charge insure adherence to the prescribed protocol and transparency of protocol implementation. This system will also monitor the status of other biodiversity resources.

b) Phase-II: Spatial and attribute data: -

The spatial and spatial data that are likely to influence tiger occupancy of a landscape will be used for modelling in a GIS domain. The vegetation map, terrain model, night light satellite data, drainage, transportation network, forest cover, climate data, Normalised Difference Vegetation Index, livestock abundance, human density, socio-economic parameters, etc will be used for modelling habitat condition and tiger occupancy. Beat-wise vegetation sampling will be done to generate broad vegetation map. Part of this component will be done in collaboration with Forest Survey of India (FSI) and Survey of India. This modelling helped in determining current spatial distribution of tigers, potential habitats, threats to crucial linkages between occupied landscapes and conservation planning.

c) Phase-III: Estimating the population of tigers and its prey: -

Phase-III of the methodology will have the answers of the questions of how many tigers and ungulates are there. Teams of researchers will be deployed for estimating tiger density and ungulate densities within stratified sampling units. The double sampling approach of Pollock et al (2002) by sampling the entire landscape for occupancy and relative abundance related indices along with other covariates (human disturbance and habitat quality - Phase I & II data) and a sub sample for estimating absolute density will be used. Indices were then will be calibrated against known absolute densities for extrapolation in that landscape (Conn et al. 2004, Pollock et al 2002, Skalski and Robson, 1992, Williams et al 2002).

1. Estimating tiger numbers: - After stratifying landscape into tiger sign abundance classes of high, medium, low and no tiger sign at the beat and larger spatial resolution (100 km². In each of these strata within a landscape estimated actual tiger density in 3-5 replicates of sufficient size (100-200 km²). Primarily depended on remote camera traps to identify individual tigers based on stripe patterns, population estimates based on mark-recapture framework were done using CAPTURE, CARE 2 and Density 4 (Carbone et al 2001, Chao & Yang 2003, Efford 2007, Karanth 1995 and 1998, Karanth and Nichols 1998, 2000 and 2002, Karanth et al 2004, Pollock et al 1990, Per Wegge et al 2004 and Rextad & Burnham 1991). These densities were then extrapolated for the areas under various density classes within the landscape to arrive at a tiger population estimate. We do realise that these population estimates have high variances, but since these estimates are not be used for monitoring trends (which is proposed to be done through the site occupancy and relative abundance data), they should suffice the need for converting a relevant ecological index to a more comprehensible concept of numbers. The tiger population reported throughout the report are tigers above 1.5 years of age and captures of cubs for population and density estimation as this age group is under represented in camera trap studies is not considered.

2. Estimating Tiger prey: - Phase-I of the protocol would be reporting encounter rates on line transects (Buckland et al 1993); these would suffice for monitoring trends in ungulate population and site-specific occupancies as the same transects would be sampled during subsequent surveys. To convert encounter rates to density, an estimate of the effective strip width of these transects would be essential. The effective strip width of a transect primarily depends on the visibility (vegetation and terrain type), ability to detect ungulates by different observers and animal behaviour response (Buckland et al 1993). Effective strip widths determined from the model and actual sighting of ungulates for different vegetation types. However ungulate response is likely to play a important role in disturbed area in determining effective strip width. The habitat and terrine specific effective stripe width will be determined by actual sampling and by modelling. These estimates of effective stripe width will be used for converting encounter rates of ungulates to density estimate by modelling detection probabilities. A team of researchers sampled the beat transects in each habitat type using distance sampling technique (Buckland et al. 1993). Pellet group counts on transects would serve as an index to the presence and relative abundance of ungulates.

d) Phase-IV: Intensive monitoring of source populations: -

The following methodology is prescribed for this monitoring: -

1. Photo registration of tigers: - Pictures of individual tigers obtained by camera traps or by regular cameras should be maintained in the form of a photo identity album. Records should be kept on the location, condition (breeding status, injury, etc) and associated tigers whenever a tiger is sighted. This will provide crude data on ranging patterns, demography and mortality.
2. Tiger pugmark and other signs: - Regular monitoring of tiger signs (pugmark tracings, plaster casts, etc) should be undertaken in every beat at a weekly interval with monthly compilation of data. With experience and exposure to the resident tigers and their pugmarks, the forest staff may be able to identify individual tigers from their track set characteristics (Panwar 1979, Smith et al 1999 and Sharma 2001). Sign surveys and individual tiger monitoring should become a regular task for every guard. The monthly data should be mapped and maintained to analyse trends.
3. Monitoring by telemetry in select areas: Use modern technology of VHF, GPS and satellite telemetry to study and monitor aspects of demography, metapopulation dynamics (dispersal, ranging patterns), mortality, predation ecology and behaviour. In all source populations, tiger abundance and density should be estimated using camera traps, digital images of pugmarks and/or DNA profile from non-invasive methods biannually.

9.3. Habitat Assessment and Monitoring Framework: -

The data collected during phase I for sampling for Vegetation, Human disturbance will be collated and put in GIS Domain. This can be correlated with tiger and prey base presence. Any change in the habitat can be monitored by serial data present in GIS Domain.

9.4. Spatial Database Development: -

The Tiger population was estimated during phase II by extrapolating the density for the area (Jhala et.al., 2011). This area wise data was put in GIS Domain to get spatial

database. The density of ungulate was also put area wise in GIS Domain do get the presence pattern.

9.5. Analyses and Reporting Framework: -

Data analysis was done by WII, Dehra Dun during monitoring tiger, co-predators prey base and their habitat, so the analysis and reporting framework developed by NTCA/WII for All India tiger Estimation (on a four yearly basis) will be used in future.

9.6. Carrying Capacity of Tigers under Tiger Preservation Zone at Manas National Park: -

Carnivore densities can vary over several orders of magnitude within species, but, in natural ecosystems, generally reflect the abundance of their prey (Bertram, 1975; Fuller and Sievert, 2001). Seminal work by van Orsdol et al. (1985) illustrated this relationship with lions (*Panthera leo*). Such relationships have subsequently been found in cheetah (*Acinonyx jubatus*) (Laurenson, 1995b) and leopard (*Panthera pardus*) (Stander et al., 1997). A relationship also exists between tigers (*Panthera tigris*) and their prey (Karanth et al., 2004). There are several predictive equations developed to compute carrying capacity of Tiger (Karant et al 2004, Carbone et al 2002, Hayward et al 2007) as well as formulations that consider an ideal predator density that does not induce trends in the prey populations (Fuller 1989). The other approach is to use a 10% cropping rate by large predators and compute the potential numbers (density) that the ungulates can support.

According to Karanth et al. (2004) an adult (male or female) tiger requires 72 chital equivalents ($72 \times 50 = 3600$ Kg.) per annum (1 chital equivalent = 50 kg., which is the assumed average body weight of a chital. However, Hayward's (2007) carrying capacity equation developed for lions based on preferred prey biomass is more applicable for tigers especially in a ecosystem with a diverse carnivore community. The equation for estimating carrying capacity: -

$y = -2.158 + 0.377x$ (for preferred prey weight range); $y = \text{Log}_{10}$ of maximum carrying capacity of predator density for the available preferred prey, $x = \text{Log}_{10}$ of preferred weight range prey biomass per unit area/sq. km.

Prey availability is the fundamental habitat requirement of large predators (Hayward et al., 2007; Karanth et al., 2004) and so determining landscape level area requirements based on preferred prey carrying capacity in each habitat may be a better option. To compute the carrying capacity of the core of Manas Tiger Reserve considering the preferred prey of tigers to be Hog Deer, Sambar, Wild pig, Gaur & Wild Buffalo. However, while calculating density of prey species due to low detection and less effort, the dataset of line transects (2012-13) were run in Distance software without habitat stratification. Furthermore, Sambar, Gaur and Wild Buffalo data was not run in Distance due to very few sightings in the transects. For this three species, density was calculated from the available Forest department census data (2008).

For the calculation of biomass, the number of individuals in each ungulate species per unit area multiplied by their average body weight provides an estimate of the biomass supported by a certain habitat (Schaller 1967). For the preferred prey of Tiger, this

information was converted to biomass km^2 using 3/4 of adult female body mass (following Schaller (1972) to account for sub-adults and young preyed upon).

The following computations show that currently the tiger population is below prey dictated carrying capacity as based on this equation a density of about 9 tigers per 100 sq. km. can be supported in the core of Manas Tiger Reserve.

Calculation: -

Table 9.1 Preferred prey biomass/ km^2 in Manas National Park-

Prey Species	Preferred Weight in kg	Average Density/ km^2	Biomass (kg/ km^2)
Hog Deer	30	6.3	189
Sambar	112.5	1.07	120.375
Wild Boar	60	4.47	268.2
Wild Buffalo	300	0.44	132
Gaur	300	0.75	225
Average Biomass/km^2			934.575

Log10 of prey biomass (x): 2.970614159

Regression equation: $y = -2.158 + 0.377 X 2.970614159$ ($y = a + bx$)

Here,

A	B	x
-2.158	0.377	2.970614159
$\text{Log}_{10} y = - 0.091605$		

Therefore, the Tiger density will be = 9.16/100 km^2

Since the carrying capacity far exceeds the current density of tigers in the area, there is a need to first understand and determine the undermining factors such as poor food availability and poaching, and whether they have impacted the density of tigers in the area. If these causes are ruled out, then appropriate habitat interventions may be required besides in-situ augmentation of prey base. However, such interventions should not change the ecological character of the forest habitat and will be in accordance with the existing habitat conditions.

9.7. Habitat Management under Grassland Conservation Zone: -

The grassland habitat forms the mainstay of all the ungulate species in the Core Zone of the Tiger Reserve. Although the carrying capacity as calculated for the National Park indicates that the current tiger densities are at much lower densities, the fact that grasslands have been reduced drastically over the last thirty years (Sarma et.al., 2008) calls for specific management interventions that are as follows:-

- To improve the present conditions of grasslands for increasing the population of prey base species.
- To arrest the succession in tall grassland areas and use fire and manual techniques (such as uprooting of trees) as a tool to prevent encroachment by woodland and invasive species.
- To create and improve grassland habitats, especially in the non-tourism forest ranges where animal density has been low.

9.7.1. Strategy & Management Prescriptions: -

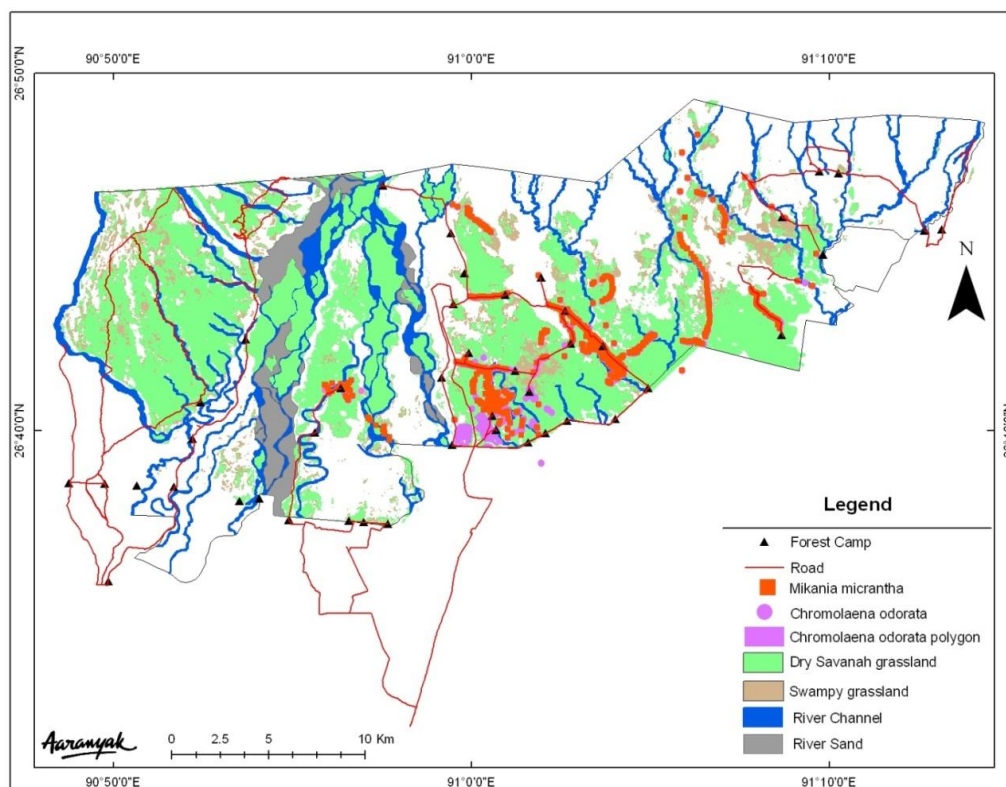
Based on the existing situations and current knowledge, the following broad prescriptions should be followed for the management of grasslands in the Core Zone depending upon financial allocations received from the state govt. and the National Tiger Conservation Authority, New Delhi. Needless to add, prime grasslands should be taken up on a priority basis: -

- g) Burning: - The Park Management should clearly identify and list out the pure patches of short (alluvial) and tall (dry) grasslands in the core area. Patch burning mosaics using fore lines should be encouraged. All burning should be carried out within Dec-January each year. Late burning, especially after March should not be encourage and fire prevention strategies should then be in place.

9.7.2. Weed Eradication: -

Weeds are obnoxious plant species, which are unpalatable and invade grasslands and compete with grasses resulting in the degradation of this habitat type. The main weed species in the grasslands of the Core Zone are *Mikania macrantha*, *Eupatorium* spp, etc. These species mushroom very rapidly and if not controlled in a systematic and phased manner, may pose a serious threat to grassland habitat. Weed eradication practice should be done preferably with the onset of the rains, taking advantage of the already wet and soft ground to manually uproot the species. The eradicated biomass should be dumped in heaps and burnt before the fire season. The management has to ensure that the next year a thorough weeding is also undertaken in the same areas for effective eradication. Considering the juxtaposition of forest and grasslands, connectivity among grasslands should also be ensured by eradicating weed and unpalatable species.

Fig9.1: Mapping invasive species and their spread in Manas National Park (as on 31.03.2014)



9.7.3. Eradication of Woody Species: -

The management should identify such grasslands threatened by the invasion of gregarious woody species such as *Bombax ceiba*, and *Dillenia indica* etc. These woody species tend to encroach into the grasslands from the periphery and gradually grow in size and area, thereby not only reducing the extent of the grassland habitat but also creating obstruction to the foraging animal population. All these woody species and their associates have to be uprooted before the end of the monsoon. If the grassland is large, a few small grooves of tree should be retained to provide the much-needed shelter to the animals in the late morning and afterwards. Prominent grasslands should be first considered for this uprootal programme, followed by the adjoining large clearings.

9.7.4. Grazing management: -

Grass lands and grazing areas have virtually disappeared from revenue village lands and as a result, there is tremendous pressure in terms of free ranging cattle being let loose in grasslands in our Protected Areas. Eco-development activities combined with awareness, penalty measures will need to be adopted as per local conditions. At present more than 15 km of solar energised fencing has been placed all along the southern boundary to prevent straying of wild animals and vice versa. Community-owned and community managed fencing can be tried out in other areas.

9.7.5. Water development: -

Water development is a very important conservation input, and in the present context includes the distribution and quantity of water, not only in the dry regions, but also where it is plentiful. This includes, besides the construction of new water bodies, the maintenance of the old ones by deepening, desilting and reshaping them.

Except in the pinch period which lasts from December to March, the availability of water in the Core Zone at present is satisfactory. Besides, the water table in the Bhabhar tract along the Indo-Bhutan Park boundary is anyways very low to harness ground water. Suitable rain water harvesting techniques shall be made mandatory while constructing new anti-poaching camps in this region.

CHAPTER TEN

PROTECTION AND INTELLIGENCE GATHERING

10.1. Formation of a Tiger Cell: -

To mainstream managerial and conservation activities towards conservation of tigers in the reserve, a Tiger Cell shall be set up which would look after all activities and measures directly related to tiger conservation as well as suggest mitigation measures for possible direct and indirect threats.

Specifically, the Cell would be entrusted with the responsibility of gathering information relating to offenders, and to establish an intelligence network and monitor the progress of pending court cases related to wildlife offences. The Cell also collaborates with the conservation partners, the Police department and informers for achieving the above objectives. Such a Cell would need to be set up for MTR.

10.1.1. The set-up: -

The Tiger Cell, comprising personnel from both the Forest Department and outside agencies shall be responsible for all implementation of better conservation measures. Its members shall include: -

- The Field Director
- The Deputy Field Director
- The additional Divisional Forest Officers from proposed additional area
- Selected and designated Range Officers
- Important members from other agencies like local NGOs/departments like Police, Army
- Tiger/conservation experts (individuals) if not falling under above categories

10.1.2. The responsibilities of the Tiger Cell: -

- Compilation and advanced analysis of all data relating to tigers in the reserve.
- Holding regular meetings to assess the progress and the present protection scenario.
- Collaborating with different agencies/departments for activities relating to tiger conservation.
- Assessment of the amount of disturbance within the reserve with help of observations resulting from various activities.
- Formulation of mitigation measures and ensuring their proper implementation.
- Maintaining the spatial databases relating to tigers and co-predators in the reserve.

- Encouragement of awareness generation activities aimed at the large population situated both within and outside the reserve.

10.2. The strike force: -

Beat guards of beats concerned are supposed to be responsible for the protection of flora and fauna. In addition to this, some anti-social elements also become active during special occasions like festivals. In order to supplement the protection activities, constitution of a separate Tiger Strike/Protection Force was felt.

There should be a schedule of patrolling prepared by deputy director and supervised by ACF for every party of Tiger Protection Force, which will be equipped with firearms and provided a vehicle and mobile wireless. Daily movement message should be sent to the Field Director's office to obtain appropriate instructions, especially at the time of urgency and emergency. The duties of the Tiger Strike/Protection Force are as under;

- a. Periodical checking of village grocers for illegal activities like wildlife trade, felling etc.
- b. Patrolling the villages located in and around the core to check illegal collection of NTFP.
- c. Keeping regular watch on the movement of antisocial elements engaged in illegal fishing activities to avoid the chances of unauthorized fishing in rivers and wetlands within the core.
- d. Illicit grazing control.
- e. Regular checking of nearby weekly markets, bus stops and railway stations to restrict the illegal transit of any wild animal article or any Forest produce.
- f. Intensive regular patrolling on highly sensitive paths for controlling wildlife crime
- g. Strict control on fishing activities.

A unique approach for Conservation Law Enforcement System in Manas National Park.

- In this system, a team of highly skilled frontline staffs carries out efficient patrol in Ranges of the Manas National Park led by the Forest Range Officer in the field and commanded by the Field Director, Manas Tiger Project.
- The system is being implemented since March 2016 starting with a three-week skill development training followed by field implementations.
- Currently two such mobile patrol team are functional in Bhuyanpara and Bansbari ranges. The team at Bhuyanpara is designated as 'Manas Tigers', and the team at Bansbari as 'Manas Panthers'.
- Both the team carries out daily patrolling extensively by foot, and also by elephant, bikes and vehicles as and when required.
- The team gathers all of the information required to understand types of threats and then directly address those through the means available in hand. This helps in

understanding a threat and seeking to shape the assets into most effective force possible, which is a key factor here in this system.

- The system emphasizes on best use of existing assets in the field at the hands of the Forest Range Officer.
- A team of highly technically skilled manpower supports the mobile patrol team on day to day operations with data management, analysis, capacity building, mentoring and empowerment.
- It does not overburden the patrol team members with new technology and equipments, rather introduces one strategy at a time to enable the team to understand, practice and empower itself before introducing another.



Manas Tiger Patrol Team

10.3. General strategy for protection and communication (as proposed by NTCA): -

While no generalized approach can be prescribed for the entire country, certain broad points are highlighted below for planning, which may be used in evolving or improving the protection strategy in tiger reserves: -

- (1) Review of the existing patrolling camps/chowkis in MNP, so that each chowki/patrolling camp has, on an average, an area of 25-30 sq. km. under its jurisdiction to ensure the desired amount of legwork/patrolling by beat guards and his camp followers posted in such patrolling camps/chowkis.
- (2) Prescribing a daily schedule of patrolling keeping in mind the vulnerability of the area from protection point of view.
- (3) Maintaining a monitoring/daily observation register in each patrolling camp/chowki in the local language preferably, in which the field personnel can record their daily observations based on patrolling.

- (4) Adopting a regular supervision schedule for field officers, along with minimum patrolling to be done by them jointly with patrolling camp/chowki staff.
- (5) Maintaining a system of “surprise checks” of chowkies/patrolling camps by senior officers.
- (6) Keeping a record of the local village level market days in the peripheral areas, and deploying staff in civil dress to keep track of any untoward incident/transaction relating to wildlife.
- (7) Organising vehicular patrolling by constituting squads comprising of field staff, labourers and police/SAF personnel, tools (if necessary), with wireless handset and paraphernalia for apprehending offenders, apart from prescribing a patrolling calendar for the squad.
- (8) Maintaining a list of vehicles passing through manned barriers, and surprise checks by senior officers at such points every month.
- (9) Evolving a monitoring system for collation of information regarding livestock depredation/human injury/loss of human life/large scale crop depredation by wild animals through wireless network and prompt payment of compensation as per Citizens’ Charter.
- (10) Wherever half eaten carcasses of livestock on account of carnivore depredation are reported, such carcasses should be incinerated in the presence of a gazetted officer to eliminate the possibility of poisoning for revenge killing retaliation by local people.
- (11) In areas where more than three incidents of livestock depredation are reported within a fortnight, continuous monitoring based on field evidences should be done by deploying trackers.
- (12) Ensuring monthly meetings with the neighbouring district officials for exchanging wildlife crime dossiers to facilitate joint action.
- (13) Exchange of crime dossiers with local police to facilitate their updation, apart from organizing monthly review meetings with the District Superintendent of Police.
- (14) Periodic meetings with the District Judge to expedite the disposal of pending cases relating to wildlife offences.
- (15) Organising surprise raids jointly with the local police in railway stations, local trains, bus-stops, buses and cafeteria.
- (16) Ensuring special site-specific protection measures, during monsoon such as ‘Operation Monsoon’ – considering the terrain and accessibility of Protected Areas.
- (17) Organising inter-state meetings at least once in three months, to exchange wildlife crime data between border Parks/Tiger Reserves/Sanctuaries.
- (18) The area should be constantly monitored to ascertain the presence of gangs and wandering pastoral people, apart from keeping an inventory of their temporary settlements.
- (19) Wherever EDCs have been constituted, a village level crime register should be maintained at the EDC level to keep track of villagers involved in wildlife offences.
- (20) At the range level, dossiers of habitual/ incorrigible offenders should be maintained, to help in tracing new crimes to old offenders.

- (21) Identifying local persons and imparting them the basics of wildlife crime detection so as to avail their services as and when required as informers.
- (22) Preparing a monthly crime map of each Protected Area on a 1:50,000 scale indicating the locations of each crime with date. It should also highlight the recorded cases of live stock depredation by carnivores during the period.
- (23) Patrolling camp/chowki staff should be instructed to collect field evidences like pugmarks, plaster cast of foot-prints on a regular basis, so that individual identities of carnivores like tiger can be fixed. This would serve as a continuous monitoring also.
- (24) Laying out impression pads near water points in villages to ascertain the presence of carnivores in the area.
- (25) Constituting a Defence Squad comprising of local, proactive villagers at the EDC level, which can assist the PA staff in apprehending miscreants involved in wildlife poaching.

10.4. Specific protection strategies: Regular patrolling by foot, elephants, bike and cars would be carried out by the patrol teams in each range. Effective ‘Anti Poaching’ measures and ‘Patrolling Strategy’ should be accorded topmost priority in a Tiger Reserve management. The need for a reliable, round the clock wireless system, strategically placed forest patrolling camps and an ever vigilant, motivated frontline staff requires no elaboration. Manas tiger reserve presents a mosaic landscape of unbroken forests, villages and tea gardens and the amount of anthropogenic disturbance is very high in some areas. Hence, enhanced protection and communication strategies are vital for safeguarding a breeding population of tigers.



10.4.1. Up-gradation of Kahitama Beat to a Range: -

Since the change in Manas-Beki river course during the massive floods in 2004-05, there has been a dramatic change in the landscape and the route of access etc. Kahitama area which is currently administered under the Range Officer who sits at Bansbari, needs to be ideally upgraded to a Range status. At present there are 6 sanctioned strength of Range officers in Manas and therefore no new posts will need to be created for such an upgradation. Similarly, with the construction of new anti-poaching camps, the area can operate as a fully fledged Range.

10.4.2. Control of poaching and illegal felling: -

Poaching is one of the major problems in the reserve. There are possibilities of cross border wildlife trade because of its proximity to West Bengal and Bhutan. In this regard, collaboration with enforcement agencies like Army, SSB become vital for checking and seizure of illegal material being carried. The M-STrIPES would be used as protection and monitoring strategy from May 2019 onwards.

The Indo-Bhutan and Assam-West Bengal borders are very porous and hence regular monitoring as well as intelligence gathering is essential for timely intervention of such crimes. Manas has also got problems of existence of myriad fringe villages throughout the area, even in the core area. Since 2011, 7 rhinos have been poached in the park, in addition to poaching of few tuskers. Hence, strict monitoring needs to be enforced in those areas.

At the same time, it is also necessary to have a legal control on Sawmills, Veneer Mills and Furniture shops. It is very much essential to regulate illegal running of Sawmills and furniture shops to protect forest assets in MTR. The following strategy is being proposed for this purpose-

- No new license to wood based industries should be issued except in accordance with the High Level Expert Committee appointed under the order of the State Govt.
- Wood based industries having no proper license should be stopped from functioning and legal action initiated against them.
- Regular and surprise checking of documents and stocks of wood-based industries should be carried out.
- Adequate precautions should be taken while issuing Transit Permits to veneer mills and sawmills to stop misuse of T.P.

These strategies are applicable to all the Management Zones. To control poaching of wild animals and illicit felling of trees, following strategies are proposed: -

(a) Rigorous anti-poaching effort by extensive patrolling: - Extensive patrolling is one of the basic and most important task of the field staff. Patrolling must be done on foot/elephant back, by vehicle/boat etc. Patrolling must involve routine inspection inside the Reserve, checking of boundaries. Effective policing shall involve analysis of each case of poaching and illicit felling and accordant action. Full moon nights are notorious for poaching incidences. Special care shall be taken during such periods.

The existing river camps on Beki shall be maintained. It shall be established and operated each year during monsoons. The river camp should be maintained throughout the



There must be a different schedule during different seasons, like monsoon patrolling summer season patrolling etc., which should be focused on specific problems during the period.

The Patrolling should be focused on following sensitive areas: -

- a. Water Sources and their approaches.
- b. Saltlicks and their approaches.
- c. Nala beds specially junctions with other nallas and roads.
- d. Electric lines.
- e. Fire sensitive areas and
- f. Checking the water holes outside the PA during summer season.

Laying out impression pad near water point in villages to ascertain the presence of carnivores in the area. To ensure the daily recording of the presence of different animals along with the description of the habitats, the time of sighting, their activities especially the feeding habits; portion of plant parts being used, plants species, time of sighting, herd strength, Season, breeding activities interaction with other animal species. Such useful information should be recorded in prescribed camp register.

The Patrolling Camp Register must be put up to the Range officer, Assistant Director and other officials for inspection and also to obtain necessary instructions during their tour.

Message of any incidence of fire, human intrusion of suspected nature, suspected death of any animal, arrival of migratory birds, cattle lifting etc. shall be immediately informed to higher authority by wireless or telephone. There should be some compulsory foot patrolling for each level of staff/officers.

(e) Monitoring of the camps: -

- Daily monitoring of activities carried out by patrolling camps should be a part of the duties of the concerned Range Assistant.
- The concerned Range officer concerned, having his jurisdiction over various camps, should regularly report in brief the activities done in patrolling camps to ACF.
- All the patrolling schedules and actual patrolling must be monitored by ACFs concerned and should periodically report to Deputy Director and Field Director. The higher authority also must go on patrolling with some patrolling party to check the patrolling activities and provide the on spot knowledge for checking the fauna and flora.
- There should be surprise checking by higher authority like R.O., ACF and Deputy Director to insure the presence of staff and watcher in the camps. This should be specially carried out in the night with night patrolling by concerning authority.

(f) Operation Monsoon: - This exclusive operation is carried out during the rainy season when most of the Reserve's area becomes inaccessible for regular patrolling by vehicles, and the probability of intrusion from the surrounding villages increases. This operation includes: -

- Sensitivity mapping
- Deployment of elephant for patrolling
- Additional temporary patrolling camps
- On foot patrolling
- Foot-path surveillance
- Patrolling Squads
- Monsoon wireless stations

(g) On Foot Patrolling: - With the ever-increasing biotic pressure on the wildlife protected areas, the importance of regular on foot patrolling by officers in a Tiger Reserve is an undeniable and indisputable fact. Aside from inspiring the regular patrolling staff, this also lends a psychological restraint over the surrounding villages.

(h) Elephant Patrolling: - In MTR, elephants have proved to be very effective in ensuring habitat protection. The protection schedule for elephant during monsoon is as following-

- The PA should be divided into patrolling units, and at least 2 elephants should be deployed per 100 sq. km. of the sensitive habitat.
- Each elephant squad should comprise of 1 forest guards, equipped with a wireless handset and a firearm, apart from two field assistants (labourers).

- Temporary elephant camps (at least 2/ unit) should be created close to a permanent water source in the patrolling unit for elephant housekeeping and feeding.
- During movement, the elephant squad should communicate with the Range HQ/ squad-in-charge through wireless after every hour.
- After the patrolling work each day, the squad-in-charge should send a wireless report to the concerned RO/PA manager highlighting the area covered and observations made. The elephant squad should also keep a record of wild animals seen during the jungle excursion



(i) Over all Patrolling Strategy: - The overall patrolling strategy of the Tiger Reserve includes the following features:-

- Staff/camps listed with duty allocation and route chart
- The teams are equipped with mobile wireless sets and firearms
- The patrolling teams systematically cover the area of allotted to them
- Special instructions/provisions for squads:
- Surveillance: hotels, tourist points, vehicles, bus stand, trains and other means of transportation.
- Surveillance: Ex-hunters and traditional hunters etc.
- Coordination with local police
- Sanctioning labourers for patrolling (2/team)
- Networking
- Preparation of daily schedule

- Regular checking of market
 - Surprise checking of barriers
 - Preparation of “crime maps” with periodic updating
 - Monitoring cattle kill, human kill, injury incidences and crop raiding
 - Monitoring issues relating to compensation
 - Monitoring water points near habitation
 - Preparation of crime gang dossiers at range level
 - Preparation of individual crime dossiers
 - Monitoring of habitual offenders
 - Preparation of monthly Crime Map on 1:50,000 scale indicating location of each crime with date.
 - Conveying progress to Field Director/Dy. Director on a daily basis through wireless
 - Deviating from routine schedule during emergencies
 - Taking note of offences registered in local police station
 - Using tape recorder/camera etc. to record evidences
 - Special monitoring of water holes near human habitation during the pinch period
 - Incineration of half eaten carcasses of livestock on account of carnivore depredation should be carried out in presence of gazetted officer to eliminate the possibilities of poisoning of revenge killing relation by local people.
 - Continuous monitoring of the area where more than three incidents of livestock depredation reported within a fortnight.
 - Village level crime register should be maintained at the EDCs level to keep track of villagers involved in wildlife offences.
 - Maintained list of vehicles passing through manned barrier and surprise check by senior officer at such point every month.
 - Providing adequate patrolling staff in beats to combat the poachers and organized smugglers:
- (j) Increasing staff strength: - Present distribution of staff in field postings is lopsided. A re-distribution of staff as per specific protection needs of various locations is necessary. This must be done. Re-distribution of staff as well as re-organisation of range and beat jurisdiction should be done as proposed. The minimum basic facilities and amenities should be provided to the staff, particularly those posted in difficult locations. Incentives and rewards should be given to staff for good works to boost up the morale of the staff. Provision of sufficient sophisticated fire arms and ammunition for staff to tackle poachers and smugglers: Fire arms are important to combat poachers and smugglers and for self protection by the staff. Manas TR will require sophisticated arms to combat with poachers.



10.5. Use of RS/GIS and ICT in Wildlife Protection and Crime Risk Management: -

Wildlife protection and crime risk management in the present scenario requires a widely distributed information network using the state-of-the art technology. GIS is a user-friendly tool for data integration to facilitate prompt action. With Internet and Intranet technologies, complemented by VSAT, GPS, wireless and fiber optic communication in networking, the PA/Tiger Reserve HQ can be connected to the state HQ, Police HQ and PT Directorate to disseminate information for field action in apprehending the offenders.

The following imperatives ensure the success of wildlife protection and crime risk management: -

- Good surveillance
 - Timely reporting and networking
 - Prompt situation analysis
 - Immediate action
- There are several elements in wildlife protection and control viz.
- Relative spatial abundance of wild animals
 - Identification of risk factors
 - Proximity to risk factors, sensitivity categorization, crime mapping and updating
 - Site-specific protection strategy
 - Immediate action for apprehending the offenders based on effective networking and communication

Geographic Information System has the ability to manage both spatial and non-spatial data and therefore provides an ideal framework for wildlife protection and risk management. Space technology has shown the interconnectivity of natural and anthropogenic phenomena occurring anywhere on earth. Thus, an integrated approach based on space remote sensing in the GIS domain with relevant biotechnological inputs can play a vital role in wildlife crime risk management.

For day-to-day communication telephone is one of the most efficient way of the communication. In MTR all the range offices, should be provided with telephone communication. For some field staff and executive staff should be given mobile facilities. Senior key staff should be given camera, GPS and much digital software for assisting in detection, registration and reporting of offence. All range offices should be provided with computer and internet connection to have proper office MIS and access to the Forest Offence Management System and other data base.

Wireless network forms the backbone of communication in the Reserve. There shall be a total of 5 control rooms altogether, one at the divisional HQ, and one each at the ranges that operate 24 hours. Apart from these individual Ranges, patrolling vehicles are also fitted with RT Sets.

- Improvement of existing wireless network, purchase of better equipments.
- Proper maintenance of equipments and facilities for the same
- Motivation of staff for timely and quick communication in case of an emergency situation.
- Maintenance of patrolling roads/paths especially during monsoon.
- Construction of additional patrolling roads in sensitive areas with strategically located check posts.
- Construction of trails/bridle paths.

10.6. Publicity and Public relations to create awareness among people: -

One important task of the MTR authorities is to improve the publicity of the management activities for propagating the cause of wildlife. This can be done through T.V., Radio, Video film, newspapers, magazines, distribution of brochure and handbills, etc. Publicity through Nature Interpretation Centre (NIC) should be improved.

10.7. Inter-agency Coordination: -

It is extremely important to share information with General/civil Administration, Police, Central Para Military forces, Army, Intelligence and Enforcement Branches in an insurgency prone area such as Manas. At the same time, wildlife and forest offences of MTR have inter-district, inter-state and inter-national overtones. Inter-agency co-ordination is extremely useful for effectiveness of any control measure. A sketchy and informal co-ordination does exist at present. MTR should make it more robust and live.

Local level Inter Agency meeting: Monthly meetings are organized between the agencies mentioned. This is done in 2 different sectors at local level.

State level: Quarterly meetings are organized between the agencies mentioned. The state level meetings include agencies like railways, narcotics, WCCB, police, army etc.

10.8. International Co-Operation to curb illegal trade on Wildlife articles: -

MTR is in close proximity with routes of illicit traffic in wildlife articles. Closeness with Bhutan and Nepal adds international character to it. International co-operation among Enforcement agencies in Bhutan, Nepal and India is necessary to curb illicit traffic in wildlife products effectively. MTR officers maintain formal contacts with their counterparts in Bhutan. This should continue.

10.9. Setting up of The Court Liaison Unit: -

In present practice, the dealing of the court cases is not much effective and the offenders are mostly acquitted for want of effective follow-up. Due to lack of proper attention, most of the court cases become weak resulting in the acquittal of the accused persons. To avoid the repetition of such situations in future, a Court Liaison Unit should be constituted for the MTR.

10.10. Strengthening road network: -

Manas Tiger Reserve has a good road network. Existing roads shall be maintained regularly as fair weather roads only. New roads in poaching sensitive should be made open. Patrolling paths must also be delineated for effective movement inside the forest. Construction of new patrolling path should be done. Maintenance of existing patrolling track will be done regularly by cleaning 3 m. wide strip, at least thrice a year.

CHAPTER ELEVEN

ECOTOURISM AND INTERPRETATION

11.1. Background: -

WTO (World Tourism Organization) defined Eco-Tourisms as – tourism that involves travelling to relatively undisturbed rural areas with the specified objective of studying, admiring and enjoying the scenery and its wild plants and animals, as well as any cultural aspects (both of past and present) found in these areas. According to WTO - Eco-Tourism is a travel to wilderness areas for admiring and enjoying the biodiversity and cultural heritage.

Existence of wildlife is an indication of biological health of an area. The recognition and understanding of inter relationship between flora and fauna by human beings is of utmost importance for existence and well being of all the three. This concept regulates tourism in protected area. Increasing tourism trends in wildlife areas brings about varieties of pressure threatening the very bio-diversity of protected areas. Therefore, a well thought well planned and disciplined tourism is the need of the time.

The protected areas can only become sustainable with presence of friendly host communities around their periphery. The communities can become friendly if they are gaining economically, socially and culturally through the Eco-development programme and tourist activities.

The solution lies in promoting Eco-Tourism instead of wildlife tourism. As per Eco-Tourism Society (ETS), Eco-Tourism means- “Responsible travel to natural area, which conserves the environment and sustains the well being of local people”.

11.2. Notified Guidelines for Tourism by NTCA: -

As per NTCA guidelines vide No./15-31/2012-NTCA dated 15 October, 2012 in the Gazette of India, Extraordinary, Part-III, Section-4. , it envisages that the State shall ensure that each Tiger Reserve prepares a tourism plan, as part of the Tiger Conservation Plan vis-à-vis the technical Guidelines of the National Tiger Conservation Authority. The plan shall include identification of corridor connectivity and important wildlife habitats and mechanisms to secure them. This site-specific tourism plan forming part of the Tiger Conservation Plan shall be approved as per the provisions of the Wildlife (Protection) Act, 1972. Prior to this approval, no new infrastructure for tourism (except for minor alterations in existing modest home stays) shall be allowed to be developed in and around Tiger Reserves. The ecotourism and interpretation sub-plan contained in this chapter is prescribed in the backdrop of the above guidelines issued by the NTCA, New Delhi.

11.3. Objectives: -

The specific objectives of ecotourism management in the core area are as under: -

- To develop facilities for promoting safe, restful and enjoyable tourism, and enhance the quality of visitors’ experience within the tourism zone.

- To complement and enhance the economy of the local communities/people living in the fringe of the Core Zone.
- To develop/maintain park interpretation facilities for creating conservation awareness.
- To ensure limited and restricted tourism and minimize its impact on the resources of the core area.

11.4. Strategies & Management Prescriptions: -

The following strategies and management prescriptions are proposed for conducting ecotourism in the Core Zone under various components: -



11.4.1. Principles of Tourism Management: -

The Park Management shall ensure that ecotourism in the core area is managed on broad principles based on the NTCA tourism guidelines, government's intents, professionalism, island nature of the protected area, and tourists' interest/ aspirations. These shall intend to provide a principled stand for tourism management in the Core Zone. Explanations and examples are also given to illustrate how best these principles can be put into practice

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11.4.2. Preservation of Natural Values & Promotion of Wildlife Conservation: -

- Nature/wildlife being important reasons for tourists.
- Offering opportunities to learn about nature/ wildlife and conservation.

- No disturbance to nature in any form.
- Tourism zone shall be limited to only 20% of the core area.
- Tourism shall be permitted into areas with suitable facilities.
- Facilities shall be designed to blend with the surroundings.
- Impacts monitored, with corrective measures taken as needed.

11.4.3. Minimum Pressure on the Tourism Zone: -

- Respect for the tranquility of wilderness.
- Complete avoidance of damage or disturbance to natural resources.

11.4.4. Opportunities to Increase Understanding & Appreciation: -

- Information/knowledge through interpretation setup.
- Attractive presentation of information.
- Excellent interpreters.
- Well trained route guides.

11.4.5. Production of Excellent Publicity Material: -

- Updated and reliable information.
- Attractive printing and publications.
- Availability of all publications.

11.4.6. Enhanced Recreational Facilities: -

- Need to divert tourists from “centric” mindset.
- Preferably outside the Core Zone.
- Visitors’ needs taken into account.
- World class recreational facilities.

11.4.7. Respect for Local Traditions & Cultures: -

- Visitors encouraged to learn about local cultures.
- Guides to be familiar with local conditions.

11.4.8. Promotion of Local Economies & Employment: -

- Local businesses relating to tourism to be supported.
- Employment opportunities exclusively for local communities.

11.4.9. Visitors’ Feedback: -

- Visitors’ opinions important.
- Provision for receiving suggestions/opinions/complaints.

- Timely review and redressal/action.

11.4.10. Coordination among Stakeholders: -

- Initiatives expected from the Park Management.
- Regular meetings and healthy discussions.
- Receptivity to other stakeholders' genuine problems.

11.5. Development of Participatory Ecotourism & Visitor Strategy: -

The following planning imperatives have to be undertaken for the development of an overall eco-tourism strategy, and will incorporate: -

- Participation of local communities.
- Sound environmental design.
- Visitor management.
- Conservation education.
- Training.
- Financial sustainability.
- Monitoring and evaluation.

11.6. Organization Setup and Management: -

Tourism in Manas is in infancy in tune with the objectives of Project Tiger and Wildlife Conservation, tourism will be allowed on a limited and regulated basis in the MTR. Manas will launch a full-fledged park interpretation programme.

The average annual tourist influx of last three year amounts to 20,000 of which almost all are nature and wildlife tourist. At times in a day, five to six thousand tourists visit the park during the months December to January on occasion of New Year.

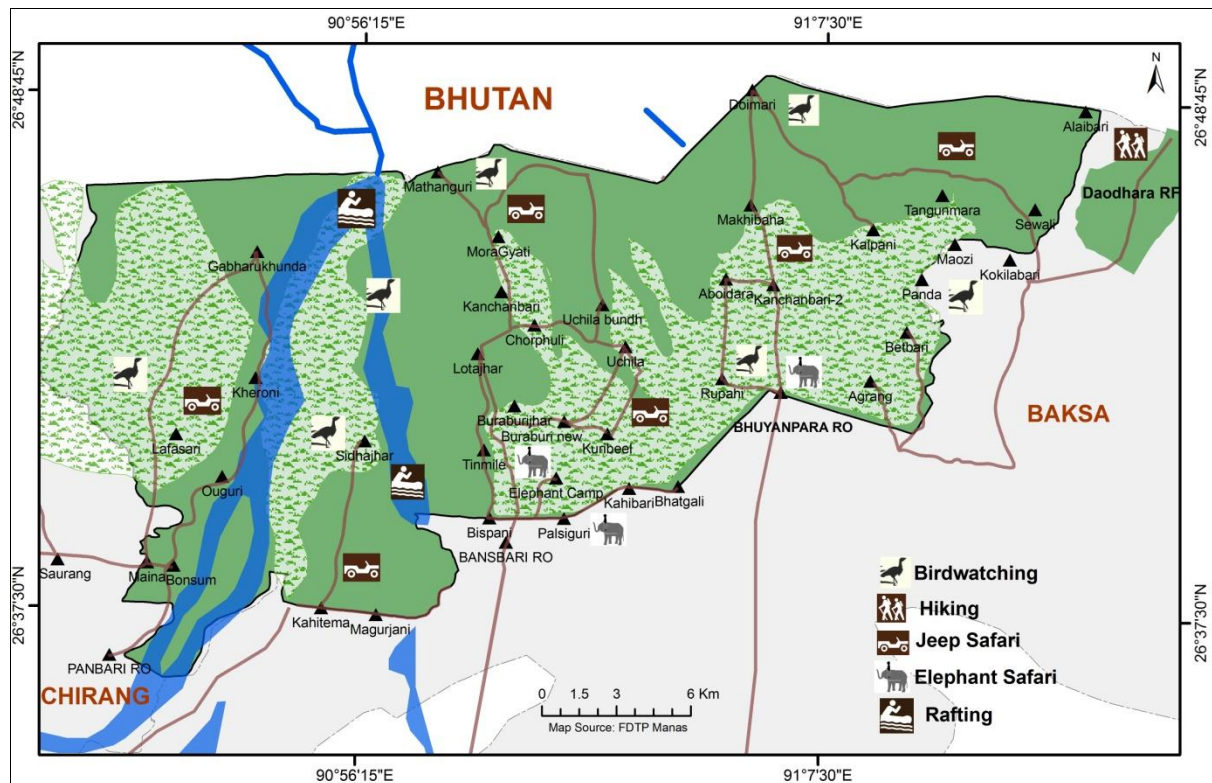
Apart from the limited departmental accommodation at Mathanguri boarding and lodging facilities of exist outside park initiated by local NGOs like Manas Maozigendri Ecotourism Society and Manas Ever Welfare Society. In a day, the total lodging facilities (Governmental/Non-Governmental) around Manas is about 100 persons.

The park has a set of rules for regulating the tourism. The Park Management provides elephants and route guides, apart from the interpretation facilities to the tourists at a nominal charge if and when the required infrastructure comes up. Entry on foot and night driving are prohibited inside the park. Only light vehicles will be allowed with a route guide.

There is an all weather motorable road from 2nd Gate, Bansbari till Panbang Civil Sub-Division in Bhutan via Mathanguri. This road which passes through the core area of

MNP, is open all the year round, since people from Panbang use this road to commute between Gelephu (Bhutan) and Barpetta Road (India) for their daily needs.

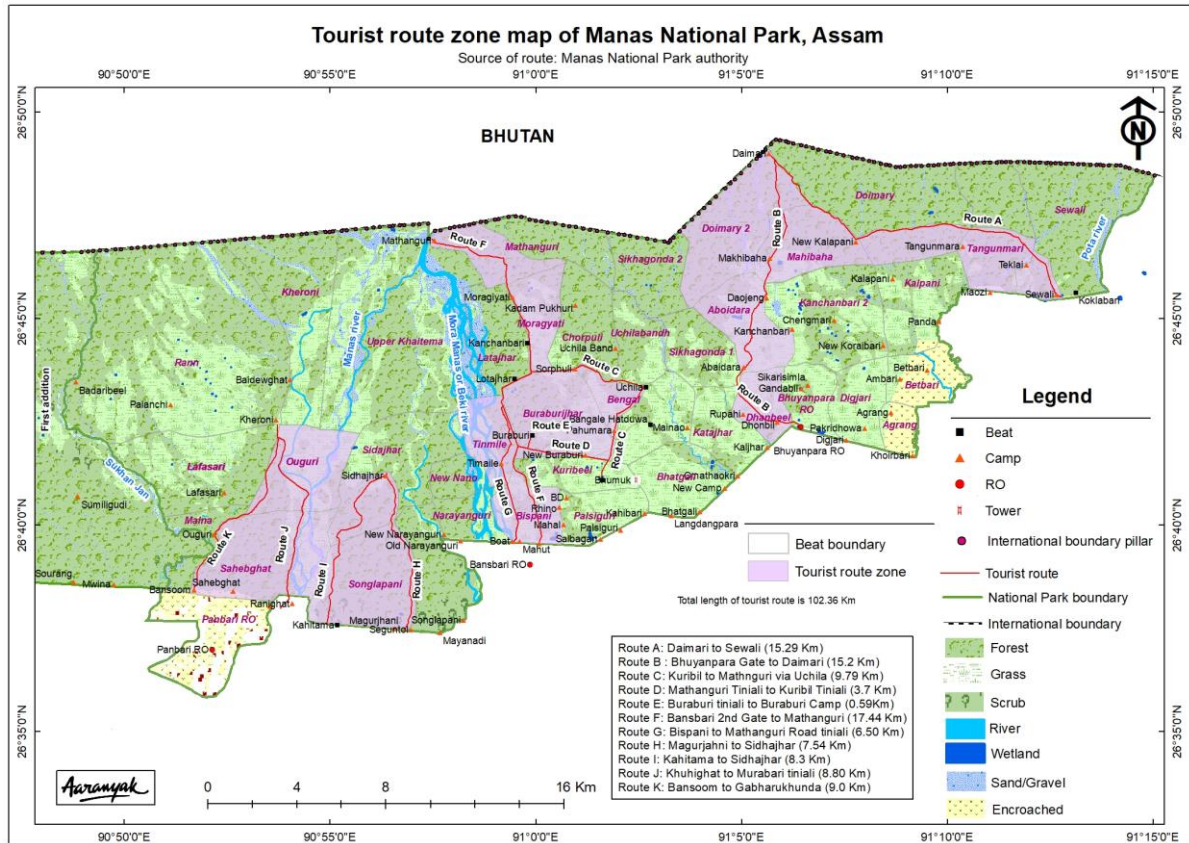
Fig 11.1. Tourism zone map of Manas National Park



- (a) **Administrative set-up:** - For the management of tourism there is no separate tourism range in MTR. The tourism will be looked after by the concerning Range officers and ACFs. There are very limited staffs for tourism regulation. At entry gates Foresters are posted for issuing tickets and checking the entry. Further some Foresters and Forest Guards will be deployed for the checking of tourist vehicles and Interpretation centre. One forester will be given responsibility to look after the booking for elephants ride. The gates will have Computerized Advance booking and Current booking system.
- (b) **Staff Requirement:** - There is an urgent need of Eco-Tourism officer, who will look after all Boarding, Lodging, Tourism operation, Interpretation and Tourism planning. The Eco-Tourism officer may be helped by one Eco-Tourism Range officer. At Each gate two foresters to issue tickets and regulate the tourist entry are essential. There should a squad of 5-6 Eco-Traffic personals, to look after guided movement of vehicles and tourists. One very knowledgeable person should be employed for Interpretation.
- (c) **Infra structure requirement:** - Following infrastructures are urgently required for the proper Eco-Tourism and Interpretation. Interpretation hall, Tourism Information Centre, low cost staying facilities, nature's shop for souvenir and outlet for host community

product, open air theatre, toilets, office of Interpretation officer and range officer are required for proper interpretation programme.

Fig 11.2. Carrying Capacity for Eco-Tourism as per NTCA Guidelines



- a) **Creation of Tourism Zone-** as per the Figure 11.2 above, tourism will be carried out in limited beat areas in Bansbari, Bhuyanpara and Panbari ranges and shall be extended to similar roads in Barnadi wildlife sanctuary area. The total tourism in core area consists of an area of 148 sq. km. which is less than 20% of the core area. Considering 850 sq. km. of MNP and 1st addition area, the total tourism zone would be 170 sq. km. Therefore, 22 sq. km. of area shall be added later as per feasibility and approachable roads within 1st addition area. The tourism zone is shown in the map. The size of Protected Area is very less, so the tourism should be restricted only to this area to minimize adverse impact of tourism on wildlife.

11.7. Need for Regulating the Tourism: -

At present the average annual tourist influx is around 20,000 mainly nature and wildlife tourism at present which may increase with the improvement of highways. Since the entire National Park is a core, which is visualised as a tranquil zone free from any disturbance whatsoever, it becomes essential to carve out separate tourist zones in buffer especially near both the entry points. In a phased manner, the infrastructural facilities need to be created at these points so as to keep the core undisturbed.

Estimation of visitor carrying capacity as per Guidelines for preparation of Tiger Conservation plan (issued by NTCA) is as following-

(a) Physical Carrying Capacity (PCC)

This is the "maximum number of visitor that can physically fit into a space, over a particular time". It is expressed as following –

$$PCC = A \times v/a \times Rf$$

Where A = Available area for public used

v/a = one visitor / M2

Rf = rotation factor (number of visitor per day)

In order to measure the PCC the following criteria must be taken into account: -

- Only vehicular movements on forest roads are permitted, hence road length is more relevant than area.
- "Standing area" is not relevant, but closeness between vehicles is important.
- There is a required distance of at least 500 m ($\frac{1}{2}$ km) between two vehicles to avoid dust (2 vehicles/km.)
- At least 3 hours are needed for a single park excursion.
- The PA is open for tourist for 9 months in a year and almost 9 hours per day.
- Linear road length (for tourists) = 107 km.

Opening period

$$\text{Rotation Factor (Rf)} = \frac{\text{Average time of one visit}}{\text{Opening period}}$$

$$9 \text{ hours} = 3 \text{ hours}$$

$$PCC = 107 \text{ km.} \times 2 \text{ vehicles/km.} \times 3$$

$$= 650 \text{ visits/day}$$

(b) Real Carrying Capacity (RCC)

RCC is the maximum permissible number of visits to a site, once the "reductive factors" (corrective) derived from particular characteristics of the biophysical, environmental, ecological, social and management variables.

$$RCC = PCC - Cf1 - Cf2 - \dots - Cfn$$

Where Cf is a corrective factor expressed as a percentage. Thus, the formula for calculation RCC is:

$$RCC = \frac{PCC \times 100 - Cf1}{100} \times \frac{100 - Cf2}{100} \times \dots \times \frac{100 - Cfn}{100}$$

Corrective factors are "site-specific", and are expressed in percentage as below :

$$Cf = \frac{M1}{Mt} \times 100$$

Mt

Where Cf = Corrective factor; M1 = limiting magnitude of the variable

Mt = total magnitude of the variable

(i) Road erosion:

Here the susceptibility of the site is taken into account.

$$\text{Total road length} = 125 \text{ km. (Mt)}$$

$$\text{Medium erosion risk} = 20 \text{ km. (weightage factor = 2)}$$

$$\text{High erosion risk} = 10 \text{ km. (weightage factor = 3)}$$

$$M1 = (20 \times 2) + (10 \times 3) = 40 + 30 = 70 \text{ km.}$$

$$Cfe = \frac{70}{125} \times 100 = 60 \%$$

(ii) Disturbance to Wildlife:

Here, species which are prone to disturbance owing to visitation are considered. The peak courtship activity for spotted deer lasts for three months before the onset of regular monsoon. As far as tigers are concerned, newborns are seen between March and May are also during the rains, hence an average value of two months in a year can be considered as the matter phase.

$$\text{Corrective Factor (Cf)} = \frac{\text{Limiting months/year} \times 100}{12 \text{ months/year}}$$

3

$$\text{Sambar, Chital} = \text{Cfw1} = \frac{\text{-----}}{9} \times 100 = 33.3\%$$

(3 months)

2

$$\text{Tiger} = \text{Cfw2} = \frac{\text{-----}}{9} \times 100 = 22.2 \%$$

(2 months)

Overall corrective factor for disturbance for wildlife in Manas National Park -
 $\text{Cfw} = \text{Cfw1} + \text{Cfw2} = 33.3 + 22.2 = 55.5 \% \text{ or } 55 \%$

(iii) Temporary closing of sites:

2 limiting week/year

$$\text{Cf1} = \frac{\text{-----}}{36 \text{ week/year}} \times 100 = 5.5\%$$

(iv) Computation of RCC:

$$\begin{aligned} \text{RCC} &= \text{PCC} \times \frac{100 - \text{Cfe}}{100} \times \frac{100 - \text{Cfw}}{100} \times \frac{100 - \text{Cf1}}{100} \\ &= 650 \times \frac{100 - 60}{100} \times \frac{100 - 55}{100} \times \frac{100 - 95}{100} \\ &= 650 \times 0.40 \times 0.45 \times 0.95 \\ &= 112 \text{ visit/day} \end{aligned}$$

(v) Effective Permissible Carrying Capacity:

The EPCC is the maximum number of visitors that a site can sustain, given the management capacity (MC) available. EPCC is obtained by multiplying the real carrying capacity (RCC) with the management capacity (MC). MC is defined as the sum of conditions that PA administration requires if it is to carry out the functions at the optimum level. Limitations in management like lack of staff and infrastructure limit the RCC.

For MTR owing to the paucity of staff the MC is around 40%

$$(\text{MC} = \text{Managerial Capacity} = 40 \%)$$

$$\text{Hence EPCC} = \text{RCC} \times \text{MC} = 112 \times 0.40 = 44.8 \text{ or } 45 \text{ vehicles/day}$$

With this background, the total ecotourism zone in the core shall be restricted to constitute around 20% of the core/ critical tiger habitat area, and shall encompass a total road length of approximately 100 km.

11.8. Implementation of Ecotourism Guidelines: -

For the proper regulation of tourism in nature Govt. of India has formulated Eco-tourism: Policy & Guidelines (2012).

a) **For the Park Management:** The following operational guidelines are proposed: -

- The eco-tourism planning shall be flexible, site-specific and participatory, and shall form part of a larger eco-development/ eco-regional plan for the area
- Assessment of existing infrastructure, surface transportation, air service, road, electricity, water supply, law and order situation
- The eco-tourism package shall invariably include:
 - Simple, adequate boarding and lodging facilities, in tune with the environment and the general setting of the landscape
 - Road network within the identified tourism zone
 - Self - guided Nature trails
 - Transportation options
 - Interpretive Centres
 - Way-side exhibits
 - Signages
 - Observation towers
 - Public conveniences
 - Garbage disposal facility
 - Living quarters for staff/personnel
 - Structures with an exotic look causing visual pollution and non-compatible and unaesthetic architecture should be avoided
- Site-specific micro - planning for community based eco-tourism.
- Temporary housing structures blending with the surrounding should be encouraged.
- Establishing building codes in regulations to ensure pollution free environment.
- Environmental, physical & social carrying capacities to limit the various developmental activities in the fringe area to be identified for eco-tourism.
- Mechanism to ensure continuous monitoring of adverse effects of tourism for quick redressal shall be devised.
- Recognize eco-tourism operators, provide incentives to deserving cases and award quality labels.
- Provide visitor information & interpretation services (bilingual) covering essential directions and instructions.
- Periodic training programmes on eco-tourism should be conducted for tourism administration, planners, operators and general public.

- Ensuring training programme to the host community in guide basics and hospitality management.
- To evolve and implement eco-tourism package in a few selected sites initially as pilot projects.

b) For Tour Operators/Developers: -

- To abide by the planning restrictions, codes and standards prescribed by the authorities
- Implementation of desired environmental principles through regulation
- Conducting EIA/environmental audits for new/ongoing eco-tourism projects
- Being sensitive to the conservation of endangered species & corridor value of the area
- To ensure construction of structures blending with the environment as per the prescribed building code
- To take into consideration the carrying capacity and sociological use-limits of the site while creating tourist facilities, and ensuring safety & convenience of tourists
- To use local material and design as far as possible, while avoiding over construction
- The planning, architectural design and construction of tourist facilities should use eco-friendly techniques viz., solar energy, recycling of garbage, harvesting of rain water, natural cross-ventilation instead of AC, self-sufficiency in food through kitchen garden & farming
- Energy & water saving devices shall be used apart from controlled sewage disposal
- Control of noise pollution, chemical pollution and air emissions
- Use of signages/boards as per the standard prescriptions in the code
- Reduced use of environmentally unfriendly items like asbestos, CIS, pesticides, inflammable material
- Respecting the historic and religious sites in the area
- Providing appropriate interpretive service to visitors for communication with nature & local culture
- Ensuring proper marketing of eco-tourism products
- Ensuring training of staff on environmental issues
- Ensuring safety and security of visitors
- Respecting local inhabitants, culture & involving them in various activities and vocations as far as possible

c) For the Visitors: -

- Abiding by the code of conduct, “Do's” & “Don'ts”

- Helping conservation, apart from protecting any site natural or cultural, which may be adversely affected by tourism
- Avoiding wastage of resources
- Avoiding littering & carrying back all non - degradable litter
- Leaving the camp sites clean before departing
- Avoiding removal of plants, seeds, drift - wood from the site
- Respecting local culture/customs
- Respecting holy places
- Strictly adhering to the safety precautions

d) For the Host Community: -

- Respect the value of environment and cultural heritage
- Avoid overusing the area
- Co-operate with the authorities in ensuring healthy eco-tourism
- Realize and react to the threat of investors who see opportunities and exploit the locals
- Be friendly with the visitors as effective “nature guides” & “conservationists”

11.9. Manas Tiger Reserve Interpretation Programme: -

Following interpretation programme will be implemented in Manas Tiger Reserve-

1. Interpretation Centre- An excellent interpretation centres will be established at Bansbari, Bhuyanapara.
2. Park safari
3. Elephant ride
4. Boating in Burasuti
5. Rafting in Beki
6. Natures trails
7. Publications – new brochures, post card etc. for MTR

11.10. Visitors’ Feedback & Action: -

The Management should also regularly monitor and evaluate the impact of tourism on the Core Zone, and visitors’ reactions to and feedback on tourism management. However uncomplimentary the remarks may sometimes seem, they help to minimize the shortcomings of the Management and improve upon its functioning. Visitors’ books kept at different forest rest houses, hutments, dormitory, and interpretation complex, letters, and emails should form a good basis for such evaluation. A visitor feedback form containing relevant points shall be prepared for getting feedback

If any provision/conditions of these guidelines is contravened in the core area of the Tiger Reserve by any person or organization, the same shall be liable of an offence under subsection (2) of 38-O of the Wildlife (Protection) Act, 1972.

5.	24/10/17	7-10 am	To Subash Chandra Sain M.S., NTCA, New Delhi
Visited Manas NP/TR on 22, 23 & 24 October, 2017. Visited Buraburi camp, Soodhan camp nearby Shukon boundary, Sorman through Sewalik camp and Mathangudi camps. Also visited along Beki/Manas river banks. Excellent landscape for rhino, elephant & tiger. Field staff are efficient and sincere. Discussed with EDC and forest guards/members from eight EDCs. They are quite enthusiastic due to excellent coordination from			Name & Address of Officer/visitors Also ~~also~~ interacted with Park Manager of Royal Manas National Park. ~~During~~ the Field Director Manas NP to interact with his counterpart of RMNP frequently for better coordination. His staff are very hard working & trying their best to improve the reserve. And their efforts are bearing fruit. Keep it up & I am certain this reserve will have tigers in perpetuity. We are proud of Manas TR. Wish all the best. Sain

2.	24.8.2017	18:30 hrs	D.P. BANIK, AL, IFS, I.G.F., NTCA Regional Office, Gtly email: dpnca.gtly@gmail.com / ageest-ntca@nic.in mobile +91 9678887103
Being IGF of NTCA, I had been visiting Manas TR for the last four years. The Park has gone through tumultuous times during which it had ~~been~~ been thrown from pinnacle in early 1980s to a Park which was given up by everybody. However, the wheel of time has now turned in favour of resurgence of Manas and there is sharp comeback in wildlife, mainly tiger. We have ~~more~~ a long road ahead to take Manas to its early 1980s level. Let's all pool our resources and align our efforts to make it happen.			The staff had been quite hospitable and willing to take up the task of re-building Manas 27/8/2017

CHAPTER TWELVE

MISCELLANEOUS ISSUES

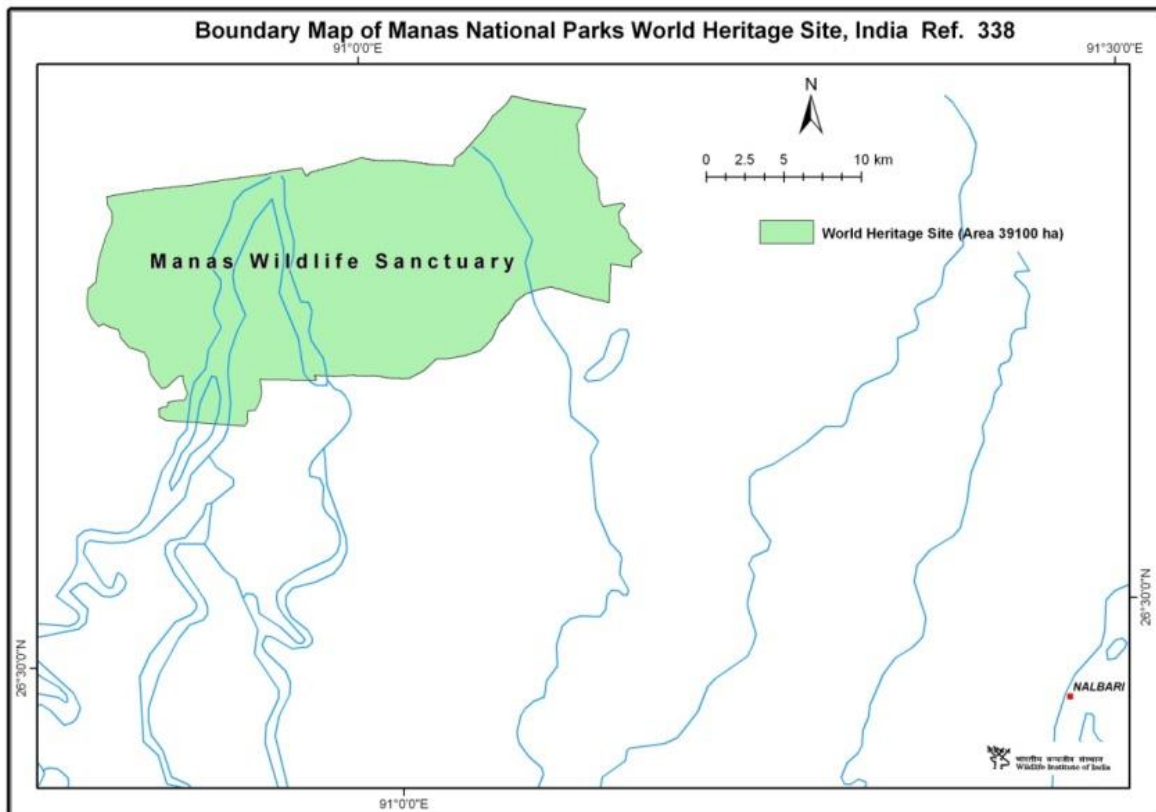
12.1. Other National and international designations: -

Besides being the core of Manas Tiger Reserve, Manas National Park has several national and international designations which must be acknowledged while formulating the Tiger Conservation Plan.

The most important other designation for MNP is being part of the UNESCO World Heritage Site. The Manas Wildlife Sanctuary was inscribed on the World Heritage List in 1985 under natural criteria (ii), (iii) and (iv), currently criteria (ix), (vii) and (x). The World Heritage Property provides critical and viable habitat for rarer and endangered species than any of the sub-continent in the Indian sub-continent, including 21 species listed in the IUCN Red Data book.

Manas WHS currently extends to an area of 360 sq. km. which also forms the core of the Protected Landscape (Map 1). The landscape also has several national designations such as National Park; Tiger Reserve; Biosphere Reserve; Elephant Reserve and Important Bird Area. Efforts are also on to propose and formally acknowledge the property as a Ramsar site for important wetlands and the single largest protected landscape for Bengal tigers and trans-boundary (Peace) Park in the world.

Figure 12.1: Boundary map of Manas World Heritage Site, India



12.2. Housekeeping of Departmental Elephants: -

A departmental 'Pilkhana' for trained elephants has been maintained in Bansbari Range. This Pilkhana at the moment maintains thirty-seven elephants. The females often mate with wild male elephants resulting in the increase of captive elephants. The surrounding is very natural and there is abundance of fodder and water in the close proximity of the Pilkhana. As elephants are kept together, the en-masse administration of various medicines and vaccination and physical check up etc. become easy.

A departmental elephant on duty should be relieved of its 'Gaddi' and 'Gadla' by 9.30 AM during hot season and by 10.00 O' clock during cold season and let lose into jungle. Otherwise gall formation will take place rendering the elephants unfit for duty for a long period. 'Gaddi' can be re-fixed around at 2 -30 to 3 - 00 PM of the same day. The Range Forest Officer, the Veterinary Assistant Surgeon and the Head Mahout must inspect the elephants three to four times in a week. The hygiene of Pilkhana should be of absolutely the highest order. Every elephant must have its own file containing relevant records and when it grows too old should be taken off duty and put under charge of a responsible Ghasi cum mahout for its care. Once a departmental female becomes pregnant she must also be treated similarly and her quota of green fodder and ration should be increased. Traditionally, from March - April onwards the departmental "koonkis" receive 5 Kg of gram while on duty; and half of that quantity while off duty. Supplements like vitamins and minerals should be provided as per prescription of the Veterinary Assistant Surgeon. During winter from October to February an elephant on duty traditionally receives 10 Kg of paddy on duty and 5 Kg during off duty. The parasitic infestations are very common. All the elephant should be de-wormed twice a year for both liver flukes and worms. At present medicines like 'Tolzan' and 'Panacur' have been extensively utilized for de - worming. Daily bath for a departmental elephant must be carried out as elaborately as possible in streams containing fresh and safe drinking water. The use of scrubbing brick call 'Jhama' is mandatory. Attention should also be given to the foot pad hygiene of the elephants, so that "Kari" does not form. Traditional medicines available should also be administered as another line of defence.

There is a regular Veterinary Assistant Surgeon, a Veterinary Field Assistant and Laboratory Attendant who take care of the captive elephants and wild animals including rescued animals Manas. In the recent years, the doctors and students from College of Veterinary Science, Khanapara, are visiting Manas almost regularly as a goodwill gesture and have been providing excellent services in maintenance of captive elephants and vaccination of livestock in the fringe villages. Because of this cooperation the number of captive elephants has increased from 23 in 2007 to 41 in 2018.

In the event of a Tusker or Makhna under musth, following precautions are to be taken-

1. On the onset the elephant should be engaged in heavy duty.
2. Rations should be reduced to keep the animal in a weak condition.

In slightly violent form, all the four legs should be tethered by chains and kept separately under guard. Administration of Hellabrun mixture can effectively control musth condition. Traditionally, administration of 1 to 1.5 Kg of garlic administered along with ration may obviate the very early stages. In some cases putting one clove each in the temporal glands ameliorate the condition in 'Pani-bhati' stage. The mahouts and the grass cutters are a class apart and on the other hand very few are concerned for their welfare. Their salary

should be increased and medically checked so that the elephants do not pick up communicable diseases.

Table: Status of Captive Elephants at Manas National Park (as on 31.05.2018)

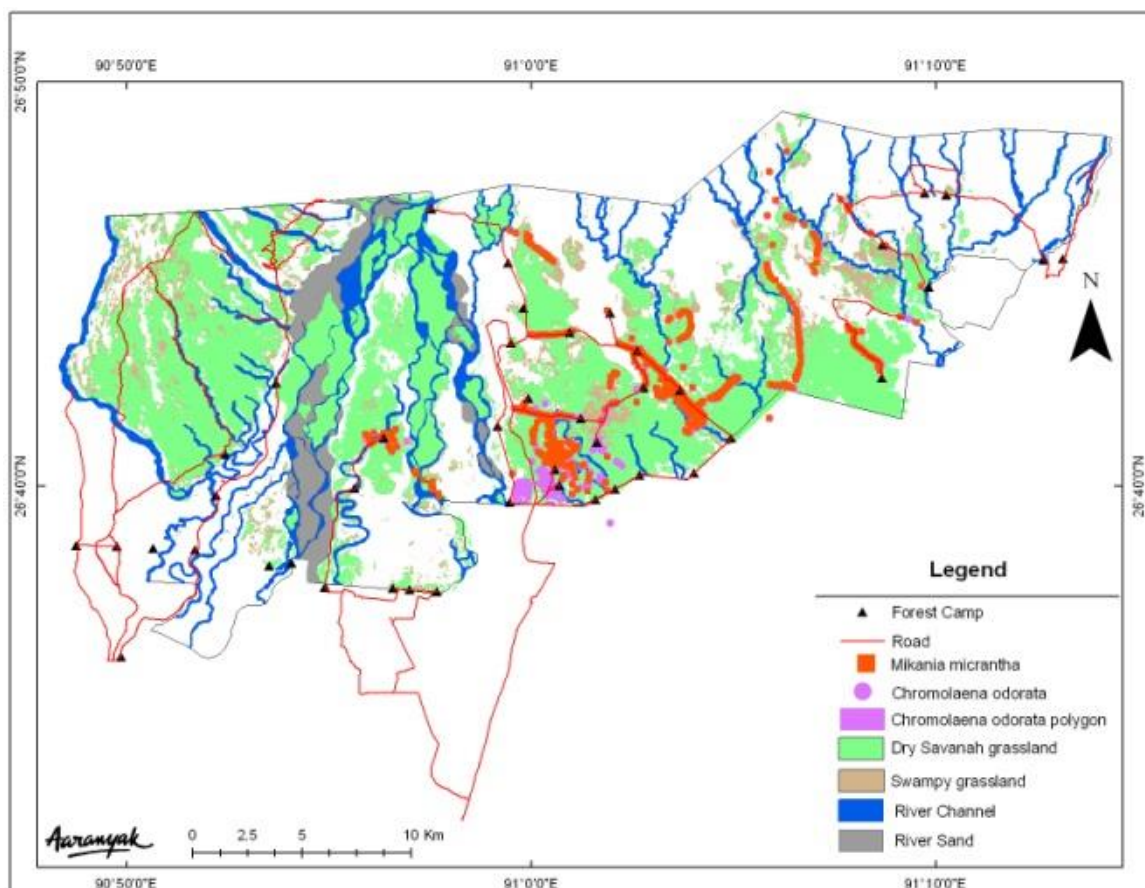
Sl. No.	Elephant Stud No.	Name of Elephant	Age/Date of birth	Sex	History/Source of Elephant	Microchip No.	Remarks
1	MNP3	Purnima	03/11/1963	Female	Captive born D/O Sundari	00064F11E3	
2	MNP4	Rukmini	01/06/1964	Female	Captive born , D/O Monimala	000659173B	
3	MNP5	Radhika	07/07/1969	Female	Captive born. D/O Monimala	0006590835	
4	MNP6	Normada	30/30/1973	Female	Captive born D/O Jamuna	0006585065	
5	MNP7	Urvasi	01/09/1975	Female	Captive born, D/O Sundori	000652B171	
6	MNP8	Pramila	1976	Female	Purchases	000647B803	Birth male calf 26/01/2018
7	MNP9	Usha	1976	Female	Captive born D/O Girimala	0006593AA2 27/11/2015	
8	MNP10	Sakuntala	01/03/1979	Female	Captive born, D/O Ratnamala	000CD643F	
9	MNP11	Menoka	03/03/1985	Female	Captive born D/O Purnima	000659168B	
10	MNP12	Manashi	02/02/1986	Female	Captive born, D/O Dalimi	0006591D14	
11	MNP13	Doimalu	28/02/1988	Male	Captive born S/O Jamuna	000659077A	
12	MNP14	Chameli	19/08/1990	Female	Captive born, D/O Manimala	0006591864	
13	MNP15	Jasoda	10/12/1997	Female	Captive born D/O Purnima	000647B49E	
14	MNP16	Meera	1998	Female	Captive born D/O Radhika	0005685604	
15	MNP17	Gaurishankar	03/01/1999	Male	From Orang NP	00065897A3	
16	MNP18	Ramu	01/07/2001	Male	Rescued on 2001	00064F1305	
17	MNP19	Panchali	15/06/2002	Female	Captive born D/O Jamuna	0006585473	
18	MNP20	Mridula	25/10/2002	Female	Captive born D/O Radhika	0006590835	
19	MNP22	Panimala	30/11/2002	Female	Captive born, D/O Purnima	000658560B	
20	MNP23	Ganga	15/04/2004	Female	Rescued 2004	00065853CC	
21	MNP25	Mahon	Rescued	Male	WTI	0006CDCE67	
22	MNP26	Pinku	Rescued	Male	WTI	0006CDED3 27/11/2015	
23	MNP28	Lakhi	DOB 2008	Male	S/O Purnima	00064F1E3	
24	MNP29	Swarasati	DOB 2008	Female	Captive born S/O Manashi	0006590F2A	
25	MNP31	Dada	20/10/2010	Male	Captive born S/O Meera	0006CD5162	
26	MNP32	Rabi Prasad	07/12/2010	Male	Captive born S/O Narmada	0006CD25B	

27	MNP33	Kartik	27/04/2012	Male	Captive born S/O Sakuntala	0006CDE54C	
28	MNP34	Protima	Age on Oct 2012,5 Yrs.	Female	FromState Zoo 25/10/2012	0006CDC166	
29	MNP36	Boloram	31/12/2012	Male	Captive born S/O Panchali	0006CD4316	Training 07/12/2017
30	MNP37	Leela	25/02/2013	Female	Captive born D/O Rukmini	0006CDCCF7 29/11/2015	Training 07/12/2017
31	MNP38	Daiboki	09/04/2013	Female	Captive born D/O Purnima	0006CB134 29/11/2015	Training 07/12/2017
32	MNP39	Munish	31/07/2013	Male	Captive born S/O Manashi	0006CD4C8E 29/11/2015	Training 07/12/2017
33	MNP40	Bhaiti	17/12/2013	Male	Captive born S/O Meera	0006CDAA39	
34	MNP41	Narendra	26/05/2014	Male	Captive born S/O Sakuntala	0006CDAC38	
35	MNP42	Pandid	29/11/2014	Male	Captive born S/O Panimala		
36	MNP43	Rashmi	24/12/ 2015	Female	D/O Radhika		
37	MNP44	Madhumala	31/08/2016	Female	D/O Usha		
38	MNP45	Maidangsri	05/02/2017	Female	D/OMeera		
39	MNP45	Tora	WTI/CWRC	Female	Rescue by WTI		Training 07/12/2017
40	MNP46	Iragdao	26/01/2018	Male	S/O Pramila		
41	MNP47	Manalisha	31/10/2018	Female	S/O Chameli		



12.3 Removal of Invasive species: - The prime grassland habitat in Manas is currently facing the onslaught of alien invasive species (weeds) that have increased in extent due to several anthropogenic factors such as increase in livestock grazing, human movement and dispersal, uncontrolled fires etc (Fig 13.1). Invasive species have been observed where ever disturbances like grazing and creation of opening in grassland for roads, camps, boma etc (Lahkar et.al, 2011). It has been observed that *Chromolaena odorata* invasion is greater in a stretch of 2–4 km along the southern boundary of the Park. Invasive weeds have spread to the southern boundary, replacing in situ vegetation that has been destroyed due to biotic pressures including livestock grazing. *Chromolaena odorata* is spreading very fast in the grasslands of Manas, where the authorities face enormous challenges to eradicate it. In addition to *Chromolaena*, the spread of *Mikania* in Manas NP grasslands is alarming. The *Mikania* invasion is observed more in riverine grassland patches and on the edge of forest patches. Invasive species have been changing the structure and function of grasslands in Manas NP. This may reduce the amount of habitat suitable for the reintroduction of rhinos, as outlined in IRV-2020.

Fig 12.1: Distribution of key invasive species in Manas National Park (2014)



The main strategy to eradicate invasive should be to set up a surveillance system to monitor new invasive species in the park and also to monitor spread of existing species. Priority wise, invaded area should be restored by removing invasive species. Few experiments plots should be established to find out best practices. Livestock grazing should also be completely stopped, as it is a major driver of spreading invasives.

12.4 Improving Water bodies: - Rhino needs water bodies both for drinking and wallowing. They preferred muddy water body for wallowing to protect themselves from ectoparasites and for rapid healing of their body injuries. Large stagnant water bodies are absent in Manas but there are some small perennial water bodies here and there towards northern sides locally called as pukhuri and beel where according to field forest staff rhinos wallowed earlier. In the Terai region towards southern boundary there are muddy areas and perennial streams where rhinos wallow. According to the field staff during flood period rhinos moved to the northern highland and during winter and summer they stayed at southern Terai region (Fig 13.2, 13.3. and 13.4). During flood period at the high land of Northern side short grasses and forbs eaten by the rhino covers the forest floor and they preferred to stay there due to availability food and water bodies. A good numbers of river system works throughout the Park. All the rivers, streams, nallas forming the drainage of the valley confluence with the river Brahmaputra flowing at the south. Rivers and streams flow from north to south. In the bhabar areas most of the rivers, streams, nalla excepting perennial ones, Manas, Hakuwa, Beki, Paglladia dried up during winter and dry seasons. But, these same rivers filled up with water in the north and regular flow in the terrain region.

12.5 Stray and Man-animal conflict management: -

In case of wild-to-wild reintroduced Rhinos, there were several instances of straying outside the Park in the initial years. This was possibly due to the fact that adult rhinos were trying to establish their territory in the new area. Few individuals strayed outside into adjacent paddy fields as well as cultivable lands and depredated crops. During January-April, 2012 there were 3 major stray incidents wherein one person was killed when he got himself very close to rhino in spite of forest personal warning him against it. Rhino stray incidences gradually came down by the year 2013, although as a precautionary measure, one crate with accessories and limited quantity of tranquilizing drugs are kept under the supervision of the Forest Veterinary Officer (FVO) for any emergency use. Certain Rhinos along with elephants also reported to stray and raid crops in the fringe areas. As evident from Fig 13.5 and Fig 13.6, the Rhino-Human conflict is highest along the southern boundary in Bansbari and Bhuyanpara Ranges. Erection of solar fencing, community watchtowers and driving rhinos inside are some of the mitigation measures that may be tested.

12.6 Disease monitoring: -

A master's dissertation study in 2013 (Phukon, 2013) focused on re-introduced population of Greater One-horned Rhinoceros (*Rhinoceros unicornis*) and their sharing of habitat with livestock in Bansbari Range of Manas National Park. It was hypothesised that the interaction of rhinos with livestock has potential to contract diseases from the livestock population, and therefore the diversity and magnitude of disease prevalence in livestock is likely to pose serious threat to the rhinos. The study quantified disease distribution pattern and commonality between livestock and rhino population and map disease gradient in MNP during the period (Jan-April, 2013). The study established wide prevalence of disease in the livestock. Given that the Zone of Influence of livestock in MNP includes home range of rhinos, it indicated that the rhino population is likely to be under disease risk and conservation efforts needs to incorporate disease perspective for recovery efforts and long-term viability of rhinos in MNP (Fig 13.7).

Fig 12.5: Human-animal conflict in Manas National Park (2011)

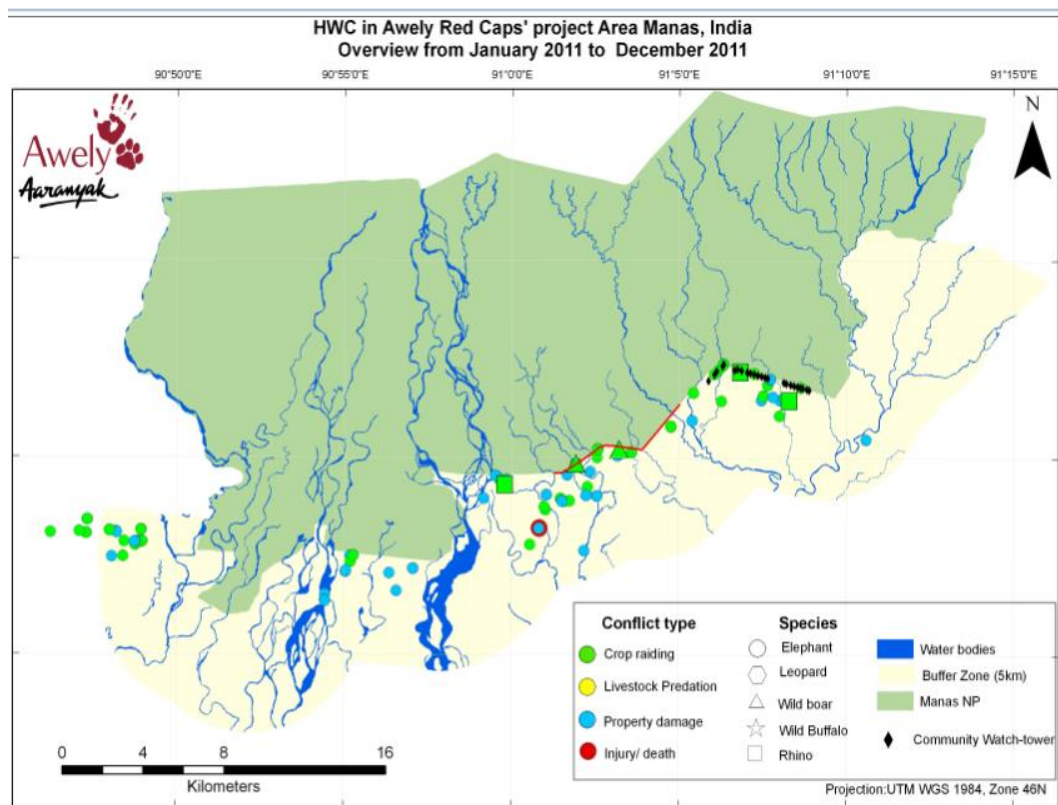


Fig 12.6: Human-animal conflict in Manas National Park (2012)

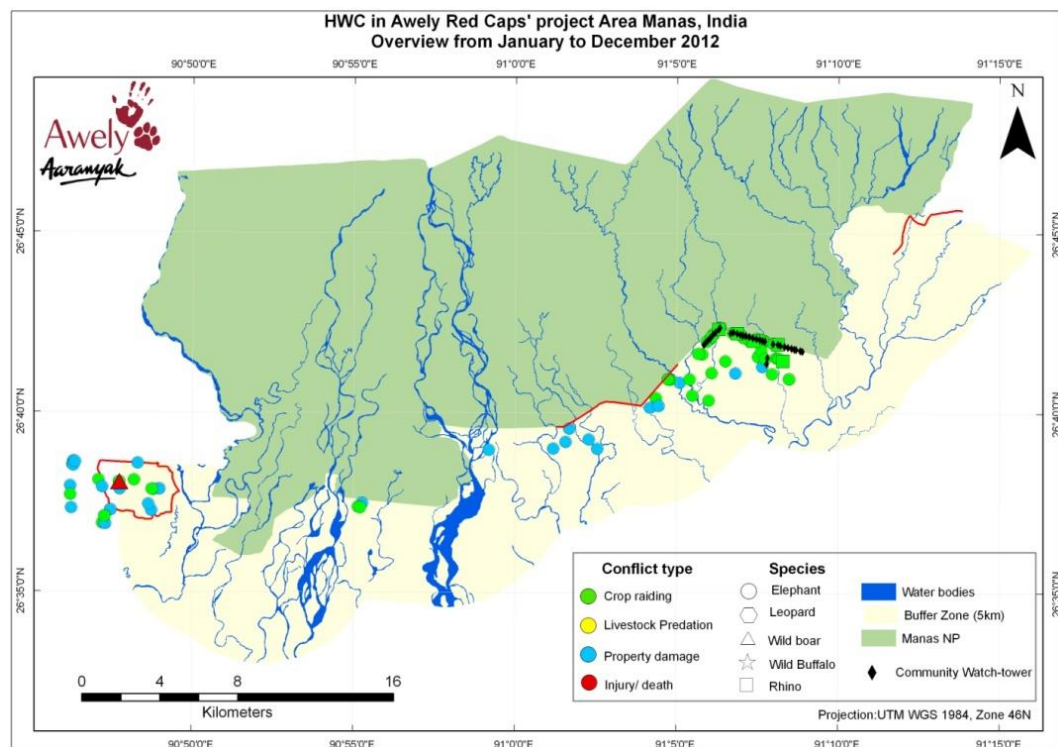
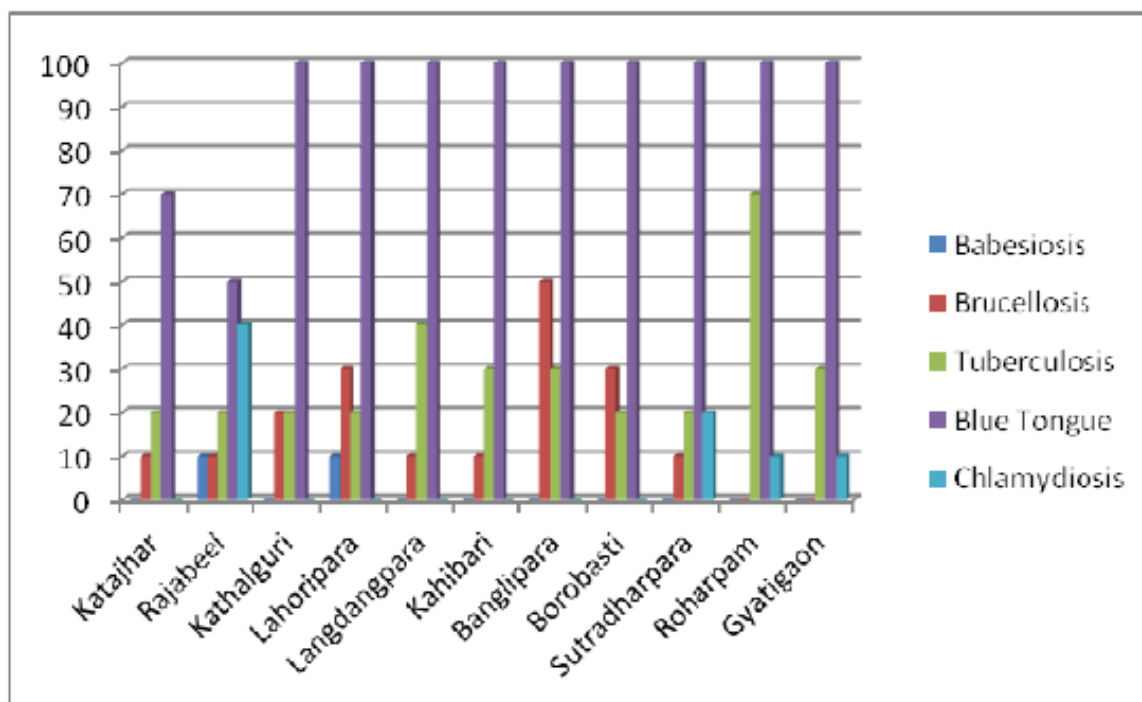


Fig 12.7: Percentage of infectious diseases in fringe villages of Bansbari Range, Manas NP (ref: Phukon, 2013).



The major intervention required includes a well planned disease surveillance and management programme, ensuring proper scientific management of livestock and restricting movement of livestock inside the park through proper checks at entry points. Efforts should be focused on villages showing high Index of threat, viz. Katajhar and Rajabeel, while executing any management interventions including veterinary care.

12.7. Anti-poaching strategies: -

Within Manas National Park, new challenges such as grassland habitat management, expanding peri-urban infrastructure along the southern boundary, trans-boundary vehicular traffic, poaching, instances of insurgency and illegal wildlife trade remain to be completely addressed. Holistically, MTR landscape needs to be managed as a trans-boundary entity with international cooperation with the Government of Bhutan. Some of the good practices that have been initiated and need mainstreaming and institutional continuity in managing Manas National Park have been the involvement of local communities, especially unemployed youth for joint protection of forests and eco-tourism initiatives. Similarly, rebuilding park infrastructure, multi-stakeholder partnership towards scientific management of tiger populations and rhino reintroduction since 2008, has contributed significantly towards rapid revival of the Park.

The need to have a unified command for the core and buffer combined with proposed up-gradation of certain good quality (> 40% canopy cover) forest areas such as Ripu-Chirang and Manas RF (part) into wildlife sanctuaries will be necessary for the increasing wildlife population from the core (in Manas National Park and Barnadi Wildlife Sanctuary) in the long run. Rapid expansion of agriculture and settlement areas along the southern boundary, increasing human-animal conflict and expansion of border towns have also contributed to

forest fragmentation and disruption of animal corridors have been some of the challenges in the buffer areas of MTR.

12.7.1. Poaching of Rhinos-an assessment: -

Rhino conservation initiatives at Manas NP under IRV-2020 gave major setback when 7 adult rhinos and 1 sub adult male rhino were poached within the period of the three year (2011 to 2014). Adult male (Rhino 1) was poached in the October, 2011. Adult female (Rhino12) was poached 23 May 2012, adult male (Rhino2) was poached in the month of January, 2013 and Adult Female (Rhino-17) was poached on 3rd April, 2013. Sub adult male Rhino-16 was poached on 16 August, 2013. Adult female Rhino-10 was poached at Chengmarijhar area of Bhuyanpara range on 29th October, 2013. On 31st December, 2013 another adult female Rhino-8 was poached at Charfuli areas of Bansbari range. In the year 2013 altogether 7 rhinos were killed by poachers. During this year one adult male Rhino-5 was poached in the month of November. Among the 7 poached rhinos 3 adult females have gave birth calves at Manas (Table 13.5).

Mortality and Birth of Wild-to Wild Translocation & Rescue-and-Rehabilitation of Rhino in Manas National Park

Year	No. of Rhino Death	Cause of Death	No. of Rhino Birth
2008	1	Natural	-
2011	1	Poaching	-
2012	1	Poaching	1
2013	5	Poaching	9
2014	1	Poaching	1
2015	1	Natural	3
2016	2	Poaching	-
	2	Natural	
2017	-	-	3
2018	1	Natural	3
2019	1	Natural	1
Total =	16		21

12.7.2. Rhino protection Strategies: -

The last security assessment had been undertaken for the Park by the IRV-2020 Security assessment team in June, 2012 (Swargowary et.al., 2012) and there is a need to conduct this again in the light of new poaching and encroachment threats to prime Rhino Habitat. Two High-level security committees have also been formed by the State government and it is important that a consolidated anti-poaching strategy be adopted for the Park. Details

of the integrative strategy and the road map for the next ten years have also been discussed in the next section.

While, several emergency measures have been rolled out by the authorities to deal with the serious poaching issue and a series of high-level security meetings were held to ensure greater coordination between the Forest Department, the Civil Administration and the Police Establishment. Seven suspected people have also been arrested for alleged involvement in the criminal offence and one intruder in the National Park was also killed in an encounter with forest guards.

Significant steps by the Manas National Park authorities with the goal of improving the protection mechanism include establishment and improvement of infrastructure (anti-poaching camps, road bridges, communication equipment), intensified patrolling, engagement of additional personnel for enforcement, filling-up of vacant positions, capacity building of frontline forest staff and local community engagement through eco-development and eco-tourism activities. The details of the same have been described in the following pages. For monitoring purposes, M-STripes is placed since May, 2019.

Poaching- Name of the Rhino, and date with sex: -

Sl. No.	Name of Rhino	Sex	Date of Death	Cause of Death
	WTI			
1	Rhino- 1	Male	14 th October, 2011	Poaching
2	Rhino- 12	Female	22 nd May, 2012	Poaching
3	Rhino- 2	Male	13 th January, 2013	Poaching
4	Rhino- 17	Female	2 nd April, 2013	Poaching
5	Rhino- 16	Male	6 th August, 2013	Poaching
6	Rhino- 10	Female	29 th October, 2013	Poaching
7	Rhino- 8	Female	31 st December, 2013	Poaching
8	Rhino- 5	Male	1 st November, 2014	Poaching
9	Rhino-10 (A)	Male	5 th May, 2016	Poaching
10	Rhino- 4	Female	28 th August 2016	Poaching

Natural death- Date, name & sex:-

Sl. No.	Name of Rhino	Sex	Date of Death	Cause of Death
1	Rhino (WTI)	Female	31 st May, 2008	Natural
2	Gopal	Male	9 th July, 2015	Natural
3	Daimalu	US	22 nd April, 2016	Natural
4	Mainao	Female	29 th July' 2016	Natural
5	Rehabilitates Female Rhino	Female	29 th October, 2018	Natural
6	Rehabilitates Female Rhino	Female	3 rd February, 2019	Natural

Table 12.5 : Summary of poaching of Reintroduced rhinos in Manas National Park

Sl. No.	Name	likely cause/arm used/remarks	Sex	Approx Age	Date of Poaching/ Detection	Location	Range
1	Rhino- 1	Probably bullet injury, carcass badly decayed,	M	10	1.10.2011	Sikagonda	Bhuyanpara
2	Rhino- 12	Gun shots wounds about 0.5cm diameter over right eye, right forearm, right shoulder, left shoulder and lower mandible, horn, nail and meat removed.	F	10	22.05.2012	Chengmarijhar	Bhuyanpara
3	Rhino- 2	Gun shots wounds about 0.5cm diameter over neck left arm, left shoulder and forehead noticed, horn meat and nail removed	M	7	13.01.2013	Daokabaha (Bhatghali)	Bansbari
4	Rhino- 17	Gun shots wounds about 0.5cm diameter size over right chest region just behind the shoulder joints, horn, nail, tail removed	F	12	02.04. 2013	Sidhajhar	Kahitema
5	Rhino- 16	Single bullet above chest, 0.315 bullet suspected; meat etc recovered from suspected poacher	M	8	06.08.2013	Kuchiabeel (Bhatgali)	Bansbari
6	Rhino- 10	Three bullets 0.303, Gajimara. Bullet and weapon recovered. One suspected poacher killed.	F	12	29.10.2013	Kochubari (Betbari)	Bhuyanpara
7	Rhino- 8	Bullets from AK47 suspected	F	9	31.12.2013	Chorpuli	Bansbari
8	Rhino- 5	Bullets from AK47 suspected	M	12	01.11.2014	Dawjeng (Kanchanbari)	Bhuyanpara
9	Rhino-10 (A)	Probably bullet injury, Nosel cutting found & horn removed	M	3	05.05.2016	Panda Area	Bhuyanpara
10	Rhino- 4	Suspected to poacher. Nasel bone found cutting & horn removed.	F	10	28.08. 2016	Sidhajhar Area	Kahitama

12.7.3. Strategic planning and enforcement of Law Enforcement Mechanism (LEMs)-M-STrIPES :-

The M-STrIPES is designed to improve anti-poaching efforts and overall law enforcement effectiveness in established conservation areas. The computer and GPS aides tools makes it possible to collect, store and evaluate data on patrol efforts (e.g. time spent on patrols, areas visited and distances covered), patrol results (e.g. snares removed, arrests made) and threat-levels. When effectively used to create and sustain information flows between frontline staff, analysts and conservation managers, the M-STrIPES approach can help to substantially improve protection of wildlife and their habitats.

12.7.4. Combating encroachment in Rhino-bearing areas (Bhuyanpara): -

The Manas NP has two identified encroachments viz. – Panbari (south) and Betbari under Bhuyanpara Ranges. These encroachments have not happened overnight and trace their origin to the insurgency period in 1990s.

In case of Bhuyanpara, it is stated that while there have been new clearings in the grassland area of the (Agrang-Betbari) area of Bhuyanpara Range, but these are not of permanent nature and there is no human settlement inside the clearing areas. This illegal cultivation encroachment is not a new issue and has been a feature for over a decade. The easternmost boundary next to Betbari camp is adjacent to the Kokilabari Agricultural Farm (approx 9 sq. km.) with only a small rivulet separating the two. The seed farm was until recently on a 30 years lease from the forest department. At the end of 2005-06, the seed farm was formally handed over to the Agriculture department, Govt. of BTC. This farm supports people from at least 57 villages who take a small portion of the land on lease from the department every year. At the same time, certain miscreants take advantage of the heterogeneity of the community and also indulge in illegal cultivation on the disputed side. The park authorities remain vigilant and use vigilant and use both conservation volunteers and armed guards to monitor and control this menace.

To keep the sanctity of the National Park and a world heritage site, the entire park area should be cleared from the existing encroachers and enforcement should be in place to prevent any further encroachment. The total encroachment area estimated within the above mentioned locations of the national park is about 15 km². Sporadic illegal activities are also at times reported from different parts of the park and the area with the highest problem is the Kahitema area in between the rivers Beki and Manas. This is mainly because of inaccessibility of the area. It is essential to stop all forms of illegalities affecting the park. The Government of Assam and Bodoland Territorial Council should come ahead to solve this key issue to maintain the sanctum of the World Heritage Site.

12.7.5. Combating encroachment in Panbari: -

1600 hectares of land in Kahitema Reserve Forest under Panbari range was encroached by about 905 Bodo families with 4500 populations in 1991. Though evicted three times (1994, 1995, and 2002) these encroachers have re-encroached the same area. The last eviction operation was carried out in 2002 in compliance of order of Hon'ble Supreme Court. However, the settlers had re-encroached the area and the compensatory package as provided by NTCA for resettlement of the original inhabitants (if any) has also been unutilised. At

present developmental activities such as roads, schools and electricity has also been provided by the civil administration to the encroachers. A reconsolidation of the boundary line by taking a pragmatic approach and political-breakthrough in removal of the settlers shall be required.

12.8. Conservation action and road map ahead:

12.8.1. Aiming for Zero Poaching: -

As is evident from the previous pages that Poaching of rhinos is the single largest impeding factor that has negatively impacted the overall conservation of Rhinos in the Park. The need to supplement the existing population with adult breeding male Rhinos for population stabilization and aiming for zero poaching is therefore the immediate action point suggested for the next two years.

Combating encroachment in Bhuyanpara (Short-term Plan): -

The encroachment in Bhuyanpara is currently on a standstill and since there are no permanent settlements a massive eviction drive with support from the District Administration is most urgently needed. The following timeline of action are therefore proposed: -

- Dec, 2014: - serving of eviction notice and eviction operation with support and coordinated action with Forest department, Baksa District administration, Police and Army.
- Dec, 2014 - Jan, 2015: - area domination will be required with support of additional manpower (with arms) support for atleast 50 staff to camp in the area. The camps at Khoirbari, Agrang, Panda, Betbari, Maozi and Tangunmara can accordingly be strengthened with the additional forces for the winter season.
- Jan-Feb, 2015: - A trench along with a solar fence and boundary pillars can be erected at the disputed site so as to permanently repossess the area. The support of three local NGOs (Manas Bhuyanpara eco-tourism Society, Manas Agrang Society and Manas Maozegendri Ecotourism Society) along with the concerned village headmen will be crucial for the success of the eviction operation.
- Dec 2016: Betbari area: Eviction drive was carried out twice with the help of district administration. However, due to lack of proper planning as well as political backlash the drive was not successful.

12.8.2. Combating encroachment in Bhuyanpara (Long-term Plan): -

It has been observed that the encroachment at Bhuyanpara is a recurring problem that has been impacting the park since the declaration of the National Park in 1990. The disputed territories in Agrang Forest village and adjoining areas have been a bone of contention, especially since it is an area for prime grasslands/agricultural area. the socio-political situation including the presence of militant outfits in the vicinity of the Park, unauthorized and illegal possession of weapons by civilians and the prevalence of country-made fire arms have also been some of the factors that have led to 'land mafia-backed' encroachment inside

the Park. As already stated, the current encroachment is not of a permanent nature and the people from atleast 30 villages from nearby areas participate in clearing and cultivating small portions of forest land. Such encroachment is often backed and controlled by armed miscreants who have been identified and the information shared with intelligence authorities. A reconciliatory attempt to talk to the encroachers and come up with an amicable solution was also attempted by the Park authorities in 2011 with support of the local NGOs. Boundary pillars had been erected and the area of actual demarcation was also agreed upon. Similarly, in April 2014, eviction notices were served and conservation volunteers from Panbari, Bansbari and Kahitema area were deployed in greater numbers to prevent any further encroachment.

All the actions as mentioned above indicate that a multi-pronged comprehensive long-term strategy (atleast five years) is required for targeting the encroachers. The tentative timeline is proposed below: -

- Jan-Feb, 2015: - Eviction of encroachers, after the paddy cultivation season is over and to ensure that no further clearing in the grassland/forest is made. All access to forest, including grazing of livestock, collection of firewood and minor forest produce, fishing and hunting to be strictly banned and the law enforced through strictest of measures. Bringing in new forest staff and rotation of existing staff to other areas will be helpful. Any added incentive such as provisioning for rations, vehicle and elephants for patrolling, wireless sets for communication and provisioning of winter gear will most certainly boost the morale of the existing staff.
- Feb, 2015: - Deployment of Eco-Task Force (Two Companies) currently based out of Kokrajhar, BTC for systematic area domination and undertaking plantation in the adjoining Daodhara and Batabari RF areas. Daodhara RF is part of the Critical Tiger Habitat and also an important elephant corridor for migratory elephant. Currently, Daodhara and Batabari RF are also facing an onslaught of clearing and illegal removal of trees. There is a tremendous potential to create large-scale plantations through the Eco-Task Force in both these RF areas. The advantage of bringing in the ETF is that they are trained army personnel and that their large numbers (two companies) will ensure area domination against the armed miscreants that support encroachers. Grassland improvement including maintenance of forest roads and creation of artificial waterholes etc are some of the additional tasks that can be handed over the Eco-Task Force in the National Park. The Task force can be based out of Kokilabari and Agrang Camps so that no further encroachment occurs in the area. The modalities for providing housing to the Eco-Task Force, the salaries, nurseries for plantation etc must be worked out in coordination with the District and Territorial Division.
- March, 2015 - Aug, 2020: - A systematic plan for creating nursery and plantations in the RF areas and complete closure of the National park to any anthropogenic pressures will ensure complete revival of the habitat and therefore the return of the Rhinos and mega herbivores.

12.8.3. Community engagement and public awareness: -

A total of 64 forest fringe villages have been identified that are in the immediate vicinity of the Park. Manas Forest Development agency has been registered and Eco-

development activities need to be initiated that instill a sense of pride and ownership among the local communities. The local NGOs, fringe communities and the youth bodies around the national park are supportive towards conservation and this has helped the park to revive. For a better understanding of the community linkage discussion was held with members from the local NGOs like Manas Maozigendri Ecotourism Society, Manas Agrang Society, Manas Bhuyapara Conservation & Eco-Tourism Society, Manas Ever Welfare Society and Panbari Manas National Park Protection & Eco-Tourism Society. It has been observed that almost every local NGO have a large number of members and a lot of them are engaged in supporting the park staff, this is healthy if used with care, however it has been learnt that the NGOs cannot sustain their large membership and often some of the guys leave the organization for other works and are not monitored. This leads to a risk of exposure of vital park information leading to complications in the anti-poaching measures. A large number of youths from the fringe villages of Manas are engaged as conservation volunteers and this is aiding building relationship and ensuring community goodwill to some extent. Some of these youths also understand that IRV-2020 is offering them a livelihood and this is helping to spread a good message.

It is also learnt that a regular community reach-out program has been organized since 2008 under the IRV-2020 program by the WWF team and almost all the villages and schools in the fringe of Basbari has been covered. It is also learnt that limited livelihood support program for the fringe community has also been extended under IRV-2020, the Government biodiversity program as well as through some other programs run by NGOs like ATREE, Aaranyak and WTI. It is very important that the community out-reach programs are continued and areas under Bhuyapara and Panbari are also extensively covered to spread the message of conservation. Further it is necessary that livelihood support programs are initiated and systematically implemented to sustain the goodwill and support of the fringe community for long term conservation success in the park.

12.8.4. Enhanced Intelligence Network and LEMs: -

The support from the local community and help from the ex-poachers has built up the possibility of setting up an intelligence network in and around Manas National Park. A functional and effective intelligence network is very essential to minimize wildlife crime in any protected area which has wildlife like rhinos, tigers and elephants. At present it is not clear if any proper intelligent network exists in the park but efforts should be made to immediately form a working network that support the park authorities that can help in enhancing the protection for the rhinos and other wildlife.

CHAPTER THIRTEEN

ORGANIZATION, ADMINISTRATION AND BUDGET

13.1. Tiger Steering Committee: -

The Wildlife (Protection) Amendment Act, 2006 (Section 38 U) provides for constitution of a Steering Committee as follows: -

The State Government may constitute a Steering Committee for ensuring co-ordination, monitoring, protection and conservation of tiger, co-predators and prey animals within the tiger range states.

The Steering Committee shall consist of: -

- (b) The Chief Minister- Chairperson;
- (c) Minister-in-charge of wildlife- Vice-Chairperson;
- (d) such number of official members not exceeding five including at least two field Directors of tiger Reserve or Director of National Park and one from the State Government's Departments dealing with tribal affairs;
- (e) Three experts or professionals having qualifications and experience in conservation of wildlife of which at least one shall be from the field of tribal development;
- (f) Two members from the State's Tribal Advisory Council;
- (g) One representative each from State Government's Departments dealing with Panchayati Raj and Social Justice and Empowerment;
- (h) Chief Wildlife Warden of the State shall be the Member-Secretary, ex officio, to be notified by the State Government, in the Official Gazette.

The steering committee has not been constituted but is under process.

13.2. Tiger Conservation Foundation: -

The Wild Life (Protection) Amendment Act, 2006 (Section 38X) provides for establishment of a Tiger Conservation Foundation (TCF) in each tiger reserve, in order to facilitate and support management for conservation tiger and biodiversity, apart from taking initiatives for involving people in conservation. The Foundation is a new institutional framework which can complement the tiger reserve management and liaison with various eco development committees and their confederations apart from production sectors in the landscape. The Foundation should be registered under the relevant rules of the State as a Trust, and as prescribed in the guidelines, will have a State Level Governing Body, apart from a field level executive committee under the Chairmanship of the Field Director with representatives of the ecodevelopment committees as nominated by the Governing Body. The Foundation would act as a "non profit center" and as a "development agency" by increasing

local participation. It can secure the tiger reserve from financial constraints by providing funding support through various sources: recycling of gate receipts, service charges, donations and the like. The Foundation, may undertake various activities related to mainstreaming of conservation: eco-development, staff welfare, visitor regulation, field research, facilitating ecodevelopment committees for market access, conducting capacity building programs, ecotourism and Joint Forest Management. The Tiger Conservation Foundation for Manas Tiger Reserve has been constituted, under sec 38 X of Wildlife Protections Act 1972. (The operational guidelines and trust deed is provided in Annexure-17)

a) Area of Operation of the Foundation: -

Manas Tiger Reserve and its adjoining landscape, forming the impact zone with possible corridor value for disposal of wild animals from the Tiger Reserve.

b) Aims of the Foundation: -

To facilitate and support the Manas Tiger Reserve management for conservation of tiger and biodiversity, through multi stakeholder participation as per approved management plans, and to support similar initiatives in adjoining landscapes, consistent with the National and State legislation.

Objective of the Foundation: -

- i) To facilitate ecological, economic, social and cultural development in the tiger reserve and adjoining landscape.
- ii) To provide support to safeguard the natural environment in the tiger Reserve and relevant places.
- iii) To facilitate the creation of and/or maintenance of such assets as felt necessary for fulfilling the above said objectives.
- iv) To solicit technical, financial, social and other support required for the activities of the foundation trust for achieving the above and related fields to support the implementing agency.
- v) Anything incidental or ancillary to the above for furthering the above said objectives.

Governing Body of the Manas Tiger Conservation Foundation – Composition: -

1. Honourable Minister, Environment & Forest Deptt, Govt. of Assam – President.
2. Honourable MLA, 33- LAC, Bijni – Member.
3. Honourable MLA, 33- LAC, Sorbhog – Member.
4. Honourable MLA, 33- LAC, Bhawanipur – Member.
5. Honourable MLA, 33- LAC, Capaguri – Member.
6. Honourable MLA, 33- LAC, Majbat – Member.

7. Principal Secretary, Environment & Forests, Govt. of Assam – Vice President.
8. PCCF, Head of Forest Force, Assam – Member.
9. PCCF, Wildlife & Chief Wildlife Warden, Assam – Member Secretary.
10. Field Director, Manas Tiger Reserve – Member.
11. One forester to be deputed by Field Director, MTR – Member

Representative

- Nominated by government of Assam – Members – 4 nos.

Executive Committee of the Manas Tiger Conservation Foundation – Composition: -

1. Field Director, Manas Tiger Reserve – Chairperson.
2. Deputy Field Director, Manas Tiger Reserve – Member Secretary.
3. Two representatives of Eco-development Committees working in the Tiger Reserve as nominated by the Governing Body – Members
4. Three front line staff serving in the Tiger Reserve nominated by the Governing Body – Members.

Registered Office of the Foundation: - Office of the Field Director, Manas Tiger Reserve, Barpeta Road, Assam, Pin- 781315.

Source of Funds of the Manas Tiger Conservation Foundation – Corpus Fund: -

- i) Grants from the Bodoland Territorial Council, State Govt and Govt of India.
- ii) Grants and contribution from corporate bodies, agencies, institutions, individuals and national and international NGOs including other funding agencies.
- iii) Loans from the Government and financial institutions.
- iv) Fees collected from visitors – that is income generated from entry fees and other charges generated out of the Tiger Reserve.

c) Proposed activities of Foundation: -

- 1) To undertake welfare measures and community development activities. For forest dependent communities and for the people residing inside and in the fringe of Tiger Reserve.
- 2) For improvement of Habitat as per the approved Tiger Conservation Plan.
- 3) For mitigation of Man Animal Conflict.

- 4) Strengthening protection measures by involving communities.

13.3. Coordination with Line Agencies/Departments: -

Co-ordination with line agencies/departments is needed for: -

- Better protection- Police, Administration, Army, SSB, Revenue, Local Council and Judiciary etc.
- Eco-development- Revenue, Rural Development, Agriculture, Health, Veterinary, Horticulture, Irrigation, Water Resources Dept, PWD, PHE, Electricity, Women and Child Welfare, Education, Tribal Welfare, Handloom & Textile etc.
- Gaps in habitat development -Local Council, Rural development, Agriculture etc.
- Conflict resolution- Administration, Police, Army, SSB, Agriculture, Tribal Welfare, Judiciary etc.

Better co-ordination will not only ease pressure on limited resources of Reserve management but will earn general goodwill among various sectors.

For co-ordination following measures could be adopted: -

- Regular meetings with line departments like police, administration, revenue, land reforms, Agriculture and animal husbandry.
- Co-ordinating with District Collector and CEO, Zilla Parishad (ZP) for organizing special meetings with line departments.
- Knowing various schemes of line departments and identifying schemes suitable for the Reserve area.
- Reserve tour of officials of line departments.
- Accreditation and highlighting achievements of other departments in Reserve area.

These are few suggestive things, but in practice convergence could be achieved only through good interpersonal relationship with officials of line departments of various levels from district to village. Officer of Reserve should interact with their respective counterparts in other departments.

13.4. Unified Command of Core and buffer areas: -

At present Field Director controls only the core area and the buffer area has been divided into five Territorial Divisions which are under the administrative control of Council Head of Department, Forests, in the present rank of Additional Principal Chief Conservator of Forests under Bodoland Territorial Autonomous Districts (BTAD). There is a Deputy Director and an Assistant Conservator of Forests to assist the Field Director in day to day activities.

It is proposed that the administrative control of all buffer areas should be brought under the Field Directorate. Similarly, two DFO posts should be re-designated as deputy

Director (East Buffer) and Deputy Director (West buffer) for better coordination and management.

13.5. Proposed Administrative set up: -

The National Park shall be administered by the Field Director in the rank of Conservator of Forests. The Park will be divided into 4 Ranges – Bhuyanpara, Bansbari, Kahitema and Panbari.

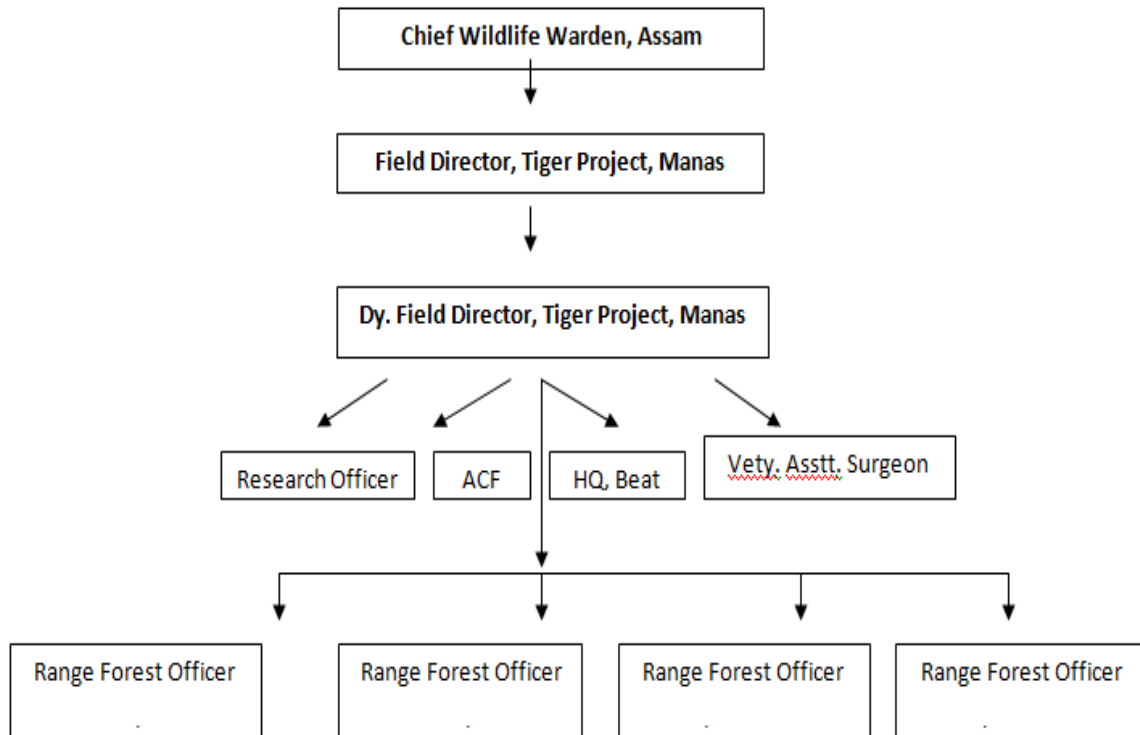
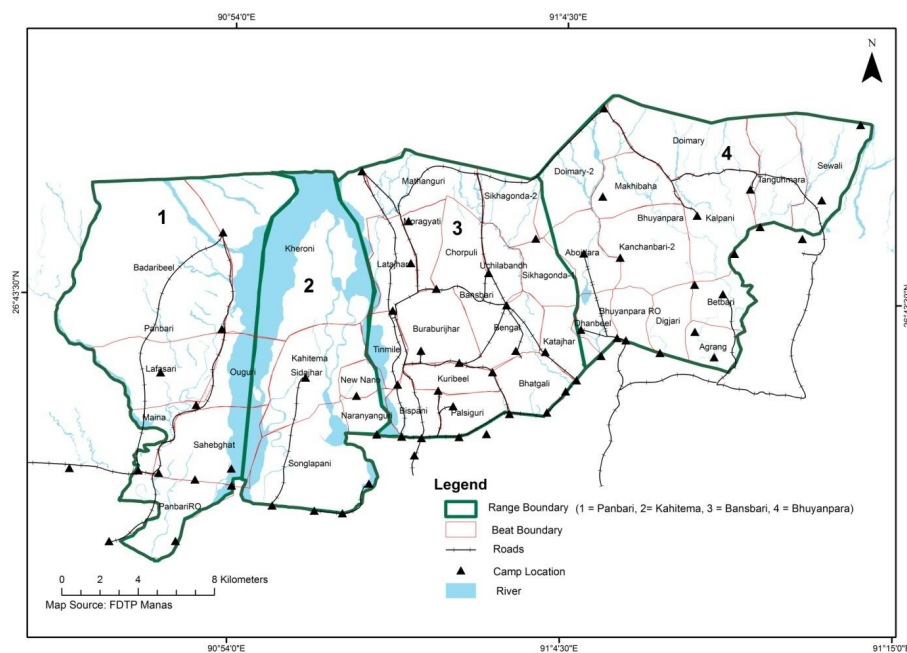


Fig 13.1. Range and Beat boundaries for Manas National Park



13.5.1. Inadequate Manpower and Infrastructure: -

With the increase in the number of camps and the complexity of protection it is felt that the current number of manpower is highly inadequate, especially at the frontline level. An analysis of age and the length of service put into Manas are also very revealing and there are several instances when the person has served for more than twenty years at the same location and at the same post. The average age of frontline staff in all categories is above 45 years. This is a severe impeding factor towards conducting physically challenging duties such as foot patrolling and night vigil.

Additional support has been provided in terms of support from local NGO conservation volunteers, armed Home Guards and Assam Forest Battalion. However due to their low wages (as in case of casual workers and conservation volunteers) and diminished levels of motivation (due to prolonged stay at the same place and temporary position for a number of years), nature of leave etc, it is suggested that a serious review and strategy be undertaken for bringing in 'change' in the existing man power.

Table 13.1: Existing Sanctioned and proposed frontline staff increase in Manas National Park (as on 16.08.2019)

Sl. No.	Name of Post	Sanction Strength	Man in position	Vacancy
1	Field Director	1	1	
2	Dy. Director	1	1	
3	ACF	1	1	
4	Research Officer	1	-	1
5	Supritendent	1	1	
6	V. A.S	1	1	
7	Sr. Asstt. (Director level)	2	2	
8	Jr. Asstt. (Director level)	5	4	1
9	Record keeper	1	1	
10	Jr. Asstt./Range Asstt.	3	3	
11	VFA	1	1	
12	Steno	1	1	
13	Forest Ranger	6	5	1
13	Deputy Ranger	5	4	1
15	Forester-I	39	36	3
16	Forester-II	20	13	7

17	Forest Guard	235	118	117
18	Mahut	27	16	11
19	Game watcher	44	32	12
20	Driver	9	6	3
21	Office peon	4	-	4
22	Chowkidar	11	7	4
23	Handiman	3	3	
24	Grasscutter	23	11	12
25	Boatman	12	3	9
26	Sweeper	1		1
27	Attendant	2	1	1
28	Laboratory attendant	1	1	
29	Duk runner	1	1	
30	Mali	1	1	
31	Paniwala	1	1	
32	Bearer	1	1	
33	Jamadar	1		1
TOTAL =		466	277	189

Table 13.2: Categories of additional Manpower available in Manas NP

Sl. No.	Category of Manpower	Availability
1	Van Mazdoor (CL) supported by NTCA	120
2	Service Provider supported by BTC	135
3	Fixed Pay Worker (State Government)	27
4	Armed Home Guards (IRV supported)	15
	Armed Home Guards supported by NTCA	140
5	Assam Forest Protection Force (AFPF)	51
TOTAL =		488

Fig 13.1: Age rendered by Range officers and deputy rangers (permanent staff) of Manas Tiger Reserve.

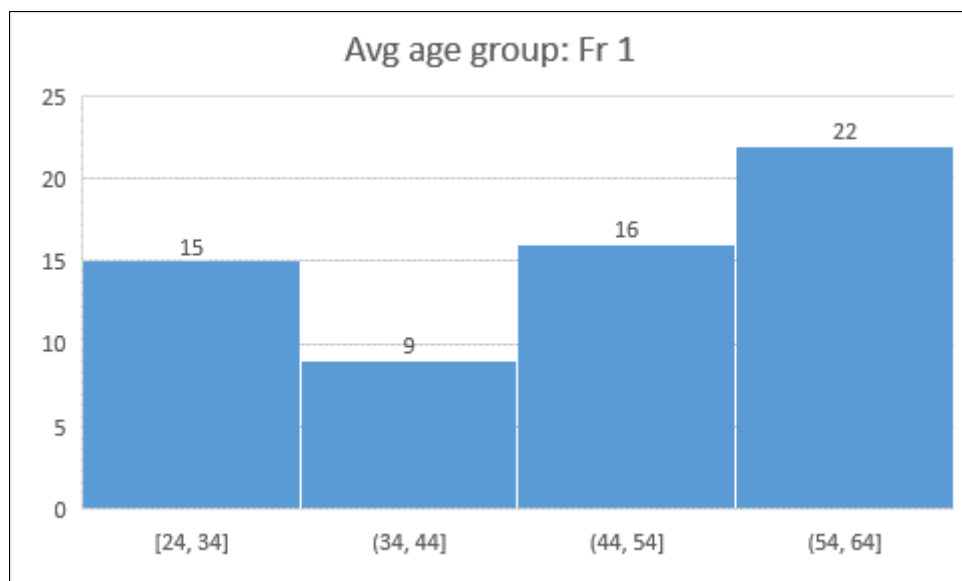
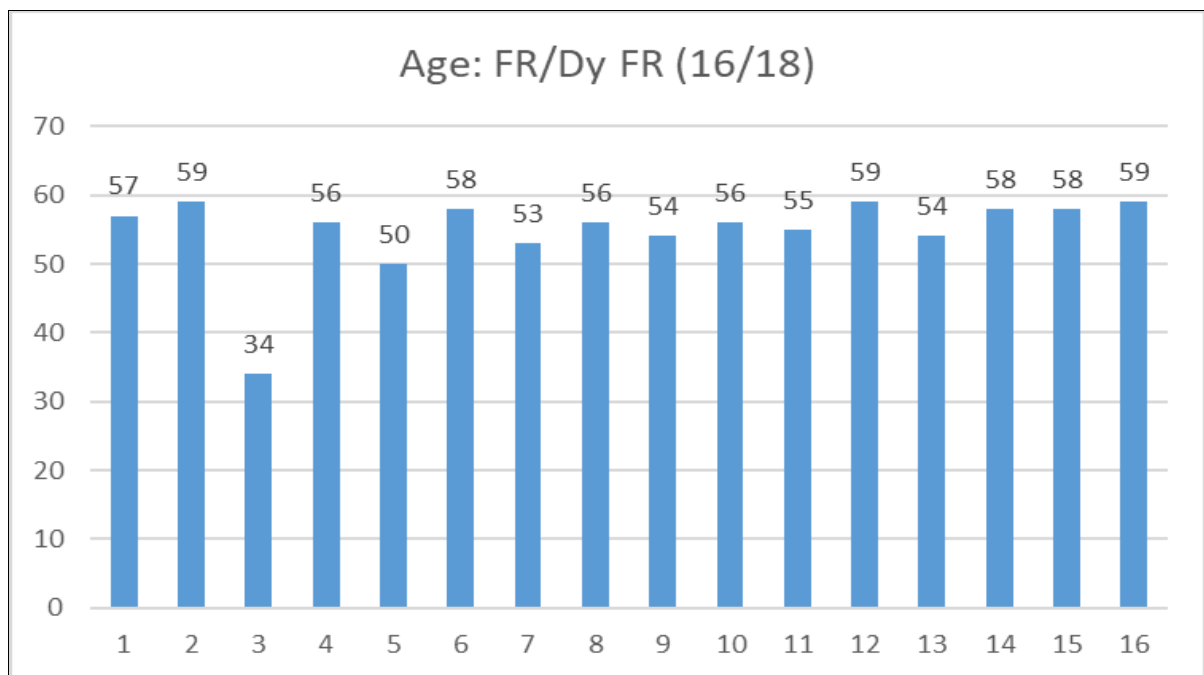


Figure 13.2: Average age group of forester I in Manas Tiger Reserve

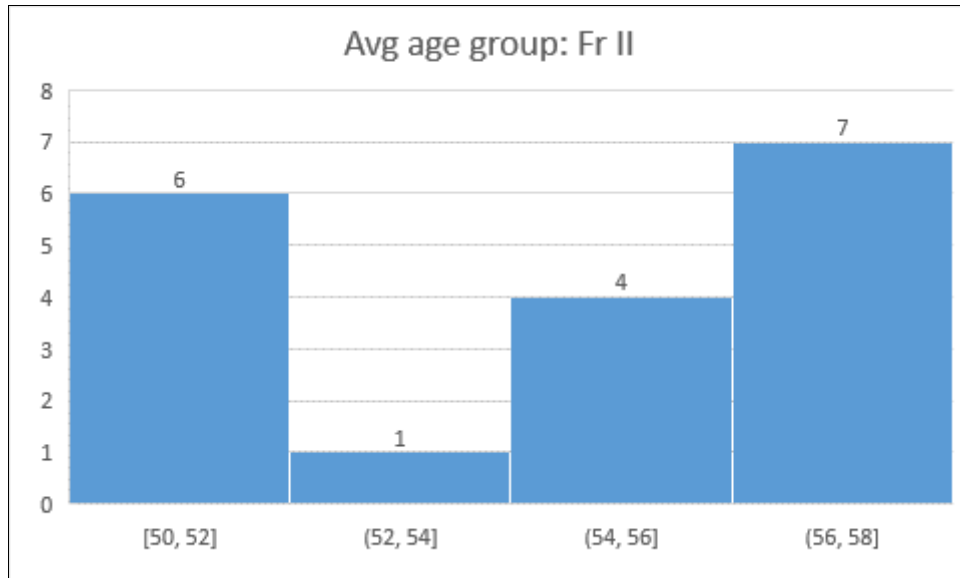


Figure 13.3: Average age group of forester II in Manas Tiger Reserve

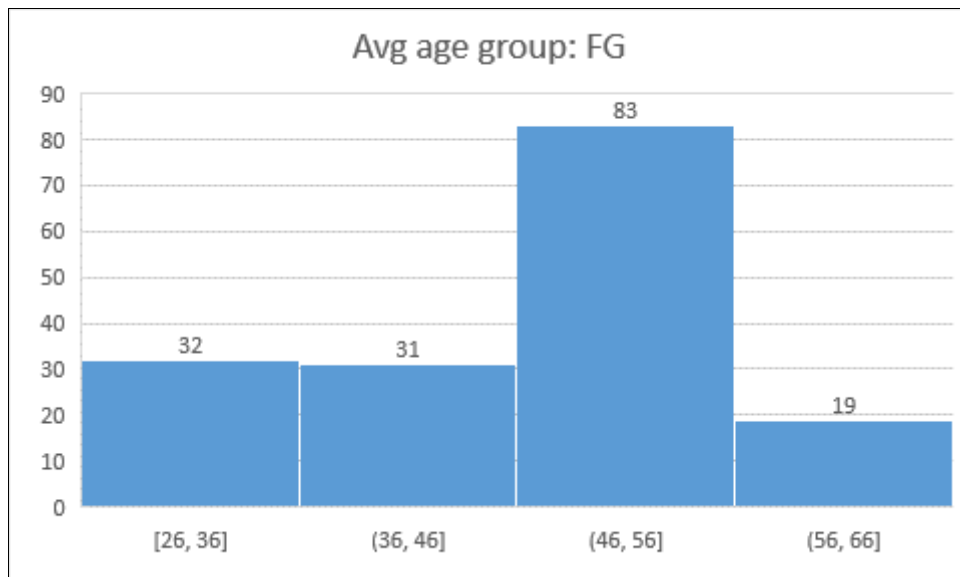


Figure 13.3: Average age group of forest guards in Manas Tiger Reserve

13.5.2. Camps and Infrastructure: -

Currently, there are about 76 numbers of anti-poaching camps (till March 2019) distributed all over the park. However, the camps are not uniformly distributed and there are several gaps in patrolling especially along the northern and northwestern part of the Park. More camps are required as the terrain is difficult and inaccessible because of which monitoring and protection have not been possible uniformly. Similarly, the number of vehicles, patrolling infrastructure such as boats, wireless sets, patrolling paths and infrastructure remain inadequate and depend on fund position to compensate for the gaps.

Fig 13.1 A geospatial analysis of gap areas for camp network in Manas National Park (ref: Swargowary et.al., 2012)

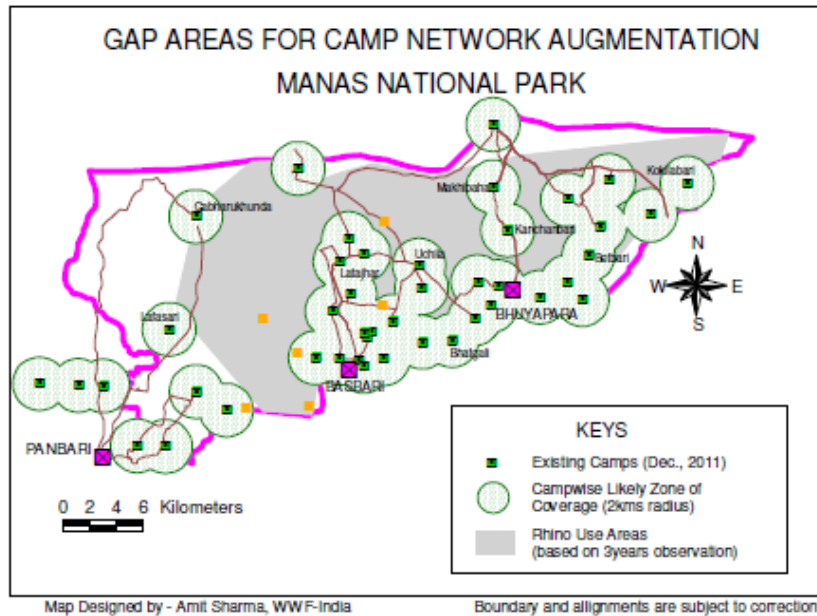
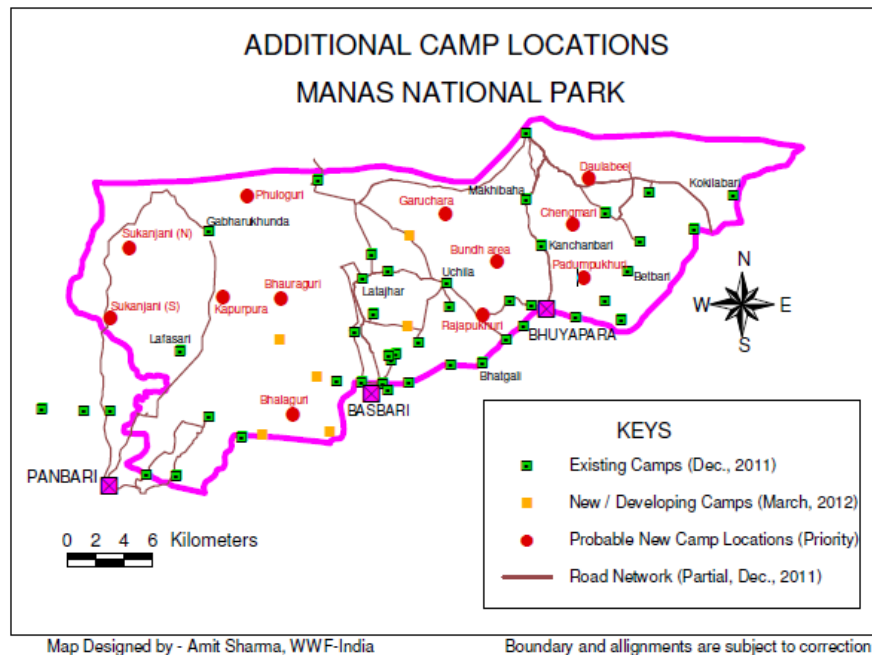


Fig 13.2 A geospatial analysis of probable areas for camp construction in Manas National Park (ref: Swargowary et.al., 2012)



Adding to the woes of the Park Authority the recently reintroduced rhinos have started occupying the unexpected and inaccessible areas which are devoid of camps. However, with the present available strength of manpower each antipoaching camp can be manned by 8 numbers of individuals mathematically. This number will go on decreasing with increasing number number of camps in the years to come. It must be kept in mind that Manas is being reconstructed in actual sense.

13.6. Fund Raising Strategies: -

State Government, Bodoland Territorial Council (BTC) supplemented by the NTCA is the main fund provider for development, eco-development, research, protection, environmental education and other activities. All establishment costs and other recurring costs are borne by the BTC, state government.

The gate money kept in civil deposit will be used for protection and management of Protected Area, Eco-tourism and development of host community. Fund may be raised from different donors through Tiger Foundation. Assistance of the Corporate sectors and NGOs maybe explored and sought on various relevant aspects.

13.6.1. Present Budget provisions: -

At present the property receives funds from Central Government (Ministry of Environment and Forests) through the State government (Assam Forest Department) for flagship schemes such as Project Tiger, Biosphere Reserve and Project Elephant. The delay in release of funds has been considerably minimized as evident from the release of funds for the year 2013-14 (**Table**). The Manas Tiger Conservation Foundation has also been set up which ploughs back the revenue generated from tourism etc. directly into the Park management. As such, the foundation money has also been taken as a loan amount to expedite essential management activities such as maintenance of patrolling paths and surveillance activities, until the Central funds are received.

Table 13.3: Disbursement of funds received from Central, State Government and BTC Govt. to Manas National Park-

a) CSS-Project Scheme

Name of Scheme	Year	Amount Sanctioned	Released by State Govt. (1 st Instalment)		Released by State Govt. (2 nd Instalment)		Remarks
			Central Share	State Share	Central Share	State Share	
CSS-Project Tiger	2011-12	694.85	479.62	73.42	-	-	1 st instalment
	2012-13	342.77	273.176	8.65	-	-	Unspent adjusted
	2013-14	496.85	372.9185	24.855	99.0765	-	Unspent adjusted
	2014-15	370.960	323.144	-	-	-	Released Rs.328.199 by state Govt. of Rs. 140.00 + 183.144 = 323.144 and balance amount to be release 5.055 lakh
	2015-16	339.800	259.8596	-	-	-	Fresh released of Rs. 54.5706 + Revalidated amount Rs. 205.289 = 259.8596 lakh
	2016-17	718.944	512.585	42.177	-	-	1 st instalment
	2017-18	617.830	439.79	44.48	-	-	1 st instalment
	2018-19	668.560	475.055	47.00	-	-	Release including unspent balance amount of Rs. 5.055 lakh
CSS-Project Biosphere	2011-12	-	-	-	-	-	Not sanctioned
	2012-13	-	-	-	60.46	-	Released 2 nd Instalment during the year 2008-09

	2013-14	-	-	-	-	-	Not Sanctioned
	2014-15	-	-	-	-	-	Not Sanctioned
	2015-16	110.876	-	-	-	-	Not released
	2016-17	-	88.7008	-	-	-	Revalidated amount (1 st Instalment) during the year 2015-16
	2017-18	67.70	-	-	-	-	Not released
	2018-19	-	-	-	-	-	Not sanctioned
CSS- Project Elephant	2011-12	3.43	3.43	-	-	-	Received from DFO, Kaziranga
	2012-13	11.17	11.17	-	-	-	Received from DFO, Zoo, Guwahati
	2013-14	-	-	-	-	-	Not sanctioned
	2014-15	-	-	-	-	-	Not sanctioned
	2015-16	0.80	0.80				Feed supliment
	2016-17	-	-	-	-	-	Not sanctioned
	2017-18	25.365	25.365	-	-	-	Ex-gratia payment
	2018-19	-	-	-	-	-	Not sanctioned

b) BTC Fund:-

Item	Year	Amount sanctioned (Rs. In Lakhs)	Amount released from BTC Govt. received by Park authority (Rs. In Lakhs).	Remarks
Govt. of BTC	2011-12	547.812	NA	Amount directly transferred to Park Authority.
	2012-13	1214.28864	1214.28864	
	2013-14	20.00	20.00	
	2014-15	213.80461	213.80461	
	2015-16	98.64047	98.64047	
	2016-17	378.17096	378.17096	
	2017-18	756.60989	756.60989	
	2018-19	408.67301	408.67301	

13.7. Schedule of Operations:-

All the operations in the PA will be completed as per the direction, APO and schedule prevailing in the department.

13.7.1. Schedule: -

The annual schedule should be prepared by the Field Directors on the basis of various prescriptions of plan proposals and should be sent to the Council Head of Department, BTC and then forwarded to the Chief Wildlife Warden well in time for approval. Once approved and forwarded by the Council Head of Department, BTC various works should be implemented as per the schedule.

13.7.2. Record of deviations and implemented targets: -

In absence of approved Management Plan, no record of deviation statements were maintained in Manas. The Tiger Reserve should pay proper attention and ensure that

deviation statements are maintained properly as per prescription of management plan. Deviation statement should be recorded and maintained in the standard prescribed proforma. The plan should provide for maintenance of a book called Tiger Reserve book to record the deviation proposals, made and approved. This will include annually deferred targets which might be accomplished during over all plan period. There also might be strategies put off indefinitely for compelling reasons. There might be new strategies not previously included in the plan. All should be recorded. At the time of revision of the plan the deviation proposals need to be referred to especially on matters which relate to strategies in the field. Further, a record should be maintained for each category of strategy proposed and undertaken e.g. fire protection, water augmentation, control of weeds, habitat improvement works etc. This is essential for evaluating the plan performance. The information from the book as relevant should annually be entered in the control forms. For this purpose, each range must maintain a Range Book.

13.7.3. Record of employment generations: -

So far no records of employment generation are maintained in Manas Tiger Reserve. It is very important to know as to how many man days have been created in a financial year through different forestry works. Range officers shall maintain a register of employment generation as per proforma.

Table 13.4: Table of item of works budgeted under Non-Recurring Expenditure for Manas National Park during the year 2018-19 under CSS-Project Tiger

Activity	Item	Sub-item Details	No. of Items (Physical Target)	Grand Total Expenditure (Central Share + State Share)
Anti-Poaching	Core Area: Establishing patrolling camps/chowkis/staff quarters etc.	2.000 2 nos. of Anti-poaching camps @ Rs. 1200000/- per camp for Manas NP * 1200000.000 = 2400000.000	2	18.09980
		2.000 Anti-poaching camp-2 nos @ Rs. 1200000/- to be constructed for Manas National Park 1st Addition * 1200000.000 = 2400000.000	1	6.00000
Anti-Poaching	Core Area: Procurement of arms and ammunition	10.000 Purchase of 10 nos. .315 rifles @ Rs. 90000/- per rifle for Manas NP 1st Addition area * 90000.000 = 900000.000	10	6.80974
		1500.000 Ammunition for .315 rifle-1500 nos. @ Rs. 125/- per no. for Manas NP & Manas NP 1st Addition area * 125.000 = 187500.000	1500	1.95000
		500.000 Ammunition for .315 rifle-500 nos. @ Rs. 125/- per no. for Barnadi WLS * 125.000 = 62500.000	500	0.62000
		1.000 Repairing of Arms for Barnadi WLS (LS) * 50000.000 = 50000.000	LS	0.40000
		1000.000 Ammunition for DBBL/SBBL Gun- 1000 nos. @ Rs. 130/- per no. for Manas NP & Barnadi WLS * 130.000 = 130000.000	1000	1.20000
		1.000 Repairing of .315 rifles & DBBL Guns for Manas NP (LS) * 50000.000 = 50000.000	LS	0.50000
		1.000 358 nos. of Hunting Boots for Manas NP(LS) * 200000.000 = 200000.000		1.79000
Anti-Poaching	Core Area: Procurement field gear, night vision device, field dress, boots, binoculars	20.000 20 nos. of Water Filters @ Rs. 3000/- per Filter for Manas NP * 3000.000 = 60000.000	20	0.60000
		100.000 100 nos. of Solar Chargeable Torch Lights @ Rs. 1600/- per Torch Light for Manas NP * 1600.000 = 160000.000		1.290000

		1.000 45 nos. of Hunting Boots for Barnadi WLS (LS) * 50000.000 = 50000.000		0.36000
Strengthening	Core Area: Construction of (patrolling camp, culverts).	4.000 Construction of 4 nos. of Culverts @ Rs. 700000/- per culvert for Manas NP * 700000.000 = 2800000.000	3	21.00000
Strengthening	Core Area: Construction of Gate/ Check-posts.	1.000 Construction of 1 no. Gate for Manas NP 1st Addition (LS) * 200000.000 = 200000.000	1	2.00000
Strengthening	Core Area: Construction of Toilets	7.000 Construction of Toilets for Manas * 100000.000 = 700000.000	7	7.00000
Strengthening	Core Area: Creation of earthen ponds.	4.000 4 nos. of Artificial Earthen Ponds @ Rs. 150000/- per pond for Manas NP * 150000.000 = 600000.000	5	1.50000
Strengthening	Core Area: Construction of ACF Quarters	1.000 Construction of 1 no. of ACF Quarter @ Rs. 1500000/- per quarter for Manas NP * 1500000.000 = 1500000.000	1	11.17123
Addressing man animal conflict	Core Area: Procurement of tranquilizing equipments, darts, rescue vehicles, drugs.	1.000 Requirement of Dart including Drugs for rescue animals for Manas NP (LS) * 100000.000 = 100000.000	LS	0.00000
Research and field equipment	Core Area: Day to day monitoring of wild animals	70.000 Purchase of 70 nos. of Android Phones + Micro SD Cards @ Rs. 8827.00 per Phone for Manas NP * 8827.000 = 618000.000	70	6.17890
Mainstreaming wildlife concerns	Core Area: Habitat improvement measures.	20.000 Removal of Oxi, Simul sappling for Manas * 15000.000 = 300000.000	20 hac	3.00000
Staff Development	Core Area: Dissemination workshops.	3.000 Three numbers of Workshop for staff @ Rs. 1500/- per no. for Manas NP * 15000.000 = 45000.000	0	0.00000
Project Allowance	Core Area: Provision of Project Allowance to staff (all categories) of Project Tiger (providing project allowance to Ministerial staff is a new component) (non recurring). Separate for al categories. See from guide lines	1.000 Project Tiger Allowance for Staffs, Ministerial Staff, Fixed pay and AFPF staff for Manas NP * 3434400.000 = 3434400.000	LS	29.81700
		1.000 Project Tiger Allowance for Staffs, Ministerial Staff for Barnadi WLS * 890400.000 = 890400.000	LS	2.83800
Staff welfare	Core Area: Provision for ration allowance to field staff	1.000 Project Tiger Ration Allowance for frontline staff, Grade-IV and Fixed Pay for Manas NP * 3199200.000 = 3199200.000	LS	29.00780
		1.000 Project Tiger Ration Allowance for frontline staff, Grade-IV for Barnadi WLS * 598500.000 = 598500.000	LS	2.37360
Staff welfare	Core Area: Supply of field kit	1.000 Supply of Mosquito Net (Medicated) for Manas NP (LS) * 150000.000 = 150000.000	260	1.30000
Staff welfare	Core Area: Supply of kerosene	1.000 Supply of Kerosene for Manas NP (LS) * 40000.000 = 40000.000	LS	0.25000
		1.000 Supply of Kerosene for Barnadi WLS (LS) * 10000.000 = 10000.000	LS	0.05000
Staff welfare	Core Area: Supply of medicine	1.000 Supply of essential medicine for field staff for Manas NP (LS) * 50000.000 = 50000.000	LS	0.00000
Staff welfare	Core Area: Supply of torch/ batteries	1.000 Torch light & Battery for Manas NP (LS) * 150000.000 = 150000.000	LS	0.00000
		1.000 Torch light & Battery for Barnadi WLS (LS) * 50000.000 = 50000.000	LS	0.32000
Fostering Tourism	Core Area: Activities for reducing resource dependency	1.000 Assistance to EDCs for promoting Eco-tourism for Manas NP (LS) * 300000.000 = 300000.000	LS	0.00000
Fostering Tourism	Core Area: Wildlife Conservation Awareness	1.000 Awareness camp during the wildlife week for Manas NP (LS) * 150000.000 = 150000.000	LS	0.75000
		1.000 Intelligence gathering for Manas NP (LS) * 100000.000 = 100000.000	LS	0.35000
		1.000 Publicity and extension for Manas NP (LS) * 150000.000 = 150000.000	LS	0.14002
		1.000 Intelligence gathering for Barnadi WLS (LS) * 150000.000 = 150000.000	LS	0.50000
Water Development	Core Area: Construction of Tank, Well, Hand Pump etc.	10.000 Installation of 10 nos. Hand Pumps @ Rs. 20000/- per pump for Manas NP * 20000.000 = 200000.000	9	1.80000

Table 13.5 : Table of item of works budgeted under Recurring Expenditure for Manas National Park during the year 2018-19, under CSS-Project Tiger

Activity	Item	Sub-item Details	No. of Items (Physical Target)	Grand Total Expenditure (Central Share + State Share)
Anti-Poaching	Core Area: Deployment of anti-poaching squads.	5.000 Engagement of 5 nos. of elephant depredation squad- @ Rs. 5000/- per no. for 12 months for Manas NP * 60000.000 = 300000.000	5	2.97000
Anti-Poaching	Core Area: Deployment of camp labourers for patrolling.	100.000 Payment Wages to Van Mazdoor (Casual Worker)-100 nos. @ Rs. 9000/- per No. per month for 12 months for Manas NP * 108000.000 = 10800000.000	100	108.00000
		20.000 Payment Wages to Van Mazdoor (Casual Worker)-20 nos. @ Rs. 9000/- per No. per month for 12 months for Manas NP 1st Addition * 108000.000 = 2160000.000	20	14.04000
		19.000 Payment Wages to Van Mazdoor (Casual Worker)-19 nos. @ Rs. 9000/- per No. per month for 12 months for Barnadi WLS * 108000.000 = 2052000.000	19	20.52000
		100.000 Arm Home Guards-100 nos. @ Rs. 9000/- per Home Guard per month for 12 months to be payment of wages for Manas NP * 108000.000 = 10800000.000	100	106.19650
		40.000 Arm Home Guards-40 nos. @ Rs. 9000/- per Home Guard per month for 12 months to be payment of wages for Manas NP 1st Addition Area * 108000.000 = 4320000.000	40	13.48800
		1.000 Payment wages to Computer Operator-1 No. @ Rs. 20000/- per month for 12 months for Manas NP * 240000.000 = 240000.000	1	2.40000
		1.000 Payment wages to Computer Operator-1 No. @ Rs. 15000/- per month for 12 months for Barnadi WLS * 180000.000 = 180000.000	1	1.80000
		1.000 Payment wages to Biologist-1 No. @ Rs. 30000/- per No. per month for 12 months for Manas NP * 360000.000 = 360000.000	1	1.50000
Anti-Poaching	Core Area: Legal support for defending court cases.	1.000 Legal support for defending court cases for Manas NP (LS) * 100000.000 = 100000.000	LS	0.00000
Anti-Poaching	Core Area: Maintenance of vehicles(boats,motorbikes, mobility)	1.000 Repairing of Vehicles & purchase of Tyres etc. for Manas NP (LS) * 600000.000 = 600000.000	LS	3.66506
		1.000 POL for Vehicles and Motorbikes for patrolling round the clock by all the Ranges for protection duties for Manas NP (LS) * 1200000.000 = 1200000.000	LS	12.00000
		1.000 POL & maintenance for Boats (Diesel) for Manas NP (LS) * 100000.000 = 100000.000	LS	0.21937
		1.000 Repaing of Vehicle for Manas NP 1st Addition (LS) * 100000.000 = 100000.000	LS	0.98340
		1.000 POL for Vehicles and Motorbikes for patrolling round the clock by all the Ranges for protection duties for Manas NP 1st Addition (LS) * 200000.000 = 200000.000	LS	1.99948
		1.000 Repearing of Vehicle for Barnadi WLS (LS) * 50000.000 = 50000.000	LS	0.50000
Anti-Poaching	Core Area: Maintenance of existing patrolling camps/chowkis.	12.000 Repairing /renovation of 12 nos. of existing camps of existing patrolling Anti-poaching Camp for Manas NP * 50000.000 = 600000.000	12	5.50000
Anti-Poaching	Core Area: Maintenance of office equipment.	1.000 Maintenance of Office for Manas * 500000.000 = 500000.000	LS	2.33262
Anti-Poaching	Core Area: Maintenance of wireless network.	1.000 Renewal fee, Royalty etc. against Wireless Licence for Manas NP (LS) * 78500.000 =	LS	0.78500

		78500.000		
		1.000 Repairing of Fix Base Station and Hand Set Mobile including replacement of battery for Manas NP (LS) * 21500.000 = 21500.000	LS	0.12250
Anti-Poaching	Core Area: Organizing surprise raids jointly with the local police(in railway stations, local trains, bus-stops, buses, catchers and cafeteria.)	1.000 Surprise raids for Manas NP (LS) * 75000.000 = 75000.000	LS	0.48000
Anti-Poaching	Core Area: Maintenance of elephants and there accessories.	1.000 Medicine for Treatment of Captive Elephant and rescued animals (if any) for Manas NP (LS) * 200000.000 = 200000.000	LS	0.56416
		1.000 Elephant Feed Supplement for Captive Elephant for Manas NP (LS) * 140000.000 = 140000.000	LS	0.93354
		40.000 Upkeepment of Departmental Elephant- 40 nos. @ Rs. 7000/- per no. per month for 12 months for Manas NP * 84000.000 = 3360000.000	40	18.99700
		1.000 Budget for Immunization for captive elephant for Manas NP (LS) * 200000.000 = 200000.000	LS	0.00000
		1.000 Cattle Vaccination cum Treatment in fringe villages under Manas NP * 200000.000 = 200000.000	LS	2.00000
		5.000 Cattle Vaccination cum Treatment- 5 nos. under Barnadi WLS * 20000.000 = 100000.000	5	0.00000
Anti-Poaching	Core Area: Rewards to informers.	1.000 Rewards to informer for Manas NP (LS) * 50000.000 = 50000.000	LS	0.20000
Strengthening	Core Area: Maintenance of (patrolling camp, culverts).	2.000 Maintenance of existing Culvert- 2 nos. @ Rs. 50,000/- per culvert for Manas * 50000.000 = 100000.000	2	1.00000
Strengthening	Core Area: Maintenance of earthen ponds.	3.000 Repairing/Renovation of 3 nos. of existing earthen pond@ Rs. 50,000/- per pond for Manas NP * 50000.000 = 150000.000	3	1.50000
Strengthening	Core Area: Maintenance of fire lines and firebreaks.	25.000 Maintenance of patrolling path cum fireline- 25 kms @ Rs. 7000/- per km for Manas NP * 7000.000 = 175000.000	25 km	1.75000
		15.000 Maintenance of patrolling path cum fireline- 15 kms @ Rs. 7000/- per km for Barnadi WLS * 7000.000 = 105000.000	15 km	1.05000
Strengthening	Core Area: Maintenance of Hardware.	1.000 Maintenance of Computers for Manas NP (LS) * 45000.000 = 45000.000	LS	0.55815
Strengthening	Core Area: Maintenance of Kitchens	5.000 Repairing of Kitchen- 5 nos. @ Rs. 0.40 lakh per Kitchen for Manas * 40000.000 = 200000.000	5	2.00000
Strengthening	Core Area: Maintenance of road network.	40.000 Maintenance of Roads- 40 kms. @ Rs. 25000/- per km for Manas NP * 25000.000 = 1000000.000	40 km	10.00000
Strengthening	Core Area: Maintenance of Software.	1.000 Up dating of computer software for Manas NP (LS) * 25000.000 = 25000.000	LS	0.00000
Strengthening	Core Area: Maintenance of Toilets	3.000 Repairing of Toilets- 3 nos. @ Rs. 15000/- per Toilet for Manas * 15000.000 = 45000.000	3	0.45000
Strengthening	Core Area: Creation of fire lines and firebreaks.	60.000 Creation of Patrolling Path cum fireline - 60 kms @ Rs. 10000 per km for Manas NP * 10000.000 = 600000.000	60 km	6.00000
Strengthening	Core Area: Creation of road network.	20.000 20 km of Roads @ Rs. 40000/- per km for Manas NP * 40000.000 = 800000.000	20 km	8.00000
Mainstreaming wildlife concerns	Core Area: Monitoring of wild animals.	1.000 Annual monitoring of Wild Buffalo, Swamp deer and Tiger (Phase-IV)etc. form Manas NP (LS) * 150000.000 = 150000.000	LS	0.00000
Staff Development	Core Area: Capacity building and training.	1.000 Capacity building on M-STrIPES patrolling system for Manas NP (LS) * 40000.000 = 40000.000	LS	0.00000
		1.000 Study tour/exposure/visit of local NGOs/EDC members/Frontline staff/fringe area for Manas NP (LS) * 100000.000 = 100000.000	LS	0.00000
		2.000 Study Tours for frontline staff on best conservation & Eco-tourism practices in other National Park- 2 nos. @ Rs. 1.00 lakh per no. for	2	2.00000

		Manas NP * 100000.000 = 200000.000		
Staff welfare	Core Area: Maintenance of torch/ batteries	1.000 Replacemnt of batteries of Solar torch light for Manas NP (LS) * 50000.000 = 50000.000	LS	0.61272
		1.000 Replacement of batteries of Solar light for Manas NP (LS) * 50000.000 = 50000.000	LS	0.47141
Habitat Improvement	Core Area: Grass land improvement, wetland improvement	5.000 Improvement of Grassland and wetland- 5 Hact @ Rs. 0.50 akh per Ha. for Manas NP * 50000.000 = 250000.000	5 hact	2.50000
Habitat Improvement	Core Area: Weed eradication	4.000 Eradication of Leea asiatica and Chromoleana odorata 4 hect- 3 times per year for Manas NP * 25000.000 = 100000.000	4 hact	1.00000
Co-occurrence agenda in buffer	Core Area: Co-occurrence agenda in buffer and fringe areas (landscape approach, sect oral integration, ecologically sustainable development programmed, livelihood options and eco-tourism) (new activity fin case of tiger reserves where buffer has not been notified so far).	19.000 Distribution of Piggery to EDC (19 nos): for 1 year including maintenance for Manas NP * 25000.000 = 475000.000	19	0.00000
		190.000 Distribution of Duckery for 19 EDCs for 1 year rearing 10 ducking for Manas * 300.000 = 57000.000	10	0.00000
		38.000 Distribution of Goatery-19 EDCs for 1 year rearing 2 Goatery for Manas * 300.000 = 11400.000	38	0.00000

CHAPTER FOURTEEN

Monitoring and Evaluation

Monitoring and evaluation are components of the field management, and hence, need to be carried out in an ongoing manner, with site-specific periodicity. In general, a snapshot assessment of tiger, co-predators, prey and habitat status is done once in four years by the NTCA, in collaboration with tiger states and the Wildlife Institute of India. Apart from this, an independent evaluation of the management effectiveness (MEE) is also done, once in four years.

At the tiger reserve level, monitoring and evaluation needs to be carried out on an annual basis to complement the national level snapshot assessment/evaluation.

14.1 Criteria

The criteria for tiger reserve level MEE, would be the same as adopted by the NTCA for the national level appraisal. For other types of monitoring, the standard criteria (peer reviewed/standardized) vis-à-vis the technical guidelines of NTCA/Project Tiger would be used.

14.2 Process

The overall monitoring process at the reserve level is highlighted as below:

- **Technical**
 - Phase IV monitoring and maintaining reserve level tiger camera trap repository
 - M-STriPES protocol (covers patrolling intensity, evaluates status and trends of carnivores at regular intervals, monitors habitat change, evaluates human pressure and generates report with quantitative information for decisions making leading to course correction)
 - Monitoring carcasses of livestock using camera traps (soon after the kill is reported) to ascertain the tiger ID for enabling safeguards
 - Monitoring the health status of wild animals
 - Monitoring of changes in vegetational status/successional stages (permanent

plots/transects) owing to protection and manipulations induced by managerial actions and habitat use by wild ungulates

- Monitoring beat level seasonal occupancy of wild ungulates through signs and symptoms
- Monitoring the anthropogenic threats to wildlife and habitat

- **Managerial/Administrative**

- Reserve level MEE.
- Routine monitoring of expenditure through reports based on physical/financial targets/projections.
- Monitoring the impact of investment (intervention) through timeline G.I.S. mapping (wherever feasible).
- Impact of ecodevelopment activities in the fringe villages.
- Transboundary cooperation and collaboration

PART II – BUFFER AREA

PART A: THE EXISTING SITUATION

CHAPTER ONE

INTRODUCTION

Manas Tiger Reserve (MTR) exists in Assam along the Indo-Bhutan Himalayan foot hills on the North of the river Brahmaputra. Manas Tiger Reserve is located between 26030'N to 26045' N and 89045' E to 92030' E in India. It was created in 1973 under the Project Tiger with a total area of 2840 km². It was also notified as a Tiger Reserve under the Wildlife (Protection) Act, 1972 by the State Govt in 2007-2010 to cover a total area of 2837.10 sq. km. (Core = 526.26 km² and Buffer = 2310.88 km²).

1.1. Name, Location, Constitution and Extent: -

Manas Tiger Reserve (MTR) is spread across the 4 districts of BTAD with a total area of 2837.10 sq. km. out of this, 500 sq. km. is notified as the core. The Core and buffer area demarcation of MTR was established vide Assam Govt Notification No. FRW.25/2008/36 dated 30.05.2008. Geographically the Reserve is bound by the river Sankosh in the East, Bhutan hills in the North, river Dhansiri in the East and a fringe of about 151 forest villages and few major townships and settlements spanning a length of 220 km² and width of 20-30 km² approximately. Administratively, MTR is controlled by a Field Director with headquarters in Manas National Park. There is also an overlapping jurisdiction with 5 Territorial Divisions in the buffer Reserved Forests (RF) areas, under the control of Council Head of Department, Forest, BTC. The notification of Buffer is enclosed as Annexure.

1.1.2. Extent (Area Statement and legal Status): -

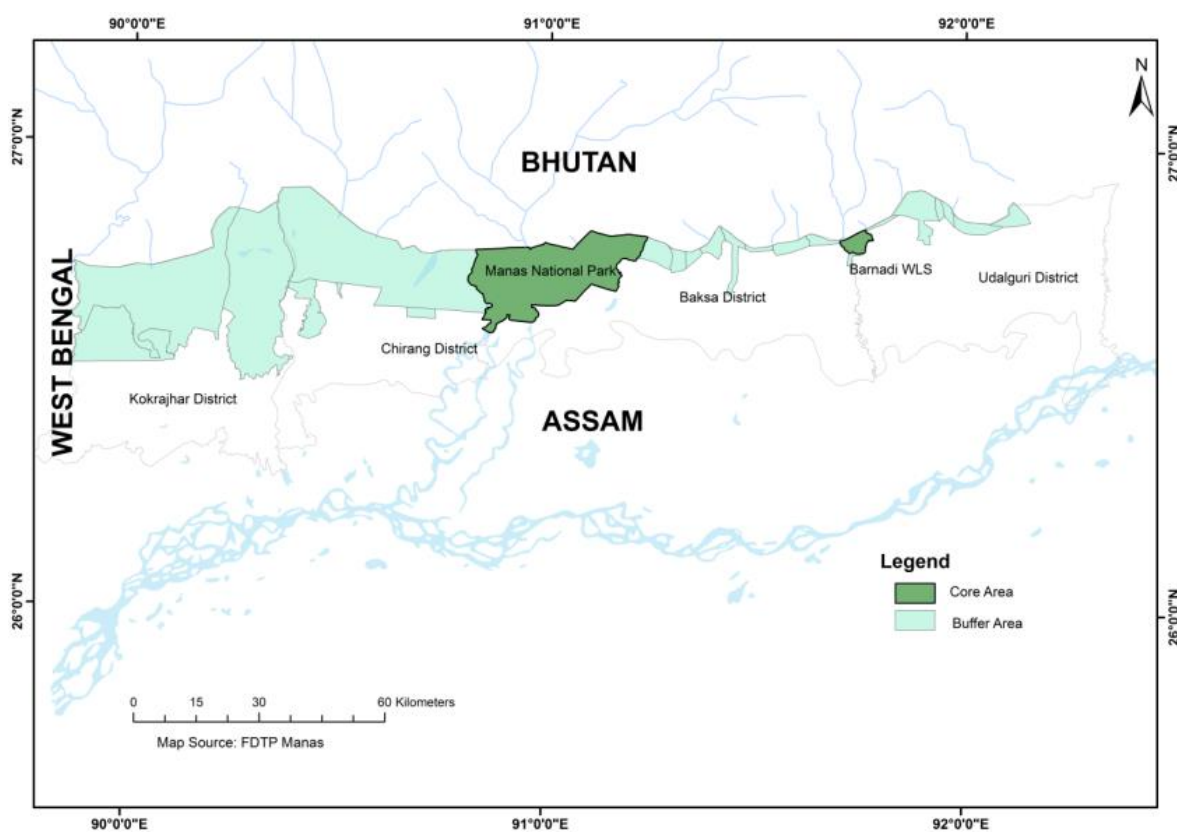
MTR stretches over a length of approximately 230 sq. km. from west to east and 30 km. from north to south. The total area of the Reserve is 2837.10 sq. km. The total Buffer area of Manas Tiger Reserve is 2310.88 sq. km. The break up of Reserved Forests and others Govt. notified forests in the Buffer is given below: -

Table 1.1: Division wise names of RF and their areas within the TR buffer as on today:

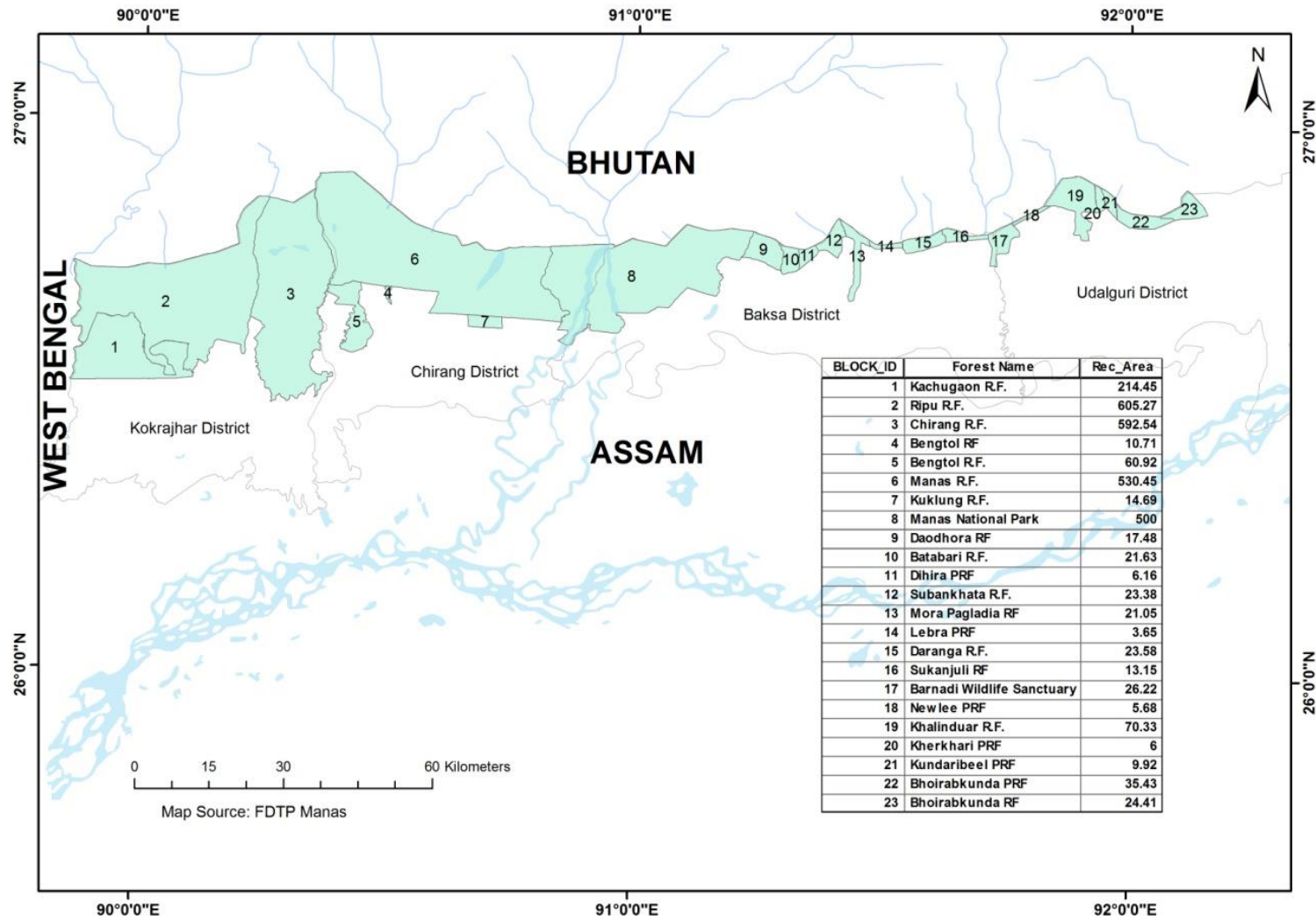
Sl. No.	Name of Division	Forest (RF/PRF)	Area (sq. km)
1	Kachugaon Division	Ripu RF	605.27
		Kachugaon RF	214.45
		Chirang RF	592.54
2	Haltugaon Division	Bengtoll RF (Part 1)	10.71
		Bengtoll RF (Part 2)	60.92
3	Chirang Division	Manas RF	530.45
		Kuklung RF	14.69
4	Baksa Division	Daodhara RF	17.48
		Batabari RF	21.63
		Subankhata RF	23.37
		Morapagladia RF	21.05
		Darranga RF	23.58

		Sukanjuli RF	13.15
		Lebra PRF	3.65
		Dihira PRF	6.16
5	Dhansiri Division	Khalingduar RF	70.33
		Kherkhari PRF	6.00
		Kundar beel PRF	9.93
		Bhairabkunda PRF	35.43
		Bhairabkunda RF	24.41
		Newlee PRF	5.68
TOTAL AREA =			2310.88

Map 1.1: Location map of Manas Tiger Reserve (core and buffer area) in Assam, India



Map 1.2: Map showing all forest areas under Manas Tiger Reserve

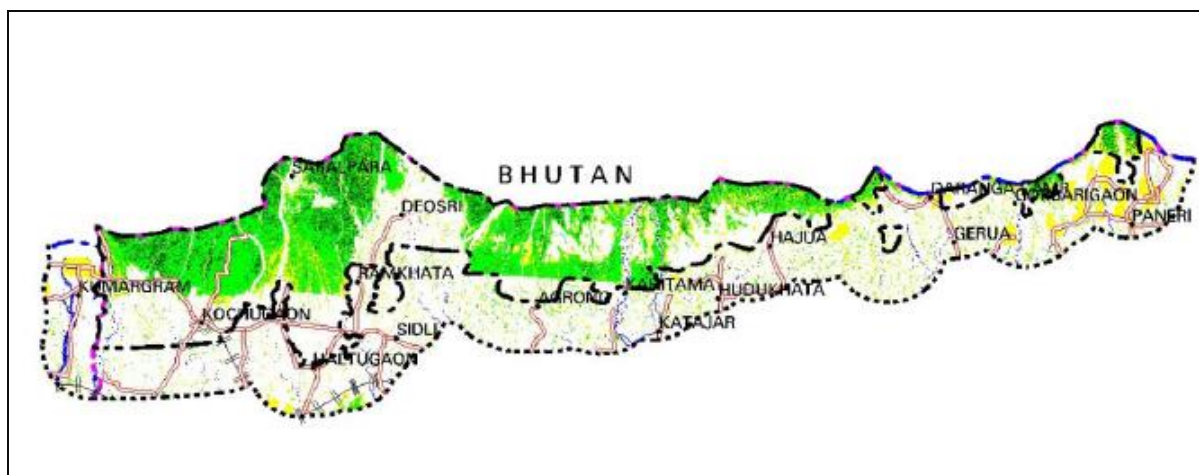


1.1.3. Legal Boundaries: -

As per the boundary description available, MTR extends from the point where the Sankosh river cuts the Indo-Bhutan International Boundary, eastwards to the point where the tri radiate pillar indicates the Assam, Bhutan and the Arunachal boundaries. From that point eastwards and then westwards along the southern boundaries of Khalingduar, Barnadi Wildlife, Morapagladiya, Subankhata, Batabari, Dihira, Daodhara RF, Manas National Park, Manas RF, Bengtol RF, Chirang RF and Ripu RF and Kachugaon RF till it meets the Sankosh river downstream. The northern boundary of all RFs excepting the Morapagladia, Baman and Korua is the common international boundary with Bhutan which is relayed by survey parties of India at regular interval of time. The southern boundary of RFs running along the cultivated field is partly clear in some areas whereas partly not clear in rest of the areas because of past encroachment. The eastern and western boundaries are formed mostly of rivers and nallahs that have also changed course over time. The situation is much more aggravated when the river course forms the boundary between cultivated land and RFs.

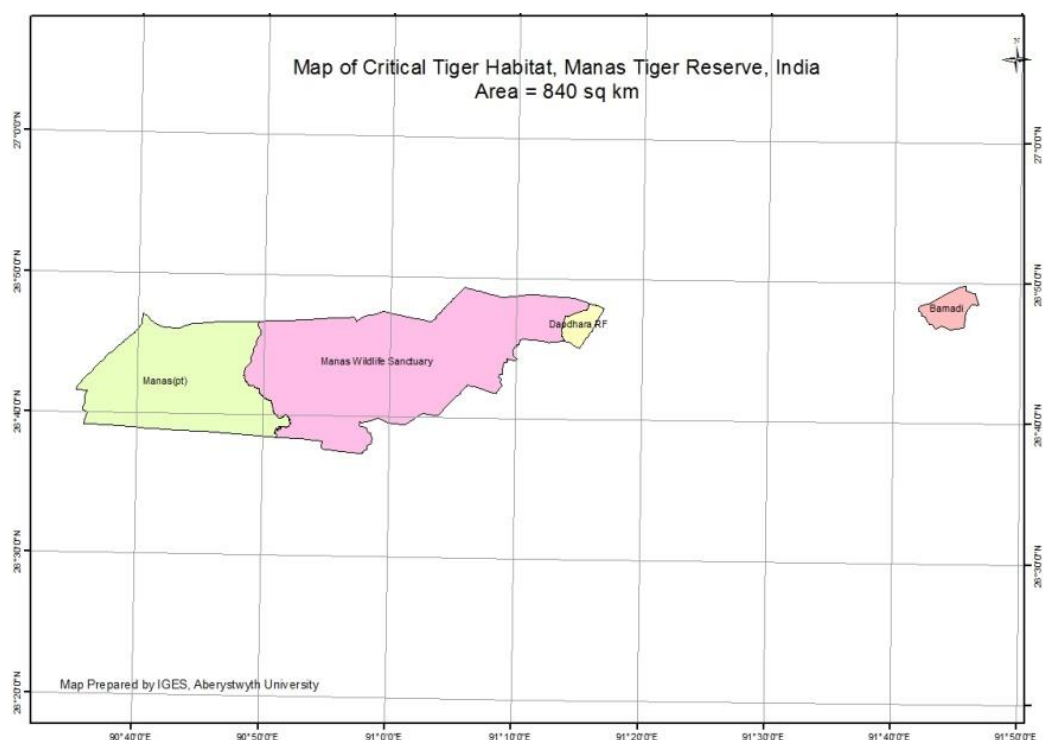
1.1.4. MTR Spatial Boundaries over time: -

Manas Tiger Reserve boundary in 1973- Very little information regarding the spatial boundary details and extent of the tiger reserve could be obtained. The Forest Survey of India Report of 2008 that estimated the change in forest cover between 1997 and 2007 thus formed the basis for delineating the boundary and area (2840 sq km) details at the time of inscription as a Tiger Reserve.



Map 1.3: Forest types and boundary delineation of Manas Tiger Reserve, 1973
(Ref: FSI, 2006)

Manas Tiger Reserve boundary in 2010-As per the amendment to the Indian Wildlife (Protection) Act, 2006, all tiger reserves now come under the purview of the highest statutory law protecting the wildlife in the country. While the core/critical tiger habitat for Tiger Reserves need to be declared by the State government, the buffer can be declared in consultation with the local community. Subsequently the Core/critical Tiger habitat for Manas has also been declared by the Assam state government recently. No spatial map for the aforementioned TR was available till date and an attempt has been made to delineate the same (Fig. 3, Table- 3).



Map 1.4: Critical Tiger Habitat of Manas Tiger Reserve

Table 1.2 Critical Tiger Habitat of Manas Tiger Reserve
(as per Assam Government notification No.FRW.2/2007/17 dated 20th Dec 2007)

Sl. No.	Name	Area (km ²)
1	Manas National Park	500.00
2	Barnadi Wildlife Sanctuary	22.21
3	Daodhara RF	17.49
4	Manas RF (part)	300.34
Total =		840.04

1.1.5. Ecological Boundaries: -

Given the dynamic landscape of MTR buffer that has seen both natural and anthropogenic led changes in the recent past, the ecological boundaries are of greater significance than the legal one. Ecologically, MTR is in proximity to a large forested landscape in neighbouring Bhutan. MTR has a contiguous boundary with Phipsu Wildlife Sanctuary in the west, Royal Manas National Park in the centre and Khaling Wildlife Sanctuary to the East of the Reserve. All together, they form the world's single largest Tiger Conservation Landscape for Bengal tigers in the world and is popularly known as the The Indo-Bhutan Tiger Conservation Landscape (IBMTCL).

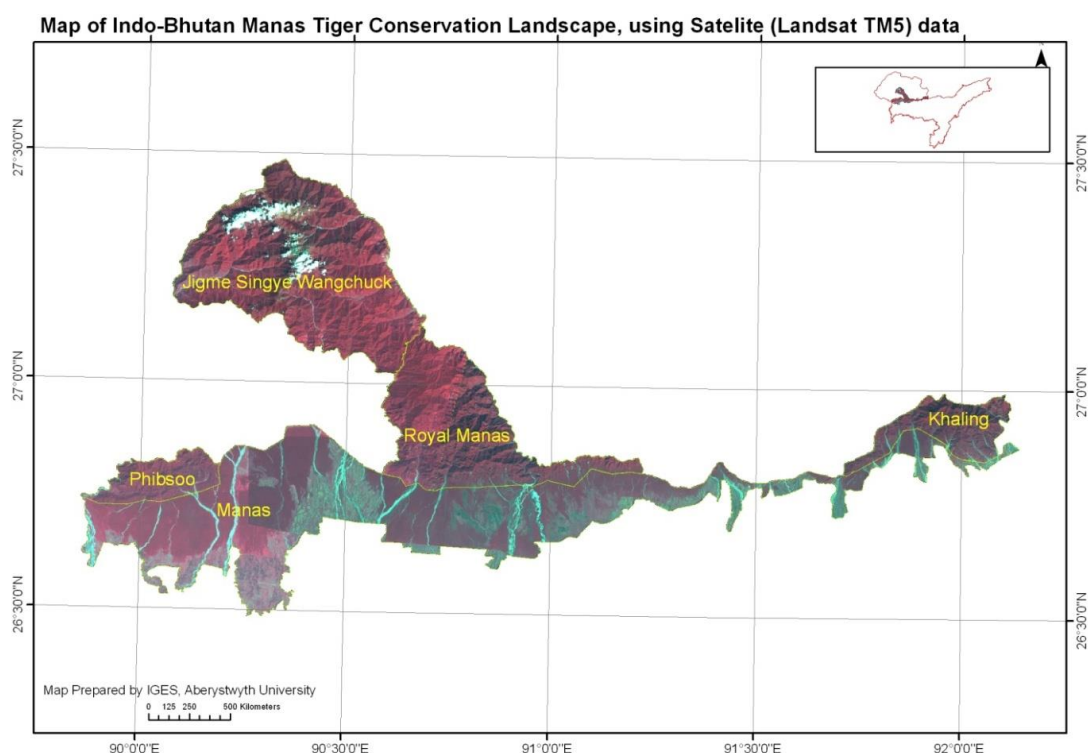
Biogeographically it lies in the Burma Monsoon Forest province and is a Category II IUCN Protected Area Category. Geographically the Reserve is bound by the river Sankosh in the East, Bhutan hills in the North, river Dhansiri in the East and a fringe of about 151 forest villages and few major townships in the south.

1.2. Approach and Access: -

The entire southern boundary of MTR can be approached from east to west by travelling on the NH 31c. Access to various forests of the buffer is connected through numerous metalled and fair weather roads. Depending on the road condition and time of travel, MTR can be accessed within 3 hours from Guwaahati. The nearest railway stations for major trains are Kokrajhar, New Bongaigaon, Barpeta Road and Rangiya. The nearest airports are at Guwahati and Bagdogra at a distance of about 150 km and 250 km respectively.

1.2.1. Statement of significance: -

Manas Tiger Reserve forms an integral part of Indo-Bhutan Manas Tiger Conservation Landscape (IBMTCL). IBMTCL lies at the critical juncture of the Indo-Malayan and the Indo-Gangetic bio-geographical pathways and was recently lauded for its outstanding natural beauty and unparalleled diversity (UNESCO, 2008). The IBMTCL forms an important connecting link between the Buxa, Nameri and Pakke Tiger Reserves in India, and the Hukaung Valley Tiger Reserve in Myanmar. Within this region, a number of Park Areas (PAs) exist, including Jigme Singye National Park (NP), Royal Manas NP, Phibsoo Wildlife Sanctuary (WLS), the Khaling WLS in Bhutan and the Manas Tiger Reserve in India. Together, they form the single-largest Tiger Conservation Landscape (TCL) for Bengal tigers (*Panthera tigris tigris*) in the world (Sanderson et.al. 2006). The IBMTCL has a total area of more than 6541.58 sq. km. and within this area, tigers are known to inhabit the low lying (50 m above sea level) savannah woodlands, sub-tropical moist deciduous and semi-evergreen forests as well as the mid-altitude temperate broadleaf and sub-alpine forests (upto 4100 m.a.s.l). These diverse and extensive habitats and the low density of human populations (in Bhutan) make the area an ideal refuge for tigers as well as other large- bodied animals such as elephants.



Map 1.5: Indo-Bhutan Manas Tiger Conservation Landscape

Table 1.3: Details on Protected Areas within IBMTCL-

Sl. No.	Name of Protected Area	Area in Sq. Km.	Forest type	Status of Tigers in the PA
1	Manas Tiger Reserve, India	2840.00	Subtropical Forests interspersed with savannah grasslands	Uncertain
2	Royal Manas National Park, Bhutan	1057.00	Subtropical	Camera-trap based density estimation currently being undertaken by the Forest Department.
3	Jigme Singye National Park	1730.00	Temperate and upland broadleaf	A single camera-trap study gave an estimate of 8 Tigers ~0.52 tigers /100 km ² . (Wang and Macdonald, 2009)
4	Phibsoo Wildlife Sanctuary	268.93	Subtropical	Uncertain
5	Khaling Wildlife Sanctuary	334.73	Subtropical	Uncertain
TOTAL =		6228.00		

1.3. Geology, rock and soil: -

The geology of Manas consists of Bhabar and Terai tract zone with sandy loam soil, granite and igneous as bed rocks. There is a well marked 'Bhabar' tract of rocky soil towards the northern boundary of the Reserve which contains sand stone, lime stone and shale, and hence very little moisture retaining capacity. The Bhabar tract generally remains drier. It is characterized by maximum relief, dissection and drainage density within it.

The Terai formation is alluvial, comprising of mixture of boulders and sand, covered by debris, sand soil, silt and clay brought down by the rivers. Boulders are of granite, gneiss and quartzite and are well rounded to sub-round. The gravel deposits contain granite, gneiss, phyllite, and slate schist. This leads to the formation of alluvial terraces, comprising deep layers of deposited rock and detritus overlain by sandy loam and then a thin layer of humus. Towards further south is the ill drained clayey terai tract. These terai tracts are more or less flat. The 'terai' tract in the south consists of fine alluvial deposits with underlying pans. The area of the Beki basin, in the west of the Park, is sometimes inundated during the monsoon but never for very long due to the sloping relief. The flood plain abuts against the dissected mountain front of the Sub-Himalayas.

Over the limestone and sandstone bedrock of the Bhabar savanna area in the north, this has formed shifting river channels and swamps and a soil of porous alluvial terraces of coarse detritus under layers of sandy loam and humus where the water level is very low. The terai grasslands in the south consist of deep deposits of fine alluvium with underlying pans where the water table lies very near the surface, making it potentially useful farmland. Elevation ranges from 50 masl on the southern boundary to 250 masl along the Bhutan hills.

1.3.1. Sub-recent to recent formation: -

The geological formations normally encountered towards the south of the Reserve are one of Sub-recent to recent origin and comprise of the following: -

- **Bhabar Formation:** - This formation is represented by loose gravels, boulders and river deposits that are highly variable in composition and texture. This is also known as older alluvium. Sub-surface data indicate that clay is mixed in varying proportion and demarcation of distinct clay bed cannot be made. Except during monsoon, the formation is apparently devoid of water and the streams carrying water disappear in the porous structure of the formation and reappear further down south in the form of springs.
- **Terai Formation:** - This formation is transitional in character between the alluvial formation in south and Bhabar formation in the north. It is better stratified and has more clay than in the Bhabar formation.
- **Alluvial Formation:** - It is mainly represented by silt and clay without much gravel or boulder. It constitutes the flat plains to the South of the Reserve which is under extensive cultivation. The soil is uniform throughout consisting of a light, friable loam varying in depth from 15 cm to 90 cm. In the uplands to the north of duars the soil is ferruginous clay.

1.4. Hydrology and Water Resources:-

The water table in the Northern Bhabar tract is usually very low. In the southern Terai region the water table is high. The perennial streams and dug wells form the main source of water supply for plantation works and human habitation. Since most of the area is covered with loose sand and gravel, there is immense potential for the development of ground water. Ground water occurs both under water table as well as in deep aquifers. Slope of water table is generally parallel with the surface slope, which is southwards. At places, the water table slope intercepts the ground surface forming springs. MTR typically represents the Himalayan Bhabhar-Terai landscape which is a zone of porous and rocky soils and a seasonally marshy zone of sand and clayey soils. Major rivers flowing through the Reserve from North to South are the Sankosh, Saralbhangra, Aie, Dhansiri, Manas and Pagladia. The entire reserve is an alluvial basin with altitude varying from 61- 110m (UNESCO, 2008).

Table 1.4: Rainfall pattern in some locations of MTR-

Month	Average Rainfall	Month	Average Rainfall
January	320 mm	July	3210 mm
February	520 mm	August	2946 mm
March	1750 mm	September	2326 mm
April	1400 mm	October	473 mm
May	1378 mm	November	120 mm
June	2551 mm	December	360 mm

1.5. Terrain:-

The Reserve is mainly situated in Bhabar and Terai areas consisting of slightly undulating land with a general inclination from North to South. It extends in some places into

the outer range of Himalayas and reaches an elevation of 250 masl. The forests of this Reserve are intersected by numerous rivers originating both from hills and plains with a general flow from North to South.

1.6. Climate:-

The climate is mainly subtropical with seasonal temperature varying from 50°C to 37°C. The mean annual rainfall is 4000 mm approximately. It rains from mid- March to October with most rain falling during the monsoon months from mid-May to September, flooding the western half of the Reserve. November to February is relatively dry when the smaller rivers dry up and large rivers dwindle (Deb Roy, 1990). The climate can be divided in four distinct seasons on the basis of variation in rainfall, temperature and winds (Borthakur, 1986). These are winter (December- February), pre-monsoon (March-May), monsoon (June-September) and retreating monsoon (October-November). These are as follows:-

Winter (December - February):- Characterized by cool weather and fog. The temperature remains 20°C + 5°C. January is the coldest month. Average total rainfall is 114 mm with relative humidity of 77% + 5.

Pre-monsoon (March - May):- It is a transitional period between relatively dry winter and hot summer and is characterized by a rapid rise in temperature. As the season advances, the amount and frequency of rainfall increases due to frequent thundershowers with hailstorms. Average total rainfall during the season is 518.70 mm. The season is marked progressively by a greater number of cloudy days. Average temperature and humidity in this season are 23°C + 5°C and 70% + 5 respectively.

Monsoon (June - September):- It is the characteristic major rainy season of the year. The average monthly rainfall is 2860 mm. The average temperature during this season is 27.17°C with an average diurnal range of over 6°C. The humidity increases to 82% + 5. August is the hottest month.

Retreating monsoon (October - November):- Towards the end of September, the monsoon weakens with an abrupt retreat followed by fair weather. With the advancing of the season the temperature falls and moving mist and fog appears. The average temperature is 27°C + 2. The average monthly rainfall is 1400 mm and the rainy days become fewer. Relative humidity is 82% + 5.

Table 1.5: Temperature profile throughout the year in MTR-

Month	Maximum	Minimum
January	21.0°C	8.0°C
February	22.8°C	9.8°C
March	24.7°C	15.2°C
April	26.9°C	18.7°C
May	29.4°C	23.1°C
June	31.0°C	24.0°C
July	32.0°C	25.1°C
August	30.6°C	25.0°C
September	29.0°C	23.95°C
October	28.9°C	23.2°C
November	24.1°C	16.6°C
December	22.1°C	9.6°C

Table1 6: Humidity Profile throughout the year in MTR-

Month	Maximum	Minimum
January	75%	46%
February	82%	42%
March	82%	52%
April	90%	56%
May	91%	61%
June	91%	69%
July	95%	68%
August	97%	74%
September	93%	73%
October	89%	67%
November	78 %	63%
December	75%	45%

1.7. Vegetation types:**1.7.1. Biogeographic classification:-**

The Burma Monsoon Forests of Manas lie on the borders between the Indo-Gangetic and Indo-Malayan bio-geographical realms and is part of the Brahmaputra Valley Biogeographic Province. The combination of Sub-Himalayan Bhabar Terai formation with riverine succession leading up to Sub-Himalayan mountain forest makes it one of the richest biodiversity areas in the world. As per the revised classification of Indian Forest type by Sri H.G. Champion and Sri S.K. Seth (Champion & Seth, 1968), the forest types present in MTR are as follows:-

1. Very Moist Sal Forests : 3C/CI
 - (a) East Himalayan Upper/Lower Bhabhar Sal : 3C/Cib (i) & 3C/CI/Cib (II)
 - (b) Bamba Sub-Type Sal Forest : 3C/Cib(i) (IV)
 - (c) Eastern Terai Sal forests : 3C/CIC
2. Sub-Himalayan High alluvial Semi evergreen forests : 2B/CI/ISI.
 - (a) Jam -Bhelu-Sam Sub-Type : 2B/CI ISI (b)
 - (b) Sapa Sub-Type :
 - (c) Bonsum Sub-type : 2B/CI/IIS (C)
3. Moist mixed deciduous forests : 3C/C3b & 3C/C3/2SI
4. (a) Moist Sal savannah (Dry grass-land) West grass land): 3/ISI
5. Riparian fringing forest : 4E/RSI
6. Khair-Sisoo forests : 5/IS2

Floristic description:-**A. Very Moist Sal Forest 3C/CI**

The general appearance and composition of the main canopy is indistinguishable from that of the moist Sal Forest. Sal remains as the gregarious species. The tree grows from 25 M to 40 M according to site quality with annual burning. The under-growth is also closely similar in appearance and composition, consisting mostly of shrubs under a closed canopy.

Grass invades rapidly wherever the canopy is at all broken. An evergreen lower story and shrub growth redevelops and fire protection is afforded. The associate of the Sal are markedly fire hardy.

- (a) East Himalayan Upper/Lower Bhabhar Sal:- 3C/Cib (i) & 3C/Cib (ii)- The description of these two sub-types, the upper Bhabhar Sal and Lower Bhabhar Sal are given together, since it is very difficult to differentiate these two sub-types due their close similarity of the crop quality and the associates. The upper Bhabhar Sal occurs on alluvial well drained soil with deep boulders on the upper region of the Ripu Reserve and is characterized by the presence of dense Sau grass (*Microstegium cillatum*), while the lower Bhabhar Sal occurs in the lower region in slightly damper locality with less evidence of *Microstegium* (Sau grass). The quality of Sal in this sub-type (s) is of All India quality I/II. This type occupies most of the Ripu Reserve starting from the foot hills of Himalayas to about 15 km. southwards approximately up to Ride 2 and in between the Janali River on the West and the Hel River on the East. The principal associate species in the top storey are *Schima wallichii*, *Terminalia belerica*, *sterculia villosa*, *Bombax ceiba*, *Albizia procera*, *Amoora wallichii*, *Lagerstroemia parviflora*, *Albizia labbek*, *Fagara budrunga*, *Ilex godajam*, *Alstonia scholaris*, *Michelia champaca*, *Pterospermum acerifolium*. There is a thin middle storey of poles of the above species, *Careya arborea*, *Wrightia tomentosa*, *Callicarpa arborea*, *Premna latifolia*, *Bauhinia* species, *Dillenia pentagyna*, *Vitex penducularis*, *Lannea grandis*, *Cassia fistula* etc.

The ground cover is characterized by Sau grass with the presence of thatch (*Imperata cylindrica*) in open areas which are subject to annual burning. Along with the main cover of Sau grass and thatch in open areas, the following species are also found as scattered ground cover, *Flemingia* spp, *Coffea bengalensis*, and shrubs like, *Leea*, *Clerodendron* spp. etc. *Eupatorium odoratum* occurs in more open areas and near the village areas and is replaced by thatch with annual burning. Big patches of young Sal are found in this type along with the main crop where fire protection of grass land was carried out in the past. The young age classes are deficient in the rest of the area, but whenever the cover is pre-dominantly thatch, Sal seedlings are plenty in spite of repeated burning: but these seedlings get established immediately when the fire protection is afforded by way of controlled burning.

- (b) Bamba sub-type Sal Forests: 3C/Cib (i) (iv):- The Sub-type is characterized by the presence of some fire tender evergreen species as associate of Sal. The terrain is well drained and gently undulating with greater soil depth and less surface stones than the typical Bhabhar tract. The Sal that occurs in the tract is of excellent height and girth but its stocking is poor due to a great admixture with miscellaneous species, both of the mixed deciduous type and the evergreen type. The principal associates of Sal are *Schima Wallichii* *Terminalia belerica*, *Pterospermum accerifolium*, *Stereospermum personatum*, *Lagerstroemia parviflora*, *Bombax ceiba*, *Ilex gudajam*, *Michelia champaca*, *Alstonia scholaris*, *Cedrela toona*, *Phoebe goalparensis*, *Cinnamomum cecidodaphne*, *Disoxylum binectiforum*. A middle storey is noticeable of *Premna*, *latifolia*, *Mallotus phillippinensis*, *Wrightia tomentosa*, *Holarrhena antidysentrica*, *Bridelia retusa*, *Amoora Wallichii*, *Gmelina arborea*, *Syzigium cuminii*, *Lannea grandis*, *Dillenia pentagyna*, *Premna bengalensis* etc. The characteristic ground cover is heavy *Microstegium ciliatum* (Sau grass) under moderate canopy condition. When the canopy is very dense light Sau or shrubs like *Clerodendron infortunatum*, *Coffea bengalensis* occupy the ground. In the very open canopy condition and in areas subject to burning in the path, patches of

Imperata arundinacea along with weeds of *Eupatorium odoratum* occur. The Sal crop in Bamba consist mostly of mature trees well spaced out. Advance growth of all categories is remarkably deficient except for a few small patch of evergreen forests when the incidence of late fire is less.

- (c) Eastern Terai Sal Forests:- 3C/Cic- This type of Sal is found in a narrow belt south of the Bhabhar Sal. Conditions in Terai Sal are more moisture than in Bhabhar Sal, due to high water table and greater proportion of clay-content in the composition of the soil here. The Sal of this type does not attain such fine height growth as the Bhabhar sal, but in the well drained area on the high river bank better quality Sal (as good as Bhabhar Sal) is occasionally found. When the water table is high and result in poor drainage, the height growth of sal becomes poorer. The stocking of Sal is good. The proportion of younger classes is more here than in Bhabhar Sal. This is most probably due to heavy extraction in the past for its easy accessibility and the area being served by more floatable streams for extraction of the large sized trees. The quality of Sal is on the whole II to III. The principal associates are *Schima wallichii*, *Stereospermum personatum*, *Albizia procera*, *Bombax ceiba*, *Sterculia villosa*, *Lagerstroemia parviflora*, *Amoora wallichii*, *Terminalia belerica*, *Alstonia scholaris* etc. The middle storey is composed of *Turpinia pompifera*, *Talauma hodgsoni*, *Machilus villosa*, *Aporosa roxburghii*, *Eugenia operculata*, *Bridelia retusa*, *Dysoxylum binectiferum*, *Syzygium cuminii* etc. The undergrowth and ground cover is quite dense and consists of *Morinda angustifolia*, *Leea indica*, *Alpinia spp.*, *Microstegium ciliatum* and *Eupatorium odoratum* are common in open canopy area.

B. Sub-Himalayan High Alluvial Semi-Evergreen Forests..... 2B/CI/ISI

This type of forests occurs on the high ground of the Ripu Reserve on the North Eastern side in Bamba and Singimajuli Block and represents the climax vegetation of the locality. Three district sub-type can be recognized, the Jam-Bhelu-som Sub-type, Bonsum Sub-type.

- (a) Jam Bhelu-Som Sub-Type 2B/CI/ISI/ (b):- This sub-type can be said to be a transition belt from the deciduous to evergreen type. Here, in this type, *Tetrameles nudiflora* is the pre-dominant species. The associates are *Syzygium cuminii*, *Tetrameles nudiflora*, *Machilus bombycina*, *Stereospermum personatum*, *Albizia lebbek*, *Garuga pinnata*, *Amoora wallichii*, *Chukrasia velutina*, *Pterospermum acerifolium*, *Cedrela toona*, *Shorea robusta*, *Phoebe goalparensis*, etc.
- (b) Sopa Sub-Type 2B/CI/ISI (C):- The Sopa Sub-type occupies comparatively high ground above the Bonsum Type. There is no general canopy level and principal emergent associates are *Tetrameles nudiflora*, *Acrocarpus fraxinifolius*, *Schima wallichii*, *Michelia champaca*, *Phoebe goalparensis*, *Sterculia alata*, *Pterospermum acerifolium*, etc.
- (c) The Bonsum (*Phoebe goalparensis*) Sub-Type-Approximate To CB/CI/ISI (b) & 2B/CI/ISI (C)- The Bonsum sub-type represents the climax vegetation of the locality and occupies a high ground surrounded by the other Sub-type. The conspicuous layer in the top canopy is composed of scattered trees *Michelia champaca*, *Tetrameles nudiflora*, *Acrocarpus fraxinifolius*, *Ailanthus grandis*, *Phoebe attenuata* with *Bombax ceiba* towards the river side. Below this layer, the proper canopy occurs with *Phoebe goalparensis*, *Sterculia alata*, *Cinnamomum cecedodaphne*, *Schima wallichii*, *Canarium species*, *Dysoxylum hamiltonii*, *Gmelina arborea*, *Terminalia belerica*, *Castenopsis species*, *Pterospermum acerifolium*, *Duabanga sonneratioides*, *Stereospermum*,

chelonoides, *Garuga pinnata*, *Cedrela toona*, *Sterculia villosa*, *Terminalia myriocarpa*, *Polyalthia simiarum*. The third storey is composed of *Machilus bombycina*, *Amoora rohataka*, *Premna bengalensis* etc. The characteristic under-growth is *Morinda*, *Leea cuspidata*, *Adhatoda vasica*, *Phlogacanthus thyrsoiflorus* etc. and the ground cover consists of *Coffea bengalensis* and other evergreen shrubs.

C. Moist Eastern Himalayan mixed deciduous forest..... 3C/C3b & 3C/C3 2SI

This represents a composition of both the above forest type as mentioned by Champion and Seth in their revised survey of the forest types of India. This type of Forests occurs in between the patches of Sal, in the middle slopes and depressed areas and between the grass-land and Sal. Variations in drainage and moisture retention capability of the soil seem to be responsible for exclusion of Sal. Thus the type is definitely in a transitional stage in between the riparian forests and Sal forests and is arrested at the pre-climax stage due to local variation of soil. The predominant species in such areas (associates of Sal) *Terminalia belerica*, *Sterculia villosa*, *Lagrestroemia parviflora*, *Dillenia pentagyna*, *Michelia champaca*, *Albizzia lebbek*, *Stereospermum personatum*, *Bombax ceiba*, *Cedrela toona* etc. The middle storey is made up of the saplings of the above species and *Wrightia tinctoria*, *Emblica officinalis*, *Bridelia retusa* etc. In open canopy conditions *Imperata spp.*, *Anthistiria gigantea*, *Saccharum*, *Clerodendron*, *Phlogacanthus*, *Litsea spp.* *Coffea bengalensis* etc. are found as ground cover.

D. Savannah Forests:-

- (a) Moist Sal Savannah (Dry grass-land): 3C/C2/DSI- This is the moist extensively occurring tall grass Savannah forest type. This type is found in badly drained low-lying grounds and in more stable riparian flats which tend to be flooded during the rainy season but dry out during the rest of the year. The soil is alluvial, namely sandy, with a thin surface layer of loam with more humus. The main tree species found in these areas *Bombax ceiba*, *Albizzia procera*, *Careya arborea*, *Bischofia javanica*, *Dillenia pentagyna*, *Grewia sapida* and *Premna herbacea*. Principal grasses are *Saccharum spontaneum*, *Phragmites karka*, *Andropogon assimilis*, etc.

E. Riparian Fringing Forests 4E/RSI

This type consists of plant communities in seral stages found along the banks of the streams that flow through the Reserved Forests. The succession progresses according to the formation of soil from the river bed with deposits of silt. The principal species are *Bombax ceiba*, *Acacia catechu* and *Dalbergia sissoo*. In the later stage, *Albizzia procera*, *Bridelia retusa*, *Lagrestroemia parviflora* and a few species more characteristic of the miscellaneous deciduous type come in.

F. Khoir, Sissoo Forests 5/ISI

This type comes under primary seral succession of tropical Dry deciduous Forest and is fully described by Champion and Seth. This is found mainly along the Sankosh, the Hel, Singi Rivers and in Athiabari block between the Hel and the Saralbhangra rivers. This principal species in this type, as the name itself suggests are *Acacia catechu* and *Dalbergia sissoo* growing either in admixture with each other or in separate pure blocks. Young stands of Sissoo in excellent forms can be seen in silt formed in beds of the above rivers as well as in fresh silt deposits on the bank. Most of the growing stock is young and only a few trees of

utilizable size are available. But due to the unstable nature of the soil, the excellent growing of Sissoo or Khoir are often found uprooted and washed away by the rivers during the rain.

Out of these moist and dry deciduous forests is the most common type in the buffer areas while low alluvial savannah woodland and semi-evergreen alluvial grassland cover the majority of the national park areas. Much of the riverine dry deciduous forest is at an early succession stage. It is replaced by moist deciduous forest and semi-evergreen climax forest along the higher altitudes of the Reserve. A total of 543 plants species have been recorded from the core zone of which 30 are Pteridophytes, 139 are Monocots and 374 are Dicots.

The availability of forage to herbivores:-

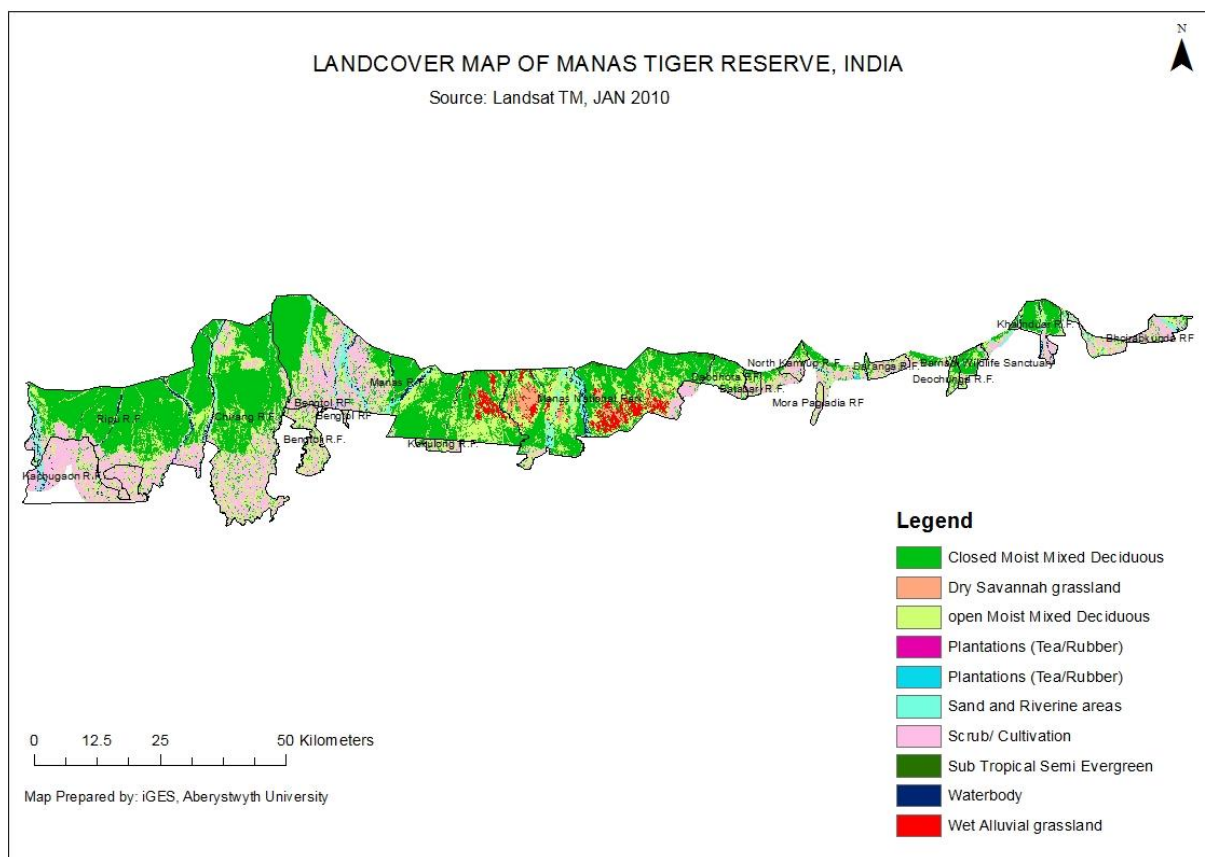
High incidence of occurrence of species per unit area and wide variety of grass, herbs and shrubs has enriched the fodder resources of the buffer forests, although they are in direct competition with domestic livestock and human interference. Besides, there are many species of bamboos and ferns which are browsed by the herbivores. The general availability of the browse species, their palatability, indices, temporal and spatial distribution of browse and temporal browse preference of the herbivores require detailed investigation. However, a list of plant species that serves food to wild herbivores is given in Tabl below:-

Table:-1.7 List of Select plant species that serve as food to Golden Langur and other wild herbivores (Source: Management Plan of Chakrashila WLS)

Sl. No.	Local Name	Botanical Name	Family
1	Amari	<i>Agalaia fiernil</i> Visw.& Ramach.	Meliaceae
2	Amlakhi	<i>Phyllanthus emblica</i> L.	Euphorbiaceae
3	Ahot	<i>Ficus benghalensis</i> L.	Moraceae
4	Bohera	<i>Terminalia beleirica</i> (Geaertn)Roxb.	Combrefaceae
5	Hilika	<i>Terminalia chebula</i> Retz	Combrefaceae
6	Zabrang	<i>Zanthoxylum rhetsa</i> (Roxb)DC	Rutaceae
7	Bandordima	<i>Dysoxylum bincetariferum</i> Hook.f. & Bedd.	Meliaceae
8	Bhatghilla	<i>Oroxylum indicum</i> (L.) Vent	Bignoniaceae
9	Bonam	<i>Mangifera sylvatica</i> Roxb.	Anacardiaceae
10	Bhelu	<i>Tetrameles nudiflora</i> R.Br.	Datisceae
11	Bhelkar	<i>Trewia nudiflora</i> L.	Euphorbiaceae
12	Bogipoma	<i>Chukrasia tubularis</i> A. Juss.	Meliaceae
13	Dudhkuri	<i>Holarrahenia antidysentrica</i> Flem.	Apocynaceae
14	Dudli	<i>Wrightia tomentosa</i> Roem & Schultz	Apocynaceae
15	Dimaru	<i>Ficus hispida</i> L.F.	Moraceae
16	Deba-San	<i>Artocarpus lakoocha</i> Roxb.	Moraceae
17	Gamari	<i>Gmelina arborea</i> Roxb.	Verbenaceae
18	Gunarugonderi	<i>Premna latifolia</i> Roxb.	Verbenaceae
19	Gohora	<i>Premna bengalensis</i> Clarks	Verbenaceae
20	Gohora	<i>Premna panduana</i>	Verbenaceae
21	Hatipolia	<i>Pterospermum acerifolium</i> Willd.	Sterculiaceae
22	Hingori	<i>Castanopsis indica</i> A.DC.	Fagaceae
23	Hiharu	<i>Albizia odoratissima</i> (L.F.) Benth.	Mimosaceae
24	Jam	<i>Syzygium cumini</i> (L.) Skeels	Myrtaceae
25	Jorath, Rohini	<i>Mallotus philippensis</i> (Lamk.) Muell. Arg.	Euphorbiaceae
26	Jia	<i>Garuga pinnata</i> Roxb.	Burserraceae

27	Jiga	<i>Lannea coromandelica</i> (Houtt.) Merr.	Anacardiaceae
28	Kum	<i>Careya arborea</i> Roxb.	Myrtaceae
29	Kanchan	<i>Bauhinia acuminata</i> L.	Caesalpiniaceae
30	Kanchan	<i>Bauhinia malabarica</i> Rox	Caesalpiniaceae
31	Kanchan	<i>Bauhinia purpurea</i> L.	Caesalpiniaceae
32	Kanchan	<i>Bauhinia varieagata</i> L.	Caesalpiniaceae
33	Kuhit	<i>Bridelia squamosa</i> (Lamk.) Gehrinann	Euphorbiaceae
34	Kadam	<i>Anthocephalus kadamba</i> (Lamk) A. Rich.ex	Rubiaceae
35	Koroi	<i>Albizia procera</i> (Roxb.) Benth	Mimosaceae
36	Maskoita	<i>Callicarpa macrophylla</i> Vahl	Verbenaceae
37	Mahithekera	<i>Cratia brachiata</i> (Lour.) Merr	Rhizophoraceae
38	Muga, Hoanlu, sungal	<i>Litsea monopetala</i> (Roxb) Perx	Lauraceae
39	Morolia	<i>Macaranga denticulate</i> (Bl) Muell-Arg.	Euphorbiaceae
40	Moz	<i>Albizia lucida</i> (Roxb.) Benth.	Mimosaceae
41	Odal	<i>Erythrina variegata</i> L. (<i>E.indica</i> Lamk.)	Papilionaceae
42	Odal	<i>Sterculia villosa</i> Roxb.	Sterculiaceae
43	Oxi	<i>Dillenia pentagyna</i> Rozb.	Dilleniaceae
44	Outenga	<i>Dillenia indica</i> L.	Dilleniaceae
45	Paruli	<i>Stereospermum personatum</i> (Hassk) Chatterjee	Bignoniaceae
46	Pani Kadam	<i>Hymenodictyon excelsum</i> (Roxb.) Wall.	Rubiaceae
47	Poma	<i>Cedrela toona</i> Roxb.ex Roth & Willd.)	Meliaceae
48	Pinchola, Bankapahi	<i>Kydia calicina</i> Roxb.	Malvaceae
49	Phakdima	<i>Trema orientalis</i> (L.) Bl.	Ulmaceae
50	Phulgamari	<i>Endospermum diadenum</i> (Miq.)	Euphorbiaceae
51	Phulsopa	<i>Michelia oblonga</i> Wall.ex Hook & Thomson	Ragnoliaceae
52	Simul	<i>Bombax ceiba</i> L.	Bombacaceae
53	Siris	<i>Albizia lebbeck</i> (L.) Benth	Mimosaceae
54	Som	<i>Artocarpus chama</i> Buch –Ham	Moraceae
55	Seura	<i>Streblus asper</i> Lour	Moraceae
56	Salleng	<i>Sapium baccatum</i> Roxb.	Euphorbiaceae
57	Sal	<i>Shorea robusta</i> Gaertn.f.	Dipterocarpaceae
58	Sonaru	<i>Cassia fistula</i> L.	Caesalpiniaceae
59	Urium	<i>Bischofia javanica</i> Bl.	Euphorbiaceae
60	Bogori	<i>Zizyphus mauritiana</i> Lamk.	Rhamnaceae
61	Titaphul	<i>Phlogacanthus thyrsoflorus</i> (Hard.) Mabb.	Acanthaceae
62	Jati bans	<i>Bambusa tulda</i> Nees & Arn.ex Munro	Poaceae
63	Patbijila	<i>Dalbergia pinnata</i> (Lour.)	Papilionaceae
64	Hatibandhalota	<i>Butea parviflora</i> Roxb.	Papilionaceae
65	Gilalota	<i>Entada pursaetha</i> DC.	Papilionaceae
66	Jangli Alu	<i>Dioscorea bulbifera</i> L.	Dioscoreaceae
67	Kuchialota, Koiralota	<i>Acacia pinnata</i> (L.) Willd.	Mimosaceae
68	Mouhilika, Kuhirlota	<i>Bridelia stipularis</i> (L.) B.L.	Euphorbiaceae
69	Panilota	<i>Vitis latifolia</i> Roxb.	Vitaceae
70	Panilota	<i>Vallisneria</i> spp	

Map 1.6 : Landuse/Landcover map of Manas Tiger Reserve
(source: Landsat TM 2010; Ghosh, 2013)



The forest cover and landuse for MTR buffer region has seen dramatic changes in the last twenty years. Very few studies have actually documented the change.

1.8. Wild Fauna, habitats and Trophic Niches:

1.8.1. Major wild fauna of MTR:-

At the time of inscription as a World Heritage Site in 1985, Manas Wildlife Sanctuary (core) was known to harbor the country's highest numbers of protected and endangered endemic species. About 60 species of mammals, 327 species of birds, 42 species of reptiles, 7 species of amphibians, 5 species of fish and around 103 species of invertebrates had been identified, out of which 21 species were listed under the IUCN Red Data Book. Recent surveys on some of the endangered species have shown a recovery in the population of some of the critically endangered species. Details on faunal recovery have been discussed in the subsequent chapters. MTR buffer is home to one of the most endangered and highly endemic primate species in the world which is the Golden Langur (*Trachypithecus geei*). The golden langur distribution is highly endemic and restricted to a pocket in Bhutan and India. The distribution in India extends over an area of over 2500 sq. km. between 26015' N to 26053' N and 89047' E to 92055' E longitude geographical coordinates, that almost overlaps with the buffer and boundary of MTR. The distribution is contiguous with the Bhutan Biological Conservation Complex where it further extends to cover an area of 3089 sq km (Wangchuk, 2005).

Table- 1.8: Population status of Golden Langur (based on block census carried out between 2010 till 2018): -

Division (RF Area)	Total area (Km ²)	Adult			Juvenile			Infant			??	Groups	Total
		♂	♀	?	♂	♀	?	♂	♀	?			
Kachugaon (Ripu RF)	605.27	426	848	48	138	173	200	1	5	422	33	241	2294
Haltugaon (Chirang RF pt)	592.54	248	565	16	97	127	107	0	6	281	3	162	1450
Chirang (Chirang RF pt)		2	3		1	2				3		1	11
Chirang (Manas RF(pt) and adjoining areas)	505.95	54	100	0	17	25	12	0	0	52	4	22	264
Manas NP (Manas RF(pt))	120.00	37	75	2	14	19	14	0	1	39	12	23	213
Total (B) =		767	1591	66	267	346	333	1	12	797	52	449	4232

Besides, Golden Langur, MTR is also one of the critical habitat and corridor for Elephants in northeast India. Elephants are known to follow migratory corridors across Buxa Tiger Reserve into Manas and also subsequently move into Bhutan, Barnadi wildlife sanctuary and then to Sonai-Rupai Wildlife Sanctuary and Nameri Tiger Reserve. Whether the sub-populations are able to intermingle in the current situation is yet to be ascertained.

Table 1.9: Population of Elephants recorded from Manas Tiger Reserve in 2010-11. (In 2017-18, elephant estimation was done using dung count in certain buffer divisions, however record of elephant population is not available as of yet)

Sl. No.	Division	Range/Block	Area (sq. km)	Adult	Sub-adult	Juvenile	Calf	Total
1	Kachugaon	Total (9 Blocks)	522.49	107	43	11	26	187
2	Chirang	Total (7 Blocks)	468.3	65	31	20	13	132
3	Haltugaon	Chirang RF	477.69	68	21	9	11	109
4	Manas NP	Total (3 Blocks)	463	420	122	122	119	780
5	Dhansiri	(12RF's)/36 blocks	353.46	NA	NA	NA	NA	79
6	Barnadi WLS	Total (2 Blocks)	26.21	92	27	24	16	159
Grand Total =			2311.15	752	242	185	177	1443

Table 1.10: Some of the other notable species and their current numbers recorded within Manas National Park-

EN=Endangered, VU=Vulnerable, CR=Cratically endangered, *based on periodic sightings only

Name (Zoological Name)	IUCN Red List Status	Year1(No)	Year2 (No)	Year3 (No)	Year4 (No)
Great One-horned Rhinoceros (<i>Rhinoceros unicornis</i>)	VU	1990(80)	1997(39)	2005 (0)	11(2011)reintroduced in Manas National Park
Swamp deer (<i>Rucervus duvaucellii</i>)	VU	1992(450)	-	-	6* (2010) in Manas National Park
Bengal Florican (<i>Houbaropsis bengalensis</i>)	CR	1988(80)	-	-	14*(2010) in Manas National Park

Besides these, presence of species such as the Malayan giant squirrel *Ratufa bicolor* (NT), Chinese pangolin *Manis pentadactyla* (EN), hispid hare *Caprolagus hispidus* (EN), capped langur *T. pileatus* (VU), Asiatic wild dog *Cuon alpinus* (EN), Asian black bear *Ursus thibetanus* (VU), Bengal slow loris *Nycticebus bengalensis* (VU), Binturong *Arctictis binturong*, clouded leopard *Neofelis nebulosa* (VU), Leopard *P. pardus* (NT), Pygmy hog *Sus salvanius* (EN), Hispid Hare *Caprolagus hispidus* (EN), Sambar *Rusa unicolor* (VU), Hog deer *Axis porcinus* (EN), Gaur *Bos gaurus* (VU) and wild Asiatic buffalo *Bubalus bubalis arnee* (EN) have also been reported.

The Park lies within one of the world's Endemic Bird Areas (Stattersfield et al,1998). Including migrants, over 450 species of birds have been recorded and about 350 breed in the area, including the threatened Bengal florican *Houbaropsis bengalensis* (CR) and Great hornbill *Buceros bicornis* (NT).

50 reptile species includes the Gharial *Gavialis gangeticus* (CR), eleven species of snakes, 2 species of monitot lizards and three species of rare turtles

Many of these wild animals are typical of the Indo-Malayan bio-geographic region and have their westernmost distribution there, while other species are at the easternmost point of their range. Hence it is a meeting point of several species (including tigers) that later found their way into the Indian sub-continent.

1.9. Tiger numbers in Manas TR:-

Due to different sampling techniques it is very difficult to validate the actual number of tigers since the inception of the Reserve in 1973. However, the recently concluded population estimation exercise using camera traps in a double sampling approach is more realistic and reliable and can serve as a base for future monitoring of populations in the protected area. However, almost no information is available for presence of Tigers in the buffer and needs to be addressed on an urgent basis.

Table 1.12: Number of Tigers estimates in Manas Tiger Reserve (Ref: State Forest Report Assam, 2006-07 and Jhala et.al. 2008; 2011, 2014)-

Year	Males	Females	Cubs	Unidentified	Total
1972	10	0	0	-	10
1975	20	16	5	-	41
1976	28	17	6	-	51
1988-89	18	31	4	-	53
1991-93	32	37	12	-	81
1994-95	29 (4)	44(8)	7 (2)	-	80 (core) 14 (buffer)
1996-97	27	54	8	-	89
2000-01	22	38	5	-	65
2006-07	-	-	-	-	~31
2009-10	4	5	-	-	9 (National Park)
2010-11	4	5	-	-	9
2011-12	6	9	-	3	18
2012-13	3	8	-	1	13
2013-14	4	7	1	-	11
2014-15	8	7	1	-	15
2015-16	4	7	-	-	11
2016-17	12	12	-	1	25
2017-18	10	19	1	-	29

(Note:- population estimates from Year 1972-2000 are based on pugmarks census technique; 2008 number is derived from tiger occupancy estimation carried out for 455 km² of MTR (Jhala et.al.2008); From 2010, data is obtained using camera traps in an area of ~500 km²

1.10. Distribution of Animals and Habitats, Habitat quality/quantity:-

Distribution of wild animal is governed by the availability of food and water in association with shelter. Manas Tiger Reserve is quite dynamic and movement of animals in different parts of core and buffer is restricted partly due to natural barriers (major rivers) and also due to forest fragmentation at some locations. Details on habitat status and proposed management have been discussed in subsequent chapters.

1.10.1. Major Conspicuous Changes in the Habitat since Inception:-

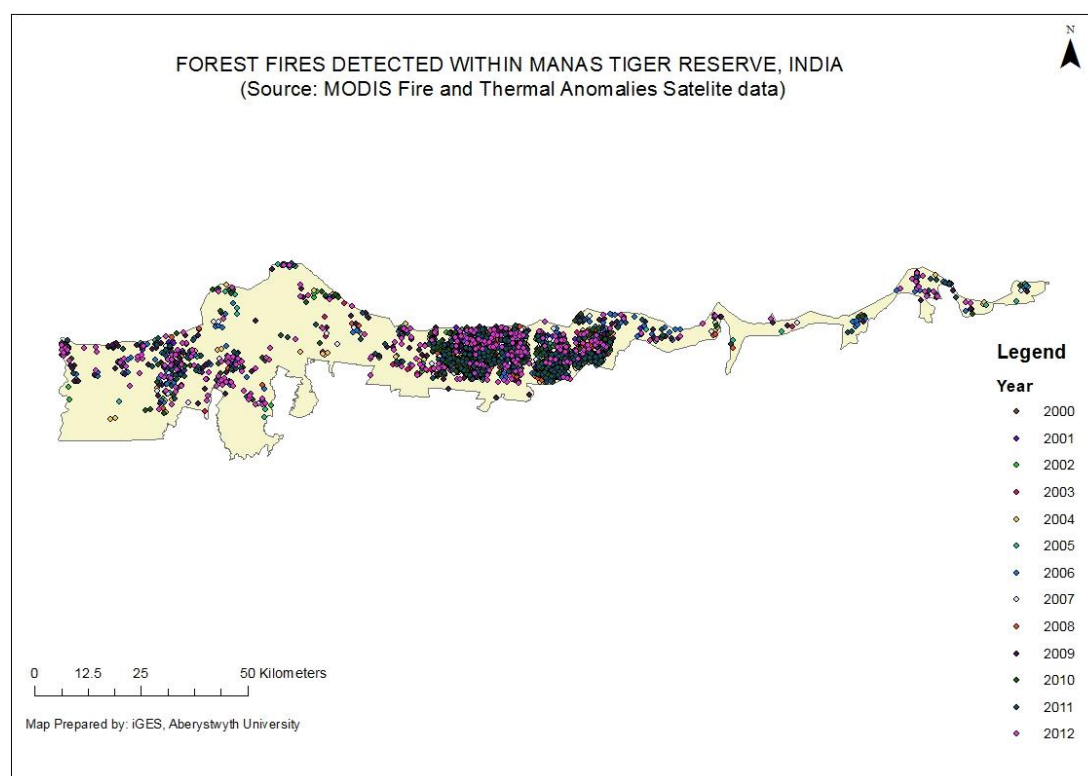
- i) **Shifting River courses and Floods:-** Wildlife habitat has been destroyed due to recurrent flood in the flood plains of river Beki and other Himalayan rivers. Manas river having changed its course in 2004 during the high flood season. It has resulted into major changes in hydrology and compartmental change of habitat in Manas. An area of about 5 km belt of forest area along the Beki was completely washed away in the flood. Usually during the month of July and August when the monsoon is at its peak, the hilly streams and rivers are in spate. Trees, Boulders, etc. are carried down and get fixed at places and form barrier. These barriers sometimes gradually enlarge and act like partial dams. The

courses of streams are diverted with the consequent erosion of banks. Earth movement is sometimes responsible for the change of big rivers course.

- ii) **Forest Logging and encroachment:-** The RF areas of MTR buffer were systematically logged to extract Sal (*Shorea robusta*), a tree species of high economic value. Working Plans for silviculture management of these forests were also periodically executed. It is estimated that the natural Sal bearing forests were converted over a period of 100 years until 1998.

At the same time, the civil unrest in 1989 to 2003 in the area also damaged the protection mechanism in the forest areas. As a result of that, attention was not able to give in the habitat management of the park, specially in the grassland management. Large scale forest fragmentation and clearing have been reported from buffer areas of MTR. Details of this has been discussed in the subsequent chapters.

- iii) **Forest Fires:-** Forest fires and the dry climate of Bhabar-Terai region go hand in hand. Majority of grassland areas within MTR are maintained due to the dynamic interaction of fire and floods. Currently all fires within MTR are anthropogenic and play a critical role in mainitaining habitat quality within the reserve. Large incidents of fires as detected by remote sensing satellites is now easily available and can help in devising appropriate management strategies.



Map 1.7: Incident of forest fires detected by satellites within MTR (2000-2012)

- iv) **Grazing and zoonotic disease:-** Grazing by cattle inside the Tiger Reserve is a serious problem as it reduces the availability of fodder to the wild herbivores and exposes them to the risk of cattle born diseases. Wild animals particularly herbivores are very susceptible to diseases most of which are transmitted through domestic cattle. So due to grazing habitat is degraded as well as it has fair chance of transmitting many diseases to wild animals. Anthrax, rinderpest, Foot and mouth Disease (FMD), Tuberculosis etc. are the common diseases which usually kill wild animals. As per available records, 4 wild elephant and 1 gaur died in 1994 due to attack of Anthrax.
- v) **Sand and Boulder mining and collection of MFP:-** While sand and boulder mining leases (Mahals) within the RF areas are virtually stopped although they continue in the revenue areas. Illegal transportation of minerals and minor forest produce such as thatch, bamboo, medicinal plants etc have been reported.
- vi) **Roads, Railways and Electric Transmission line:-** A number of P.W.D. roads and the National Highway pass through the Manas Tiger Reserve. NH 31 C is one the major four-lane National Highway that literally forms the outer southern boundary of the Park. Electric transmission line also passes through the Reserve in some areas. Access to various townships in Bhutan is also from indirectly passing through the Indian side and falls within the Reserve. There is also a proposal to construct an Indo-Bhutan highway by the Indian Govt for enhancing border surveillence, details of which are still awaited.
- vii) **Multipurpose Hydroelectric dams and Thermal power projects:-** The ambitious multipurpose project on the river Sankosh and other such rivers in Bhutan for irrigation and hydro electricity will directly impact the western boundary of the Reserve. Natural corridors for wild animals currently existing between Bhutan, Assam and West Bengal are likely to be impacted. Similarly the impact of thermal power plants at Bongaigaon Refinery and at Salakati, Kokrajhar also needs to be evaluated.

A proposal for diversion of 208.807 Ha. of forest land for construction of 400 KV D/C (Quad) from Jigmelling to Alipurduar transmission by Power Grid Corporation Limited has been submitted for approval by Executive Committee of Manas Tiger Project.

Also, a FIS (Flow Irrigation Scheme) namely Khairani FIS has been set up by the Irrigation Department inside the Subankhata RF during the year 2102-13.

1.11 Indo-Bhutan road: The boundary description of Manas Tiger Reserve extends from the point where the Sankosh river cuts the Indo-Bhutan International Boundary, eastwards to the point where the tri radiate pillar indicates the Assam, Bhutan and the Arunachal Boundaries and from that point eastward and then westwards along the southern boundaries. There are multiple roads which traverse via Manas to Bhutan. This includes following:-

Road name	Stretch	Proposed augmentation
Bg-M-1	Manas National Park to Salbari (on SH6)	2-lane
SH6	Salbari to Kumrikata	4-lane
New Road 1	A New Highway NH127 D is coming up, which will connect to Darangamela on Indo - Bhutan	4-lane

	Border	
New Road 2	A Road connecting this new NH127D to Barandi WLS can be consider	2-lane
SH6	Kumrikata to Tamalpur	4-lane
SH10	Tamulpur to Rowta	4-lane
Ch-M-5 (Via Mathanguri)	Along with Bhutan it also provides connectivity to Manas National Park. Connects Bhutan and the Manas National Park to NH31	2-lane (outside national park area)
Dantak Road	Samthaibari to Gelephu on NH 31 C	2-lane

CHAPTER TWO

STATUS OF TIGER AND CO-PREDATORS

2.1. Distribution of Tigers:-

Historically, tigers were distributed throughout the reserve including the southernmost ranges and the fringe areas. Movement across the border for a carnivore like tiger with large home ranges is a definite possibility, reliable data is still lacking on the status of breeding within the reserve and the accurate seasonal pattern of movements. MTR categorically falls under the low tiger density areas and therefore determining the home ranges and territories of the tigers to meet their ecological requirements is important.

2.2. Tiger in buffer area:- The only sampling done in the buffer area for estimating tiger occupancy was in Ripu-Chirang RF's and some part of Manas RF. This sampling also was done in the core area. The detail of the occupancy sampling done in the area is provided below.

2.2.1. The forests of the Manas Tiger Reserve, a World Heritage Site, in western Assam, India have been threatened by insurgency problems and illegal logging due to political unrest since the early 1990s. In the last 10-15 years approximately one third to one half of the three Reserve Forests - Ripu, Chirang, and Manas, has been deforested. These Reserve Forests and the Royal Manas Sanctuary of Bhutan that borders to the north are one of the potential habitats for large umbrella species like tiger in Assam and Bhutan. Habitat occupancy for tigers was sampled across around 2500 sq. km. area in the landscape, employing spatially replicated surveys to understand tiger use of the area. Sign detection data was generated from occupancy sampling to demonstrate ecological predictions about tiger presence in grids each of 100 sq. km. size. 10 × 10 sq. km. grids were superimposed on the land-cover map of MTR and carnivore sign surveys was carried out in each spatially replicated segments of each grid. All the grids in were surveyed as far as possible within MTR because the key objective was to map tiger distribution to identify 'source populations' at higher densities and also as sufficient manpower was available. Grids with <10% tiger habitat (20 sq. km.) habitat and forest fragment of <10 sq. km. were excluded from the survey, because tigers were unlikely to occupy these areas. Thus some major area falling under Manas Reserve Forest was left out of the survey.

2.2.2. Field protocol:- The survey was conducted in the dry season (December-February) to minimize variations in animal detection probabilities induced by rainfall. Fresh signs of tigers, leopards, dholes and major ungulate prey species in MTR were identified. Only unambiguously identified signs were recorded. Overall, the number of spatial replicates in a grid (sampling effort) varied from 2 to 7, depending on the extent of habitat in the cell. The survey teams comprising 2-3 skilled trackers walked the trails from morning to dusk. Signs of tigers, leopards, dholes and ungulate prey species, as well as signs of livestock or human presence were photographed, geo-referenced and recorded. The survey had an effort of 320 man-days, involving 823 days of walks along trails, and led to the detection of 77 tiger signs (57 pugmarks, 8 scat deposits, 5 rake marks, 6 kills and 1 vocalisation). Analyses were performed using the program PRESENCE to estimate the overall occupancy rate, ψ , with the inference applying to the entire tiger reserve matrix framed by the 15 surveyed grids.

2.2.3. Result for occupancy survey:- Overall the probability of site occupancy within the whole sampled area was estimated to be 0.39 (SE 0.08) and the probability of detection estimate was 0.2 (SE 0.04). The sign present were observed in the core area only. The

anthropogenic pressures in form of human disturbance may be one of the factors leading to no tiger signs in the buffer areas.

2.2.4. Co-predators:- The different co-predator signs indicate presence of leopards, clouded leopards, jungle cats, leopard cats and fishing cats. Camera trap data generated from core area also confirms presence of these species as well as some other species.

2.3. Survey in Bornadi and Khalingduar:

2.3.1. Bornadi Wildlife Sanctuary is located in the Darrang District. It covers an area of 26.22 sq. km; it is an ideal bhabar tract. It received the status of a sanctuary in the year 1980 by the Government of Assam and along with Khalingduar Reserve Forest; it forms part of Manas Tiger Reserve. The Khalingduar Reserve Forest with an area of 70.33 sq. km. is under the Dhansiri Forest Division in Udalguri district. The area houses a variety of animals and birds, like Elephant, Gaur, Tiger, Leopard, Small Indian Civet, Jungle Cat, Chinese Pangolin, Porcupine, Himalayan Black Bear, Barking Deer, Pygmy Hog, Wild Pig, Hispid Hare, Capped Langur, and others. Birds like Peafowl, Hornbill, Swamp francolin, Kingfishers, Peacocks, Bengal Florican, Woodpeckers and others, along with many migratory birds also make the area their home.

2.3.2. Methodology:- In order to determine the present status of tigers and other wildlife in the area an initial reconnaissance survey was carried out, which consisted of sign surveys of animal signs such as pugmarks, scats, rake marks, kills, hoof marks, pellets etc. and recording their GPS locations. This was followed by a rapid intensive camera trapping exercise in 16 locations where indirect animal signs were recorded best. The exercise lasted for a period of 21 days. CUDDEBACK ATTACK camera traps were used for the study; they were kept operational for 24 hours a day. A total of 336 trap days of effort yielded interesting result. Following faunas were recorded within the study area.

2.3.3. Herbivores/ungulates:-

1. Barking Deer
2. Sambar
3. Wild Boar
4. Asiatic Elephant
5. Rhesus Macaque
6. Assamese Macaque
7. Indian Hare

2.3.4. Carnivores:-

1. Leopard
2. Wild Dog
3. Leopard Cat
4. Binturong
5. Crab-eating Mongoose
6. Yellow-throated Marten
7. Himalayan Crestless Porcupine

2.3.5. Birds:-

1. Khalij Pheasant
2. Red Jungle Fowl
3. Peafowl
4. Black Stork

Management implications:-

The central region of the park seems to have a high concentration of carnivores. The magnitude of grassland fires and its high concentration in certain areas is a cause of concern. Studies show that tigers, leopards and clouded leopard's distribution patterns are overlapping with each other to certain extent (Borah & Ghosh 2013 unpub data). Previous studies have speculated that the clouded leopard alters its behaviour according to competition with larger carnivores and may even be less nocturnal, where other large carnivores, such as tiger, are absent. There is a need to protect the grassland habitat which would ensure sympatric survival of these species.

2.4. Assessment of Threats:**2.4.1. Hunting and Poaching:-**

Poaching statistics of MTR showed that within a period of 20 yrs. (1988-2018) about 25 tigers were killed. Similarly, entire population of rhinos was also wiped out, which was reintroduced later.

Table 2.2: Poaching of wildlife in Manas Tiger Reserve-

Year	Rhino	Elephant	Tiger	Leopard	Clouded Leopard	Pangolin	Sloth Bear	Otter	Deer (Sambar, hogdeer)
1988	-	-	3	-	-	-	-	-	-
1991	3	2	8	-	-	-	-	-	-
1992	11	4	2	-	-	-	-	-	-
1993	22	3	2	-	-	-	-	-	-
1994	4	3	9	1	-	-	-	-	-
1995	1	5	-	-	-	-	-	-	-
1996	-	2	-	-	-	-	-	-	-
1997	-	1	-	-	-	-	-	-	-
2000	-	-	-	1	-	-	-	-	-
2001	-	-	-	1	-	-	-	-	-
2006	-	-	-	1	-	-	-	-	-
2008	-	2	-	1	-	-	-	-	-
2009	-	3	1	3	3	1	1	5	3
2010	-	-	-	-	-	-	-	-	-

2011	1	1	-	-	-	-	-	-	-
2012	1	-	-	-	-	-	-	-	-
2013	5	-	-	-	-	-	-	-	-
2014	1	-	-	-	-	-	-	-	2
2015	-	1	-	-	-	-	1	-	-
2016	2	3	1	-	-	-	-	-	1
2017	-	2	1	-	-	-	-	-	3
2018	-	6	-	-	-	-	-	-	-
2019	-	-	-	-	-	-	-	-	-
Total	51	38	24	8	3	1	2	5	9

Division wise records of human wildlife conflict in the buffer area of MTR is provided below:

1. **Dhansiri Division:** This information is for damages caused by elephants only.

Year	Elephant death	Human deaths	House damaged (in nos.)	Crops damaged (in Hactares)
2008	2	3	No record	No record
2009	2	6	No record	No record
2010	10	10	4385	30
2011	1	2	73	28
2012	4	19	747	220
2013	9	10	655	180
2014	10	19	1053	210
2015	7	23	650	390
2016	5	21	420	320
2017	6	8	350	45
2018	8	7	380	260
2019	4	19	280	230
2019-20	1	13	160	172
Total	69	160	9153	2085

2.4.2. Grazing:- Grazing by cattle inside the Tiger Reserve is a serious problem as it reduces the availability of fodder for the wild herbivores and exposes them to the risk of cattle borne diseases. As per rules, no grazing is allowed. However, because of presence of large number of forest and fringe villages, livestock grazing is a serious threat for MTR.

2.4.3. Disease:- Wild animals particularly herbivores are susceptible to diseases transmitted through domestic cattle. So, Grazing, besides degrading habitat also create chances of transmitting of many diseases to wild animals viz. Anthrax, rinderpest, Foot and mouth Disease (FMD), Tuberculosis etc. are the common diseases, which usually kill wild animals.

2.4.4. Encroachment:- Forest encroachment is of serious concern in MTR buffer areas. Since the time of its inscription under Project Tiger in 1973, the landscape has drastically changed and several RF areas (e.g. Kachugaon RF) are now completely devoid of forest cover. The reasons for these are many, including insurgency, the settlement of forest villages prior to 1973 and the ad-hoc demarcation of the Tiger Reserve boundary without actual assessment of the field conditions. There is a need to take up a pragmatic view on reorganizing the MTR buffer boundary.

Table 2.3: Status of encroachment of buffer areas in MTR as on 31.03.2009- (source: WPO, Kokrajhar)

Name of the Forest Division	Name of R.F.	Area (Ha)	Area (Ha) under encroachment	Percentage
Haltugaon	Chirang	59254.12	15000.00	25.3147
	Manas (Pt.)	2962.00	100.00	3.376097
	Bental	1071.00	60.00	5.602241
	Nandangiri	1019.80	10.00	0.980584
	Satbendi	273.20	270.00	98.8287
Chirang	Manas Pt.1	18569.00	1350.00	7.270181
	Manas Pt.2	29064.00	3050.00	10.49408
	Bengtal	6092.80	1819.00	29.85491
	Kuklung	1469.00	350.00	23.82573
	Sisubari	509.20	509.20	100
	Teklai	111.36	111.36	100
	Ranisundri	48.60	48.60	100
	Katribari	33.20	34.00	102.4096
Kachugaon	Ripu	60526.89	2172	3.588488
	Kachugaon	21445.00	90	0.419678
	Elasijhar	226.00	154	68.14159
Dhansiri	Batabari	3121.00	2340	74.97597
	Subankata	2337.00	1635	69.96149
	Morapagladia	1123.40	898	79.93591
	Darranga	4637.00	4525	97.58465
Baksa	Sukanjuli	1315.00	1315	100

	Khalingduar	7033.00	1200	17.06242
	Bhairabkunda	2441.00	400	16.38673
	Rowta	7742.00	200	2.583312
	Barnadi WLS	2622.00	400	15.25553
Manas National Park	North Kamrup	27102.00	400	1.475906
	Panbari	1630.00	1650	101.227

2.4.5. Fuel and firewood collection:-

MTR faces a huge threat in terms of fuel and firewood collection. Firewood is collected by people not only for their own use but also for sale in local markets. For this purpose, local people even fill green trees. Firewood is removed by headload and cycle.

2.4.6. Illegal removal of N.W.F.P.'s:-

N.W.F.P. collection by FPC/EDC members is legally permissible as per Govt. order. But there is no definite harvesting procedure for it. FPC/ EDC members, many Tea garden labourers are also involved in its collection. Thatch is collected from grasslands for thatching roofs. Several people enter illegally into the forest for collection of medicinal plants, bamboo, orchids and other decorative plant products that find a ready market in neighbouring West Bengal. This causes great disturbance including opportunistic hunting of wildlife.

2.4.7. Tea and Rubber Industries:-

There are several tea gardens situated in the fringe of the Tiger Reserve. Tea Gardens communities are known to be associated with illegal removal of timber, firewood, N.W.F.P.s, and hunting of deer, Wild pig, hares, Jungle fowl and other birds. Tea gardens act as a barrier for easy movement of Wildlife from one forest to another especially for elephants and gaur. Also, the associated settlements create additional pressure on the forest in terms of fuel, firewood and NTFP collection. A large number of small and medium scale rubber growers have also recently cropped up in BTAD and they are also encouraged by the state welfare departments.

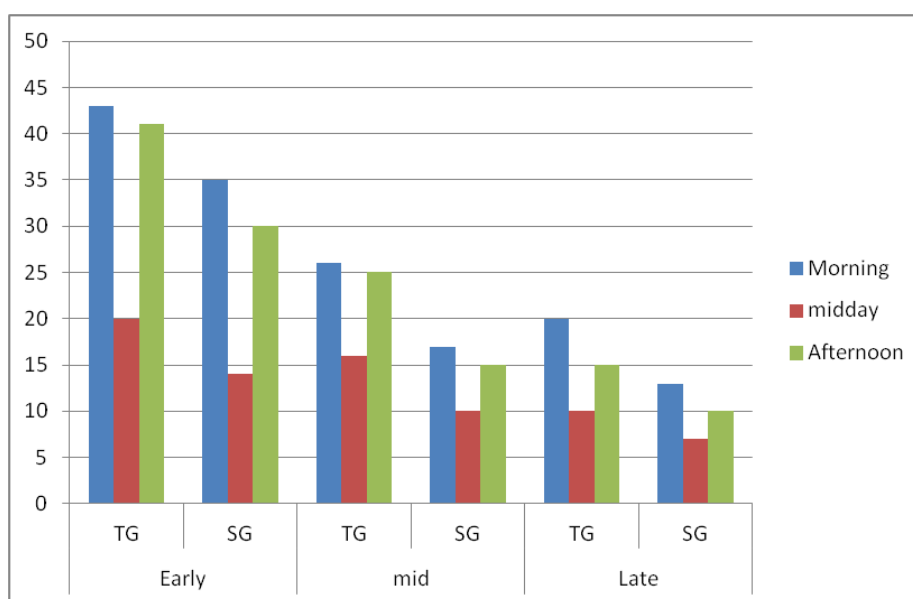
2.4.8. Wild fires:-

Fire is not uncommon in MTR. The occurrence of fire particularly in the month of January to April is common in foothill areas. Fires and Terai grasslands go hand in hand as the latter provides ready fuel whereas the former is the main agent for grasslands to exist in the first place. Fires along with a soil-moisture gradient (with high concentration of rainfall and inundations) appear to be the primary controlling agent for habitat organization of the Terai grasslands. Historically, fires would have been caused by lightening, these days they are mostly anthropogenic with accidental and intentional fires accounting for the highest incidents of forest fires in the region. Fires are usually lit to remove the dry and unpalatable grasses and also for better visibility and access. The new grass that usually sprouts within 2-3 days of a grassland fire is highly nutritious and attracts a large number of herbivores. Such has been the usefulness of fires to control and manage grasslands (and high concentration of herbivore animals therein) that is often prescribed as a management tool for Protected Area managers. Grassland burning techniques to benefit grazing lands have been well-developed

for economic purposes, and suggest that the use of fire is beneficial for the conservation of endangered large herbivores. Control burning or prescribed burning is therefore carried out early during the onset of dry season with an overall aim to provide fresh fodder and prevent larger accidental fires in the peak dry season. Ancillary benefit includes increased visibility for wildlife viewing, tourism and also for access to areas that are otherwise inundated during the wet season.

Types of fires:-

Fires within the Terai have generally been classified as canopy fires, surface fires and below ground fires. Canopy fires are large scale and impact trees which burn very rapidly. Forest fires of this nature are often uncontrollable and most detrimental to flora and fauna. Similarly below ground fires are slow and often undetected. They usually occur in coal rich areas and are extremely detrimental to soil moisture and nutrients. Surface fires are rapid but they mainly impact grasslands and are common in the Terai landscape. A recent study on the timing of surface fires in MNP indicated that these fires move very rapidly and can cause the burning of 1 ha above ground biomass in tall grassland within 45 minutes of its origin (Lahkar, 2008). The fastest fire spreading time is during midday and the slowest is in the morning. The rise in temperature during the peak burning of a surface fire is very brief and does not last for more than five minutes and the highest temperature does not persist for more than a few seconds after the fire is stopped. The highest temperature recorded after 5 minutes of fire was 35° C where the normal temperature just before ignition was 26° C.



Y axis = time in minutes, TG = Tall grasslands, SG = short Grasslands

Fig 2.1: Fire spreading time in grasslands of Manas National Park (ref: Lahkar, 2008)

Temporal patterns of fires:-

Within MTR - The total yearly number of fires recorded within the MTR increased substantially from around 5 at the start of the study period (Dec, 2000) to over 300 in 2004. There was a large inter-annual variation in monthly patterns of fire occurrence; the highest recorded in 2011 (394) during which highest monthly fires were recorded in December (102). The patterns clearly indicated that 2002, 2004 and 2011 were exceptionally dry years when high incidents of fires were recorded. The transitional period before and after the monsoon season (the first and the last two months of the-dry season) experienced fewer fires. The

common pattern of fire occurrence was a distinct increase from December to January after a low during October-November, with the number of fires declining after February and dropping even further from April to May. According to the mean of fire counts among the eleven dry seasons shown in Fig 1, December - March had the highest frequencies of fire and accounted for bulk of the fire occurrences.

Detecting Fire intensive areas:-

The fire density map (Fig. 20) for MTR indicates that fire locations were not evenly or randomly distributed throughout the Reserve. In fact, fire was concentrated (over 63%) within MNP where four distinct areas of heavy burning could be; the largest concentration was located along the western part of the park under Panbari range, while the others were spread across the grasslands along Manas-Beki rivers and low lying grassland areas of Bansbari and Bhuyanpara ranges. Almost all the forest fragments on the eastern side of the Reserve in Barnadi wildlife sanctuary, Dhansiri and Udalguri forest divisions were influenced by medium occurrences of fire. Incidents of fire along the Bhutan border in Kachugaon and Haltugaon forest divisions were also low as these were largely covered with dry deciduous and semi-evergreen forest types. Such high concentration of fire within 300 sq. km. of the Reserve, clearly indicates the impact of fire on regulating the landscape dynamics.

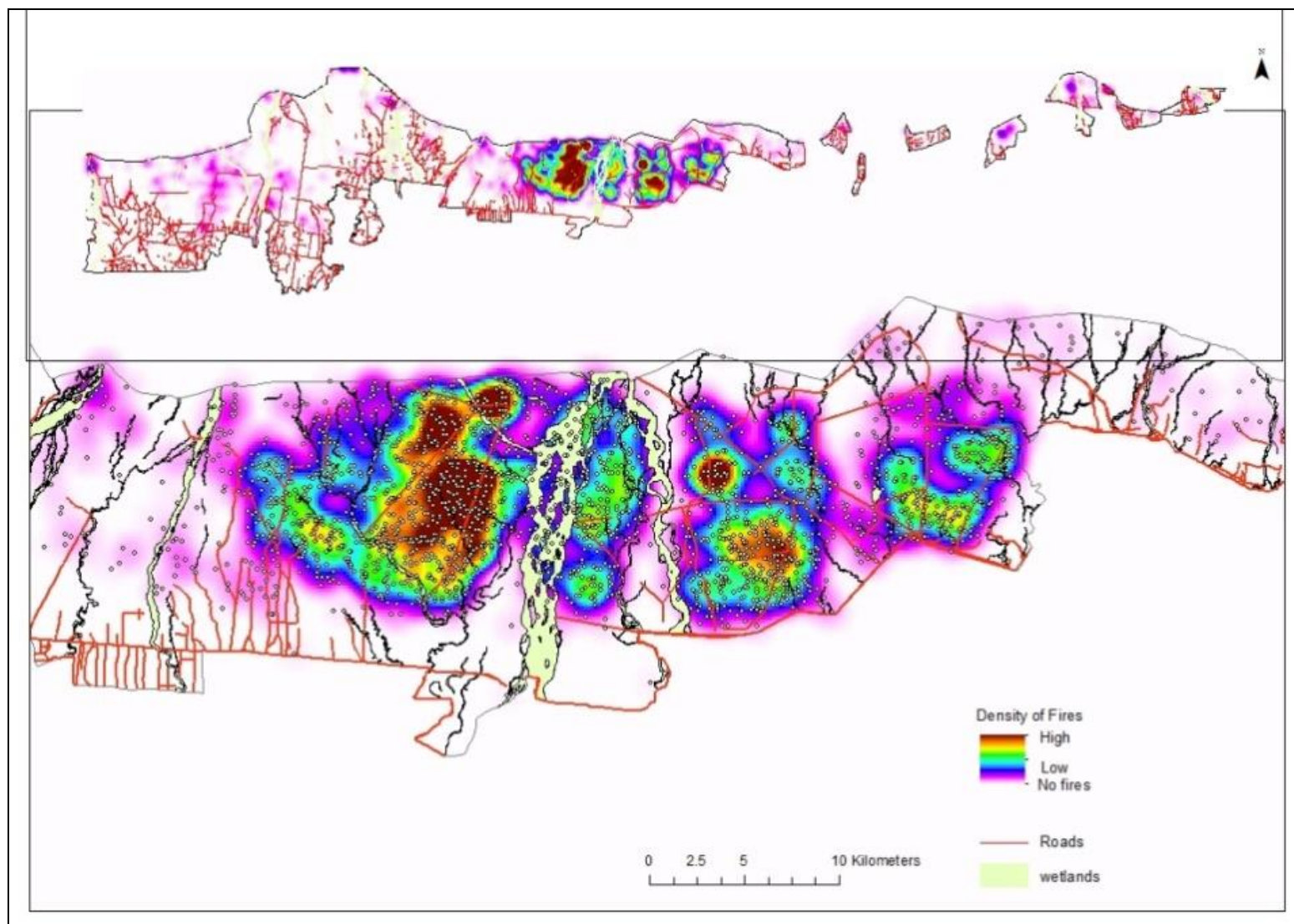


Fig 2.2: Density of fire occurrence in Manas Tiger Reserve during 2000-2012

Management implication of Fires:-

The present studies (Lahkar, 2008; Ghosh, 2013) clearly indicates that fire is a major driver of landscape dynamics and change within MTR. Their high concentration (over 63%) within a small core area of 500 sq. km. in Manas National Park also indicates the co-evolution of fire-climax vegetation types that are periodically regulated by fires on an annual basis. This fire-climax vegetation mainly comprises of tall and short grasslands associations as have been reported by field studies earlier (Lahkar, 2008). Such tall and short grasslands are true representative of the Terai region and have been mostly converted to agriculture elsewhere. It is only in protected areas (Fig. 22) that they are able to exist as patchy fragments albeit in a natural state, and hence of high conservation value. These grasslands are regulated by fires in the dry season and floods during the wet season thereby making them highly productive throughout the year. This also attracts a large number of herbivore prey that in turn supports large carnivores such as tigers. Therefore protection and management of such fire-intensive areas will be critical for survival of tigers and other large carnivores in the area. Fires may also modify ecosystem composition and functioning. Depending on the fire regimes, plant species are frequently eliminated by burning and the successional pathways following fire are altered within plant communities. At the same time fire can also have beneficial effects on ecosystem resources. Positive impacts of fire include the management of vegetation structure and composition, the reduction of potentially flammable fuel loads, the improvement of grazing for livestock and pest control. Studies in Australian savanna landscapes have shown that traditional Aboriginal fire regimes have served to maximize biodiversity by maintaining habitat diversity, savanna patchiness and species diversity. To establish sound fire management programs as part of an integrated ecosystem management strategy, the contrasting effects of fires need to be considered and evaluated and the resulting information need to be incorporated in the analysis of benefits and costs. As part of developing this management strategy it is important to understand the drivers of land cover and land use change and the causes of fire. The role of fire in perturbing biogeochemical cycles of carbon, nitrogen, sulfur and phosphorus needs to be understood both directly e.g. the effects of fire on soil nutrient cycling where burning takes place, and indirectly e.g. the transport and deposition of aerosols and trace gases produced during biomass burning. The impact of fire in changing biodiversity needs to be understood at the local and landscape scale. Similarly the impact of fire on modifying ecosystem composition and functioning modifications need to be understood.

The highest occurrences of fires were recorded between December and March indicating this being the crucial season for fire management. Fires were triggered by anthropogenic sources such as roads and they are in all likelihood for deliberate reasons such as improved access and for grazing by livestock. Fires also occur in the wetland areas indicating the seasonal nature of these water bodies. A very dry season combined with draught can perhaps lead to water scarcity and therefore suggests the need to build and manage permanent waterholes in areas where highest number of fires are periodically recorded. In areas outside the National Park, fires are also along roads and in the vicinity of human settlements. Law enforcement and vigilance during the fire season has found to be very effective in controlling accidental fires and it is in this case that remote sensing can aid in forest protection measures.

2.4.9. Mining:-

While sand and boulder mining leases (Mahals) within the RF areas have virtually stopped, they continue mining in the revenue areas. Illegal transportation of minerals and minor forest produce such as thatch, bamboo, medicinal plants etc have been reported.

2.4.10. Roads, Railways and Electric Transmission line:-

A number of P.W.D. roads and the National Highway pass through the Manas Tiger Reserve. NH 31 C is one the major four-lane National Highway that literally forms the outer southern boundary of the Park. Electric transmission line also passes through the Reserve in some areas. Access to various townships in Bhutan is also from indirectly passing through the Indian side and falls within the Reserve. There is also a proposal to construct an Indo-Bhutan highway by the Indian Govt for enhancing border surveillance, details of which are still awaited.

2.4.11. External Development Threats:-

The ambitious multipurpose project on the river Sankosh and other such rivers in Bhutan for irrigation and hydroelectricity will directly impact the western boundary of the Reserve. Natural corridors for wild animals currently existing between Bhutan, Assam and West Bengal are likely to be impacted. Similarly, the impact of thermal power plants at Bongaigaon Refinery and at Salakati, Kokrajhar also needs to be evaluated.

2.4.12. Patchiness of the core-buffer zonation:-

As discussed elsewhere, the core-buffer zonation within MTR had not been actually verified in the field in 1973 and hence makes ground management extremely difficult. The distribution and situation of the core area does not coincide with areas of maximum tiger usage and habitat potential. Areas like Manas RF and some parts of Ripu-Chirang RF hold potential for tigers and also other endangered and endemic species such as the Golden Langur and elephants periodically report tiger signs but are still not included in the core. Similarly, densely populated and degraded areas like Kachugaon RF are unlikely to be restored in the present situation. The realignment of the National Highway along the southern boundary also needs to be relooked at while conducting a fresh survey.

2.4.13. Invasive plants and weeds:-

Several Invasive plant species are known to occur in the buffer areas. This is primarily due to excessive grazing pressure and forest clearing for illicit timber felling. The present status and extension of invasive species needs to be ascertained.

CHAPTER THREE

HISTORY OF PAST MANAGEMENT AND PRESENT PRACTICES

3.1. Conservation and Forest Management History

MTR has a chequered forest history of more than 100 years that ranges from prime importance given to silvicultural operations for the production of best quality timber in the buffer areas and also the preservation of game in the grassland areas. Due to lack of access to exact records while writing this proposal, it is difficult to establish a causal relationship between extirpation of tigers and armed conflict at this point of time. However, it is expected that the historical dates and events will help in narrowing down on further research. The timeline of important forest events can be constructed as follows:

A. Dates and History of Manas Tiger Reserve (Buffer):

Historical timeline of forest conservation and its impact on Tigers in Manas Tiger Reserve, Assam India.

February 1826: The treaty of Yandabo signed between British India and the princely state of Burma. Ended the first Anglo-Burmese war and among other commitments, ceded the territory of Assam to the crown. The British foresters then started to look for revenue generation through agriculture and forestry expansion in the region.

1857- 1893: First survey of forest areas undertaken and large tracts of land in the buffer zone of present day MTR declared as Reserved Forests. Land also leased out to private/British tea planters. Rights of local people extinguished or diminished to an extent of controlled grazing, and permits for forest produce collection. At the same time, tribal from central and eastern India settled in forest villages to provide cheap labour and increase land revenue.

1871-1907: Game or hunting reserves declared in low productivity areas such as the flood-plain savannah areas of present day Manas National Park. trophy hunting became a privilege of the elite and decimated wildlife populations to a large extent. (for e.g. atleast 207 rhinos were hunted in the forests of Cooch Behar and Buxa (adjoining MTR) by the Maharaja of Cooch Behar and the British aristocracy during this period).

1893- 1920: First working Plan written for forest areas implemented with special emphasis on silviculture management of Sal (*Shorea robusta*). Introduction of rides and parallels as per the German forestry model and Asia's first ever tram line laid out for industrial extraction of forest produce. Santhal and Adivasi tribals from central and eastern India brought in and new forest villages established. This significantly impacted the demographic profile of the region as the the population of the district which increased only by 1.4 per cent in 1881-91 and 2 per cent in 1891-1901 shot up by 30 per cent in 1901-11.

1919- Introduction of the 'Line system' that demarcated between hills and plains tribe areas and prevented outsiders to settle in the hill tracts. MTR region and its inhabitants (also termed as Bodo-Cacharis) come under the plains tribe areas.

1928- Declaration of Manas wildlife sanctuary and further expansion of the protected area.

1935- As armed rebellion continued among the hill tribes, more stringent laws in the form of

excluded and partially excluded areas and the concept of tribal belt and blocks brought in to administer northeast India.

1939- Grazing reserves opened up to settle immigrants under the 'grow food' campaign.

August 15, 1950- Devastating earthquake (of 8.6 magnitude on the Richter scale) in Upper Assam that changed the course of rivers and displaced massive populations.

1955-56: Discovery of highly endemic Golden langur (*Trachypithecus geei*) primate by E.P. Gee in buffer of Manas Tiger Reserve. People living on *Char* (river islands) and *Chaporis* (low-lying flood-prone areas) were most impacted.

1955: Manas wildlife sanctuary expanded to cover a total area of 391 km².

1967- The Plains Tribals Council of Assam (PTCA), demands a union territory of Udayachal to be carved out of Assam so that central aid and development could reach the tribal areas.

1958-1973: Princely or *Zamindari* forests abolished and majority of private forests converted into state forests. Categories such as Reserved Forests, Proposed Reserved Forests, Unclassed Stated Forests identified. Survey settlement and demarcation of rights for most of the forest areas other than Reserved forests are pending till date.

1973-1985: Core area of Manas Tiger Reserve recognized for its high biodiversity and its legal status strengthened by area expansion and declaring it as a National Park and a World Heritage Site. At the same time, Assam movement to expel outsiders from the province launched in 1979. Inter-communal clashes continue with overall deterioration of law and order.

1985: Signing of the Assam Accord between the government of India and the leaders of the Assam agitation thus paving the way for indigenous political parties. Also led to formulation of policy that people entering Assam later than 25th March 1971 were to be considered illegal immigrants.

1987: Official Bodoland movement for an independent state started by the All Bodo Students Union (ABSU). Also led to the rise of two main factions of militant groups; the National Democratic Front of Bodoland (NDFB) and the Bodo Liberation Tiger Force (BLTF) in 1986 and 1996 respectively.

1989-1993: Availability of illegal sophisticated weapons with militant groups resulted in looting and marauding of forest resources and infrastructure. Extortion and kidnapping for ransom from government personnel became widespread leading to further deterioration of law and order. As a result of habitat destruction and heavy wildlife loss caused by civil unrest, UNESCO lists Manas World Heritage site “in danger” zone.

Feb 1993: First tripartite accord signed between government of India and ABSU and the Bodo People's Action Committee, paving the way for creation of Bodoland Autonomous Council (BAC). The accord soon collapsed due to factional splits and violence erupted in Bodo areas leading to displacement of over 0.5 million people between 1993 and 1998 in the area (NRC, 2001).

1992-1995- Manas closed to tourists due to presence of militant groups inside the Park.

1995- Local extinction of rhinos in MTR and virtual collapse of all habitat management activities inside the National Park.

1999- Expiry of most forest working plans and a landmark court ruling banning extraction of timber and all forest-based industries from Northeast India.

2001: MTR declared the core zone for Ripu-Chirang Elephant Reserve by the Central Government (2837 km²).

Feb 2003: Second tripartite agreement between Government of India, Assam and representatives of BLT, along with laying down of arms by over 26,41 members of the militant wing. This paved the way for creation of BTAD (Bodoland Territorial Areas District) an autonomous self-governing body within the state of Assam.

May 2005: The first general elections for BTAD held. Bodoland People's Front (BPF) voted into power with thumping majority.

June 2005: Ceasefire by NDFB militants under an agreement with the Government of India, that stipulates laying down of arms and cessation of hostile action against security forces and civilians until further talks.

2006-10: Massive forest infrastructure rebuilding and revival of forest administration. Critical tiger habitat of MTR expanded 840.04 km². Plans for relocation of select forest villages from the core and allotment of forest-land for tribal and other forest dwellers under a new National Act (The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006) initiated.

April 2010: Second general elections and BPF again voted to power.

Oct 2010: Large scale eviction by forest department of over 1500 people from 120 sq km of encroached area in the buffer of MTR. Eviction drive met with strong political protests.

Jan 2011- Camera-trap studies reveal the presence of 9 tigers in Manas National Park. The tigers share their area with royal Manas in Bhutan thereby emphasizing the need to manage the landscape as a trans-boundary reserve.

June 2011: Manas removed from danger list and reinstated as a UNESCO World Heritage Site in recognition of the recent conservation efforts including signs of recovery of the natural heritage values.

Oct 2011- one of the reintroduced rhino in National Park, poached and the horn removed.

Feb 2012- Kidnapping of 6 researchers surveying in the forest areas of MTR. Alleged payment of ransom before they could be released without harm.

May 2012- One more rhino that had strayed out of the National Park is poached, bringing the number down to 22.

July 2012- Large scale communal clashes claiming more than 100 lives and displacement of 400,000 people. Sporadic incidents of violence have continued in till date.

Improvement of Habitat:

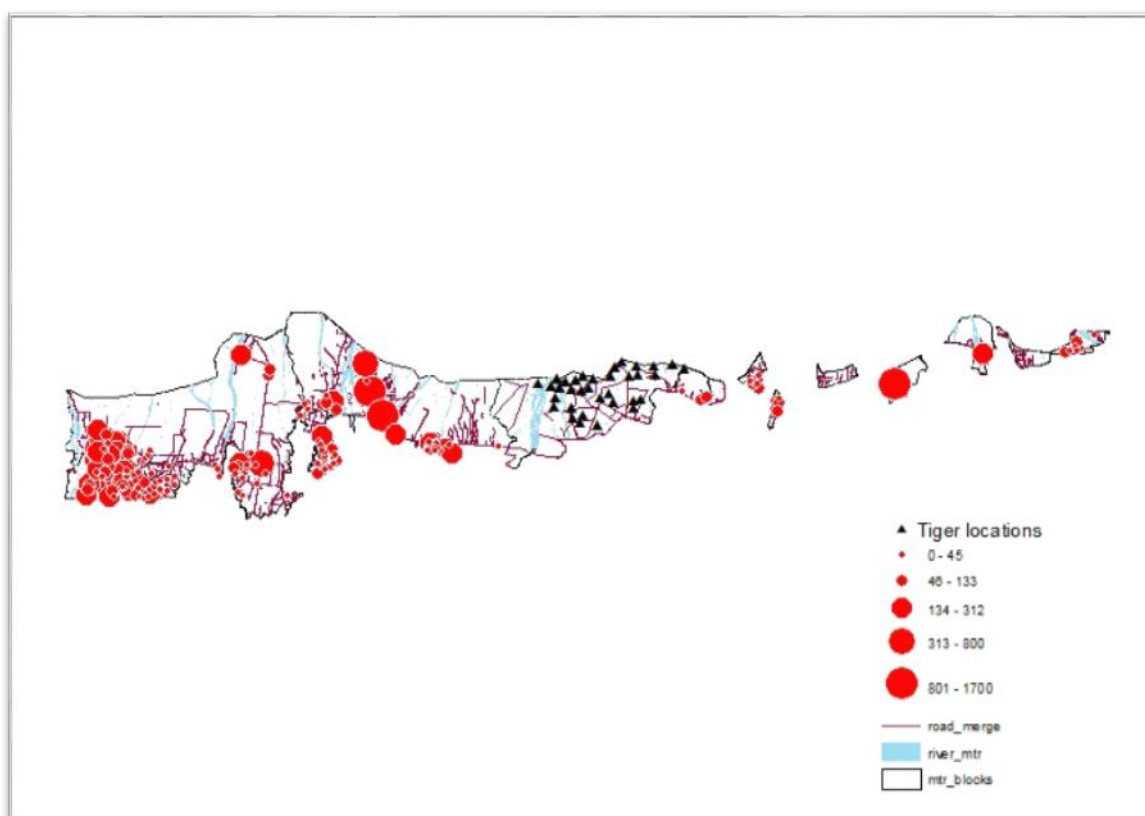
Habitat improvement within the buffer RF areas have seen more than 100 years of intensive forestry operations and management under various silvicultural systems especially for the production of highly valued Sal timber. The original forest was, therefore, completely changed to have an even aged Sal dominated crop, remnants of which can still be seen in certain areas. Besides Sal, plantations of other valuable species such as *Michelia champaca* and *Tectona grandis* were also attempted in certain areas. However, all this was undone during the period of insurgency and civic unrest that lasted almost 20 years. The original Sal forests do exist in patches but no systematic silvicultural operation is in place. Besides, with the implementation of the Supreme Court ruling in 1996 and subsequent closure of saw mills,

plywood and veneer mills in Assam, the forests are mostly protected for maintaining ecological security and as a refuge for wild flora and fauna.

Forest Villages:

There are a total of 151 forest villages that roughly occupy an area of 241.87 sq. km. in the buffer region of MTR. Forest villages are distinct from revenue villages as they were primarily created to provide the manpower for working in the forest areas. Most of them are inhabited by people who were initially brought in from outside Assam state in the early 19th century and included tribal groups such as *Adivasi*, *Santhali* and *Nepali*. The present day forest villages also have a substantive population of *Bodos*, *Rabhas* and *Koch-Rajbongshi* tribal. Each forest village was allotted a certain forest area in their vicinity for agricultural purposes and in return the villagers were required to put in certain number of work hours for forestry operations. As the timber logging operations gradually diminished and also completely stopped by 1995; the people of these villages took to other non-forestry occupations such as dairy farming and commercial crop plantations. At the same time militant uprisings and lack of law and order led to a 'free for all' situation where forest resources in the vicinity of such villages were plundered. The civil strife combined with remoteness of these villages also added to the backwardness of the people. Today, about 28,800 inhabitants live on the fringe of the core area (Project Tiger, 2001; Jhala *et.al.*, 2011). Relocation of forest villages and reforestation of encroached forest land are some of challenges faced by the forest department.

Fig 2: Location of forest villages versus tiger presence within MTR. (villages are represented in graduated symbols indicating the population strength at each location)



3.2 Protection of tiger, its prey and habitat

Regular patrolling is organised to protect the forests and Wildlife. Rifle and D.B.B.L. guns are used for self-protection during patrolling. Patrolling is done regularly on foot, on bicycle and by vehicle. Patrolling is done on elephant back during monsoon in inaccessible areas.

R.T. networks have been installed in most of the Range and in some Beat Offices. Walkie Talkie is used by Patrolling teams. There are 18 range offices within the buffer areas of the Tiger Reserve. To elucidate the level of importance given to the buffer area of the Tiger reserve, Assam Govt. and BTC have posted around 200 Forest Guards, around 100 Forester-I, around 50 Forester-II, and more than 20 Forest Ranger and Deputy Rangers, apart from various Game Watcher, Mahouts and Grass Cutters.

To strength the firepower of the said staff, AFPFs and Home Guards are stationed inside the Buffer Area. To increase the manpower in the Buffer areas, more fixed pay casual workers have also been engaged in the said areas. Finally, the conservation volunteers deserve mention for the uniqueness of the model of Manas Protection.

Since recent past conservation volunteers have been deployed to assist the forest department, which is funded by BTC. These conservation volunteers are selected from the local youth and are generally in the age bracket of 18-30 years. They are largely semi-educated and unemployed, but are well versed with the forest area in their vicinity. The programme has been a big success and is a model for community development in northeast India. The protection mechanism is also detailed in Chapter 13 of MTR-TCP (Buffer)

3.3 Other land use-villages, agriculture, developmental programmes, tourism etc.

3.3.1 Villages and agriculture:

There are a total of 151 forest villages that roughly occupy an area of 339.21 sq. km. in the buffer region of MTR. There are also numerous tea gardens and revenue villages on the southern side. Most of the people living in non-tea estate areas depend primarily on agriculture. Their income is also supplemented in most cases by primitive animal husbandry. Forest villagers cultivate their land and rear large number of cattle.

3.3.2 Land use patterns:

The village areas located at the outskirts of forest in south are mostly rain-fed cultivated fields. In the eastern and extreme western portion, tea gardens dominate. Rubber plantations have also copped in between the forest areas. Agriculture is mostly rain fed. Household orchards contain jack fruit, banana & areca nut. Agricultural crops raised during pre-kharif are maize and jute. Millet, mustard, potato and vegetables are grown during Rabi season. Paddy is the main crop. Traditional practice is followed for agriculture but the pattern is changing gradually.

3.3.3 Socio-economic and cultural environment:

The socio-economic and cultural factors exert strong influence on the forest. Some more research on ascertaining the impact of forests in people's livelihood needs to be ascertained. The inhabitants of fringe villages belong to different ethnic composition including: Bodo, Bengali, Assamese, Adivasi, and others includes Muslim, Rabha, Garo, Nepali and Rasbongsi. The native communities of the reserve are socially, culturally and emotionally attached to the area. The livelihoods of the people of these villages are mainly of agriculture based and cattle rearing. The socio-economic conditions of the majority of villages mainly inhabited by tribal and other backward communities are very poor. As the existing wildlife laws strictly prohibits access to the Park, and the scopes will have to be explored towards alternatives for cattle grazing, collection of fuel wood, fishing etc.

Majority of the local people in the region are subsistence farmers and the prime crop cultivated is paddy (Summer & Winter). In agrarian economy land is a complex issue and it is more so in the case of tribal area. Some of the existing alternative livelihood activities that the SHGs are involved in, includes Weaving, Farming, Piggery, Dairy Farm, Goatery, Poultry. Even though they are doing these activities but they are not working in a systematic way. Most of these activities they are involved as part of their daily life activities and in an inefficient, unscientific and non-commercial manner. Hence for these reasons they are not been able to get desired economic benefits. Besides, farming is the prime source of livelihood in these areas. Also most of the households in these areas rear poultry, goats and cows. However, all these existing livelihood activities are being carried out very casually, in unsystematic and unscientific way.

3.3.4 People's economy and major employment sources:

People residing in and around the Tiger Reserve are very poor. There is no industry except tea. Agriculture is the main occupation. Villagers follow the traditional agricultural practices. Irrigation facilities are poor and majority of the agricultural lands are mono cropped. Huge labourer force is present. The sources of employment that now exists are forestry works, buildings and road construction, cane industry, fishing in rivers, soil conservation and river training works, honey and other NWFP collection, works in tea gardens, etc. The main season of unemployment is winter (December – March). Villagers maintain large number of cattle, which are poor in milk production but sturdy and low – maintainance assets. No dairy co-operative is present. Cow dung is used mainly as manure in agricultural fields. People largely depend on forests for fuelwood. Number of regularly employed is very little. In tea gardens, labourers get employment from April- November. December to April is the lean period. During this lean period, most of the tea-garden labourers cut firewood from forests. No in-depth study report on resource dependency of local people is currently available for the area.

3.3.5 Implications of the land use and resource dependence for the conservation issues in the Tiger Reserve:

As people have subsistence level of economy, they augment their scarce income villagers by illegally removing trees, cutting fodder grasses and thatch and grazing cattle inside the forest. This exerts tremendous pressure on the Reserve.

Flood and soil erosion from time to time cause heavy damage to vegetation and agricultural land. Forest villages situated inside the forest also hold more land beyond their allotment. Human and cattle population of forest villages is also increasing. This increases pressure on wildlife habitat.

Large quantity of firewood is removed through head loads. This is sold for earning livelihood. This is degrading habitat. Grazing is reducing palatable fodder resources of the reserve affecting population dynamics of wild animals. Graziers fire forest floor and extensive area is burnt. This degrades habitat quality. A large number of people collect NWFP.

Man-animal conflict is increasing gradually due to human settlement, development of agriculture and tea and rubber industry. Wild animals, particularly elephant and gaur, occasionally come out of the forests and cause damage to the cultivated field.

Deforestation, because of biotic pressure, is damaging the natural flora and fauna. Consequently, soil erosion enhanced by high rainfall and swift flowing of hilly streams is causing damage to the land.

Developmental programmes:

Developmental programs under MGNREGS, IAY, JFM etc are currently being carried out in the buffer region. A consolidated report of the same will be provided in the near future.

3.3.6 Tourism

Ecotourism is being carried out locally in the buffer region and also in the core. However, an Integrated Tourism plan is currently lacking. Presently the main tourist attractions in the buffer are namely Zamduar, Ultapani, Runikhata (Gelephu in Bhutan), Kalamati, Manas National Park, Subankhata, Barnadi, and Bhairab Kunda. Most of the tourists are local as well as a few from neighboring West Bengal and also from Assam. Foreign tourist also visit the area but are presently very minimum in number.

3.3.7 Research, monitoring and wildlife health

In the buffer region, very few research comprehensive studies have been undertaken. Only recently, the rapid survey report for prioritizing biodiversity areas (Menon *et.al.*, 2008), a Golden langur and elephant population census (Ghosh, 2008; 2009), a checklist for birds (Nath *et.al.*, 2008) and butterfly status (Choudhury, 2010) have been compiled. Administrative boundary delineation and spatial mapping of select megafauna has also been achieved to some extent (Lahkar *et.al.*, 2010). All this, along with community conservation

works (Horwich *et.al.*, 2010), have provided a strong base to carry forward the case for scientific management of the MTR for positive effect.

3.3.7.1 Research Priorities: Following strategies shall be adopted:

- a) Establishment of Field Research Station
- b) Posting of a Research advisor with office and financial support.
- c) Co-ordination of various research activities in buffer areas.
- d) Funding of research activities.
- e) Establishment of computerized data storage and retrieval system
- f) Enriching MTR library through purchasing some relevant Journals and Books.

3.3.7.2 Proposed projects for departmental/collaborative Research:-

- Occupancy surveys and population assessment for tigers and their prey for the entire MTR.
- Study on enumeration of major wild animals in buffer areas.
- Study on institution development, participation and empowerment of social organizations and financial sustainability of village institutions.
- Study on river systems in MTR and Environmental Impact Assessment (EIA) of boulder extraction from river beds.
- Study on Inventory, Status and distribution of lesser cats in MTR.
- Poaching and illegal wildlife trade.
- Study on prospects and strategy for Eco-tourism
- Documentation of flora of MTR
- Study on wildlife health and diseases:
- Current distribution status of herpetofauna.
- Current status of invertebrates and fishes.
- Impact assessment of dependency of local people on MTR
- Study on effect of fire incidences on flora and fauna of MTR and mitigation measures.
- Use of RS/GIS technology for habitat assessment and monitoring.
- Trans-boundary movement of wild animals into Bhutan and identification of large mammal corridors.

3.3.7.4 Monitoring framework:-

The Park Management shall continue to ensure that the monitoring of biological resources form a basic routine activity in protected area management, and it is the principal way in which the management can identify trends or changes, and so gauge the effectiveness of its managerial inputs. Though it may sound an unplanned and subjective procedure, it is easy to collect useful biological information in a simple, systematic and scientific manner.

The management shall strive to include a number of useful monitoring activities in the routine duties of the staff, as well as regular annual estimation of wildlife, counts and other activities. All such data shall be incorporated in the MIS in a routine manner.

3.3.7.5 Monitoring wildlife health and diseases:

It shall be done regularly as there is danger of spread of epidemic through domestic cattle grazing in the Reserve. Water Samples shall be regularly checked by field research Laboratories. Survey of adjacent fringed villages shall be done to know about the spread of any epidemic. Vaccination of fringe cattle against F.M.D., Anthrax, H.S.B.Q, etc. shall be done at suitable intervals by veterinary unit.

Wildlife Health interventions in Manas Tiger Reserves has been conducted through

- Prophylactic vaccinations of domestic livestock against viral disease outbreaks like FMD and bacterial diseases like HS-BQ, Anthrax in collaboration with Animal Husbandry and Veterinary Department and supported by various other Govt and Non-Governmental agencies
- Post mortem disease investigation procedures with laboratory confirmatory diagnosis in appropriate cases as a routine measure.
- Opportunistic sampling of sick and rescued wildlife and health management of captive Asian elephants.

3.4 Nature education and interpretation: Such education programme is aimed at enlisting support of local people mainly forest villagers, fringe villagers and Tea garden labourers. To focus on the issues that are crucial with local people who live in and around MTR, the nature and environmental education plan is to be based on the biological importance of the area. The following programs shall be organized in the area: -

(i) Nature and Wildlife education camps are to be organized for villagers. A few camps would be organized every year for the people living in and around MTR. The value of MTR eco-system, its special features and the negative impact of its misuse by local people and other groups shall be highlighted.

(ii) PRA training including training on rural resource development would be imparted as per prescription and requirement of the eco-development project. Staff and NGO would be involved to conduct PRA exercise in the villages.

(iii) The process of extension work in MTR may involve holding slide and film show in villages, holding discussion with the villagers to resolve conflicts, encouraging discussion among villagers on critical issues related to management, establishing demonstration model for village eco-development.

(iv) **Workshop/ Seminar:** A seminar is a good tool to obtain broad agreement with local people, other stakeholder groups, administrators, scientists and nature lovers on the issues related to management of MTR and implementation of the eco-development plan. Frequent meeting with the FPC/EDC is needed occasional meeting (at least one meeting in each Gram panchayat/year) shall be conducted involving panchayats and NGOs to make them aware about this project and for reminding them their duties and responsibilities in respect of MTR's natural resource management.

Every year workshop and field study shall be organized at MTR level to share the experience gain during the field works and disseminate the new knowledge and practices being used in other PAs. During these types of workshop and field training regular interactions/ discussions between officers and field staff would also add to the understanding of new perspectives relating to wildlife management.

3.5 Administration and Organization

The buffer area of Manas Tiger Reserve is divided into five forest divisions, which is under administrative control of respective Divisional Forest Officers (DFO). Each DFO reports to the CHD, BTC, for administrative purposes which is headquartered at Kokrajhar, Assam. The entire buffer divisions has been divided into well demarcated blocks which are managed and protected by Beats or Sub Beats. The boundaries of these Beats and Sub Beats are demarcated by natural features like rivers, streams and nallahs mostly.

3.6 The details of working plan of five forest divisions within Manas Tiger Reserve are given hereby in concise manner for evaluating their implications on tiger conservation.

3.6.7 Baksa Forest Division

General history of management: The general history of the management as recorded in various forest records and reporting detail are mentioned in the working plans.

Prior to 1850, it seems that there has been no organized or uniform attempt in Assam to realize dues on timber felled and a system of realization of unauthorised cess by fiscal officers was reported to be in vogue. During that time, the collector of Kamrup imposed a tax of Rs.15/- per 100 logs with a check on felling of young trees. This system was however abolished in 1852 by the Board of Revenue, which formulated a system of forming certain tracts of forests to be given to the highest bidders for a period of 5 years. In this system there was no restriction as regards size of trees to be felled and the revenue was collected by fiscal officers. These fiscal officers were replaced by mouzadars, in 1968, with the change of revenue system. The constitution of reserves started during 1870-71, with the appointment of first Forest Officer in Assam. The first Reserved Forests to be notified was Daodhara Reserved Forest.

The N.K. Division was created by curving out reserved forests from erstwhile Darrang, Goalpara, Haltugaon and Kamrup Division. In order to deal with the past history of management of present R.Fs of N.K. Division now Baksa Division, it is deemed worthwhile to discuss the relevant management system adopted for R.Fs presently under N.K. Division from the past working plans of Darrang, Goalpara, Haltugaon and Kamrup Divisions. In order to have a glimpse of past history of management the following excerpts for the progress report of first administration and order notes deserve mentioning. The excerpts are recovered from the previous working plan of the Division by Sri P.C. Das and Dr. R.M. Dubey.

Past Systems of Management and their results :-

The first regular Working Plan for Sal forests of Goalpara Division was formulated by Hoyal during the year 1894-95, which was followed by Working Plans of Perree and Dr. Bor for the period covering up to 1938. The Goalpara Division was bifurcated in 1934 into Goalpara and Haltugaon Division. The forests of western part of N.K. Division were then brought under Haltugaon Division. A new Range was created at Kuklung in 1936. Kuklung Range is now under Chirang Division after reorganization of Aie Valley Division and Chirang Division after creation of Bodoland Territorial Council. The first plantation of Sal, Sissoo and khoir at Kuklung centre were created in 1934.

S. Eardley Wilmot (1903-04 to 1905-06), the Inspector General of Forests, inspected the forests in 1906 and recommended substitution of improvement felling for selection felling. As per Perree who visited the forests for his plan, he found satisfactory regeneration in the areas.

Current Working Plan :- There is no working plan that is currently being implemented. However, various plantation have been raised in Daodhara, Batabari and Marapagladia Reserve Forests under the schemes such, RDF, Matchwood, Sal Artificial Regeneration, Hardwood Plantation etc. Species planted include Bonsum, Lali, Belkar, Ajhar, Gamari, Sisso, Teak, Kadam, Siris etc. Similarly plantation activities have been undertaken through Joint Forest Management that has been implemented in the Division since 2006-07. State Government schemes such STP, Forest Village Development, Compensatory Afforestation and Project Elephant have also been implemented in the Division.

Result of Past Management :-

The Division has been more than 100 years of intensive forestry operation and management under various Silvicultural System especially for the production of highly valued timber spp. The original forest crop has seen completely changed with its composition and mother trees are mostly removed in various ways and now in degraded state. The dominant crops are no longer remained dominate crop and now only remnants can be seen in certain areas. Various plantations with valuable species also been attempted in certain areas under different schemes. However all this was undone during the period of insurgency and civic unrest that lasted about 20 years span. The original Sal, Bonsum, Titachapa forest do exist in patches but no systematic Silvicultural operation is in place. Besides, with the implementation of the Supreme Court ruling of 1994 and subsequent closer of saw mills, plywood and veneer mills in Assam, the forest are mostly protected for maintaining ecological security and as a refuge for wild flora and fauna.

3.6.8 Chirang Forest Division

Past System of Management

General History of Forest Before Reservation: Goalpara Forest Division was first created in 1857 (and it probably included Garo Hills as well) W.R. Fisher was the first Divisional

Forest officer of the undivided Goalpara Division. The H.Q. of the Division was at Dhubri. In 1881-82 Garo Hills Division was created with H.Q. at Tura in 1934, the Division was further bifurcated into Haltugaon and Kachugaon Division. It appears that the names of Haltugaon and Kachugaon were changed to Goalpara East and Goalpara West respectively sometime during 1946 to 1948, as post war reconstruction drive. Prior to the commencement of the first Working Plan of the erstwhile Goalpara Division in 1894 the areas were managed as open forest with a certain number of species declared as reserve trees or tax- paying trees. Initially there were 29 tax paying trees, but the number was reduced to 12 in 1877. The removal of a taxpaying tree was allowed only in open forest without restriction. No uncontrolled removal could be done from the reserved forests from the year 1876. Forests were classified as superior or inferior in order to impose restriction on alienation of forest for agricultural purposes. In 1878 the open foresees was converted into protected forests. However till 1881, the open protected and district forests (other wastelands) were exclusively managed by the Deputy Commissioner assisted by a Forest Daroga. Full control of the areas was brought under the District Forest officer with effect from 29-12-1881. The forest areas were first surveyed by the imperial forest survey in 1889. The work continued till 1893. The whole length of the Bhutan boundary was also surveyed during the period. Working plan surveys commenced in 1889 and terminated in early 1893. The Division has been administered under 11 Working Plan periods since its inception.

Current Working Plan :

There is no working plan that is currently being implemented. However, various plantations have been raised under Runikhata Range, Amteka Range and Kuklung Range under the schemes such RDF, Matchwood, Sal Artificial Regeneration, Hardwood Plantation etc. Species planted include Bonsum, Lali Bhelkour, Ajhar, Gamari, Sal, Sissoo, Teak, Kadam, Siris, Khoir etc. Similarly plantation activities have been undertaken through Joint Forest Management that has been implemented in the Division since 2003-04. Other central/ state government schemes such TSP (Tribal Sub Plan) Forest Village Development, Compensatory Afforestation and Project Elephant have also been implemented in the Division. Raising Plantations and other schemes under APFBC also carried out in the Division.

Result of Past Management :

The Division has been more than 100 years of intensive forestry operations and management under various silvicultural systems especially for the production of highly valued Sal timber. The original forest was therefore completely changed to have an even aged Sal dominated crop, remnants of which can still seen in certain areas. Besides Sal, plantations of other valuable species such as *Michelia champaca* and *Tectona grandis* were also attempted in certain areas. However all this was undone during the period of insurgency and civic unrest that lasted almost 20 years. The original Sal forest do exist in patches but no systematic silvicultural operation is in place. Besides, with the implementation of the Hon'ble Supreme Court Ruling in 1994 and subsequent closure of Saw Mills, Plywood and veneer

Mills in Assam, the forests are mostly protected for maintaining ecological security and as a refuge for wild flora fauna.

3.6.9 Haltugaon Forest Division

The past management is similar to Chirang Forest Division, since it was part of the earlier mentioned Goalpara Forest Division.

Interim period without working plan prescription (1992-93 to 2007): The interim period has seen a major upheaval with insurgency and civic unrest that has heavily impacted the forests. Since no compartment histories were maintained or could be traced back, it is not possible to comment exactly upon the effect of the prescriptions of Das's Plan. An attempt to write the working plan (for the period 2001-2002 to 2013-2014) was initiated by M.K. Yadav but the same is still pending approval. Since the data used for M.K. Yadav's plan was based on satellite imagery and enumeration survey carried out in 2000, it has been suggested to rewrite the management plan using the latest satellite imageries. Further, the Haltugaon Division has come under the administrative control of BTC and has also been sub-divided to exclude some of its forests for Chirang Division i.e the portion falling under Chirang district in between Chmapamati river to Bhur river from Indo-Bhutan Boundary to the junction point of the said two rivers. Therefore, the need to come up with a new Working Plan for the year (2019-20 to 202-30) is justified.

Activities in the Forest areas after expiry of the last Working Plan 1993: At present the Forest Division falls under the administrative jurisdiction of BTAD (Bodoland Territorial Areas District). BTAD also popularly known as Bodoland Territorial Council (BTC), a new born Autonomous council area unraveled from the northern part of western Assam under the sixth schedule of the constitution of India in 2003. BTC has 4 districts with headquarters at Kokrajhar which was also the original district in Assam. In addition, it has 3 newly carved out districts of Chirang, Udalguri and Baksa. **Under the powers conferred by Sixth Schedule of the Constitution of India, the Council has Legislative, Administrative, Executive and Financial powers over 40 subjects including Forests.** The council formulates its own integrated plans and schemes for the development of the area. Under the BTC schemes, several amenities have been provided such as construction and rebuilding of forest infrastructure, forest village development and tree plantation schemes. Besides these, regular Plantations also have been carried out under Regeneration, Matchwood, Teakwood, Plywood, RDF, Khoir, QGS, MFP, Compensatory Afforestation, CAMPA, APFBC schemes and Revolving fund schemes from Government of Assam. Joint Forest Management (JFM) scheme of National Afforestation and Eco-development Board (NAEB), Government of India, is a new scheme under which Plantations are currently being carried out by Social Forestry Division, Kokrajhar. More than 1500 ha of plantation works have been carried out in 47 JFMC's since 2003-04. Similarly 200 ha of bamboo plantation have been undertaken under National Bamboo Mission (NBM) since 2007-08. Several other programmes under Project Elephant, Project Tiger APFBC etc. have also been implemented from time to time.

3.6.10 Dhansiri Forest Division

General History of Forest:- Prior to 1850, there seems to have been no organized or uniform attempt in Assam to realize dues on timber felled and a system of realization of unauthorized cash by fiscal officers was reported to be in vogue. At that time, the collector of Kamrup imposed a tax of Rs.15/- per 100 logs with a check on felling of young trees. This system was however abolished in 1852 by the Board of Revenue, which formulated a system of forming certain tracts of forests to be settled to the highest bidders operation of trees for a period of 5 years. In the system there is no restriction as regards size of trees to be felled and the revenue was collected by fiscal officers. These fiscal officers were replaced by Mouzadars, in 1968, with the change of revenue system. The constitution of reserves started during 1870-71, with the appointment of first Forest Officer in Assam. The first R.F. to be notified was Khalingduar R.F.

The present Dhansiri Division was carved out from N.K. Division which was then created by carving out R.Fs from erstwhile Darrang, Goalpara, Haltugaon and Kamrup Division. In order to deal with the past history of management of present R.Fs of N.K. Division, it is deemed worthwhile to discuss the relevant management system adopted for R.Fs under N.K. Division during that period i.e. from the past Working Plans of Darrang, Goalpara, Haltugaon and Kamrup Division- now Baksa and Dhansri Division. In order to have a glimpse of past history of management the following excerpts for the progress report of first administration and order notes deserve mention. The excerpts are recovered from the previous working plan of the Division by Sri P.C. Das and Dr. R.M. Dubey.

Past Systems of Management and their Results:- The first regular Working Plan for Sal Forests of Goalpara Division was formulated by Hoyel during the year 1894-95, which was followed by the Working Plans of Perree and Dr. Bor for the period covering up to 1938. The Goalpara Division was bifurcated in 1934 into Goalpara Division and Haltugaon Division. The forests of western part of the then N.K. Division were brought under Haltugaon Division. A new Range was created at Kuklung in 1936. The first plantation of Sal, Sissoo and Khoir at Kuklung centre was created in 1934.

S. Eardley Wilmot (1903-04 to 1905-06), the Inspector General of Forests inspected the forests in 1906 and recommended substitution of Improvement Felling against Selection Felling. As per Perree who visited the forests for his Plan, found satisfactory regeneration in the areas.

Interim period without working plan prescription (1999 to 2008): The interim period has seen a major upheaval with insurgency and civic unrest that has heavily impacted the forests. The main areas of destruction were in Khalingduar R.F., Rowta R.F. and Bhairabkunda R.F. where the forests were clear felled and converted into paddy lands. As such no compartment histories were also maintained. Further the Dhansri Division is a bifurcation of N.K. Division and has come under the administrative control of BTC after formation of BTC in 2003. The Dhansiri Division is a newly created Division, therefore there is need to come up with a new Working Plan for the period from 2019-20 to 2029-2030 is justified.

Activities in the forest areas after expiry of last working in 2000: At present the Forest Division falls under the administrative jurisdiction of BTAD (Bodoland Territorial Areas District). BTAD also popularly known as Bodoland Territorial Council (BTC) is a new form of Autonomous Council Area carved out and created from the northern part of Western Assam under the Sixth Schedule of the Constitution of India in 2003. BTC has 4 district with council headquarters at Kokrajhar which was also the original district in Assam. In addition, it has 3 new carved out districts of Chirang, Udalguri and Baksa under the power conferred by Sixth Schedule of the Constitution of India. The Council has legislative, administrative, executive and financial powers over 40 subjects including forests. The council formulates its own integrated plans and schemes for the development of area. Under the BTC schemes, several amenities have been provided such as construction and rebuilding of forests infrastructure, forest village development and tree plantation schemes. Besides these, regular plantations have also been carried out under Regeneration, Matchwood, Teakwood, RDF, Khoir, QGS, MFP. Compensatory Afforestation and Revolving Fund Schemes etc. from Government of Assam. Joint Forest Management (JFM) Scheme of National Afforestation and Eco-Development Board (NAEB) Government of India is a new scheme under which plantations have also been carried out by the Territorial Division besides NAP. About 400 Ha. plantation under JFMC have been carried out all over BTC area under different Territorial Divisions. Forest village roads, culverts, repairing and also school buildings have been constructed under forest areas. Programmes under Project Elephant have also been implemented from time to time.

Current Working Plan :- There is no current Working Plan that is currently being implemented under Dhansiri Division. However, various plantations have been raised under Khalingduar, Rowta and Bharabkunda R.Fs under schemes such, RDF, Matchwood, Sal Artificial Regeneration, Hardwood Plantation etc. Species planted include Bonsum, Lali, Belkar, Ajhar, Gamari, Sissoo, Teak, Kadam, Siris etc. Similarly plantation activities have been undertaken through Joint Forest Management that has been implemented in the Division since 2006-07. State government schemes such as STP, Forest Village Development, Compensatory Afforestation and Project Elephant have also been implemented in the Division.

Result of Past Management :- The Division has been more than 100 years of intensive forestry operation and management under various Silvicultural Systems especially for the production of highly valued Bosum, Titachap and Sal timber. The original forest was therefore completely changed to have an even aged Sal dominate crop, remnants of which can still be seen in certain areas. Besides Sal, Bonsom, Titachapa and other valuable species plantations also attempted in certain areas. However all this was undone during the period of insurgency and civic unrest that lasted for 20 years. The original Sal, Bonsum, Titachap forests do exist in patches but no systematic Silvicultural operation is in place. Besides, with the implementation of the Supreme Court ruling in 1994 and subsequent closer of saw mills, plywood and veneer mills in Assam, the forests are mostly protected for maintaining ecological security and as a refuge for wild flora and fauna.

3.6.11 Kachugaon Forest Division

Past System of Management

General History of Forest Before Reservation: The Goalpara Forest Division was first created in 1857 (and it probably included Garo Hills as well). W.R. Fisher was the first Divisional Forest Officer of the undivided Goalpara Division. The HQ of the Division was at Dhubri. In 1881-82, Garo Hills Division was created with HQ at Tura. In 1934, the Division was further bifurcated into Haltugaon and Kachugaon Divisions. It appears that the names of Haltugaon and Kachugaon Divisions were changed to Goalpara East and Goalpara West respectively sometime during 1946 to 1948, as a post war reconstruction drive. Prior to the commencement of the first working plan of the erstwhile Goalpara Division in 1894, the areas were managed as open forests with a certain number of species declared as reserve trees or tax-paying trees. Initially there were 29 tax-paying trees, but the number was reduced to 12 in 1877. The removal of a taxpaying tree was allowed only in open forests without restriction. No uncontrolled removal could be made from the reserved forests from the year 1876. Forests were classified as Superior or Inferior in order to impose restriction on alienation of forests for agricultural purposes. In 1878, the open forests were converted into protected forest. However, till 1881, the open, protected, and district forests (other wastelands) were exclusively managed by the Deputy Commissioner, assisted by a Forest Daroga. Full control of the areas was brought under the District Forest Officer with effect from 29.12.1881. The forest areas were first surveyed by the Imperial Forest Survey in 1889. The work continued till 1893. The whole length of the Bhutan boundary was also surveyed during this period. Working Plan surveys commenced in 1889 and terminated in early 1893.

Interim period without working plan prescription (1989-99 to 2011): The interim period has seen a major upheaval with insurgency and civic unrest that has heavily impacted the forests. The main areas of destruction were in Maktaigaon, Pechadabri, Gangia, southern part of Ripu, Polo, Hel, and Athiabari blocks of Ripu RF where the forests were clear felled and converted into paddy lands. As no compartment histories were maintained, it would not be possible to comment exactly upon the effect of the prescriptions of Goswami's Plan. An attempt to write the working plan (for the period 2001-02 to 2011-12) was initiated by M.K. Yadav but the same is still pending approval. Since the data used for M.K. Yadav's plan was based on satellite imagery and enumeration survey carried out in 2000, it has been suggested to rewrite the management plan using the latest satellite imageries. Further, the area has now come under the administrative control of BTC and the BTC has proposed 590 sq km of Ripu reserve forest to declare as wildlife sanctuary; therefore, the need to come up with a new working plan for the year 2019-20 to 2029-30 is justified.

Activities in the Forest areas after expiry of the last working plan in 1999: At present the forest division falls under the administrative jurisdiction of BTAD (Bodoland Territorial Areas District). BTAD also popularly known as Bodoland Territorial Council (BTC) is a new born Autonomous council area unravelled from the northern part of western Assam under the sixth schedule of the constitution of India in 2003. BTC lies between 26°7'12" N to 26°47'50" N and 89°47'40" E to 92°18'30" E longitude and has 4 districts with BTC

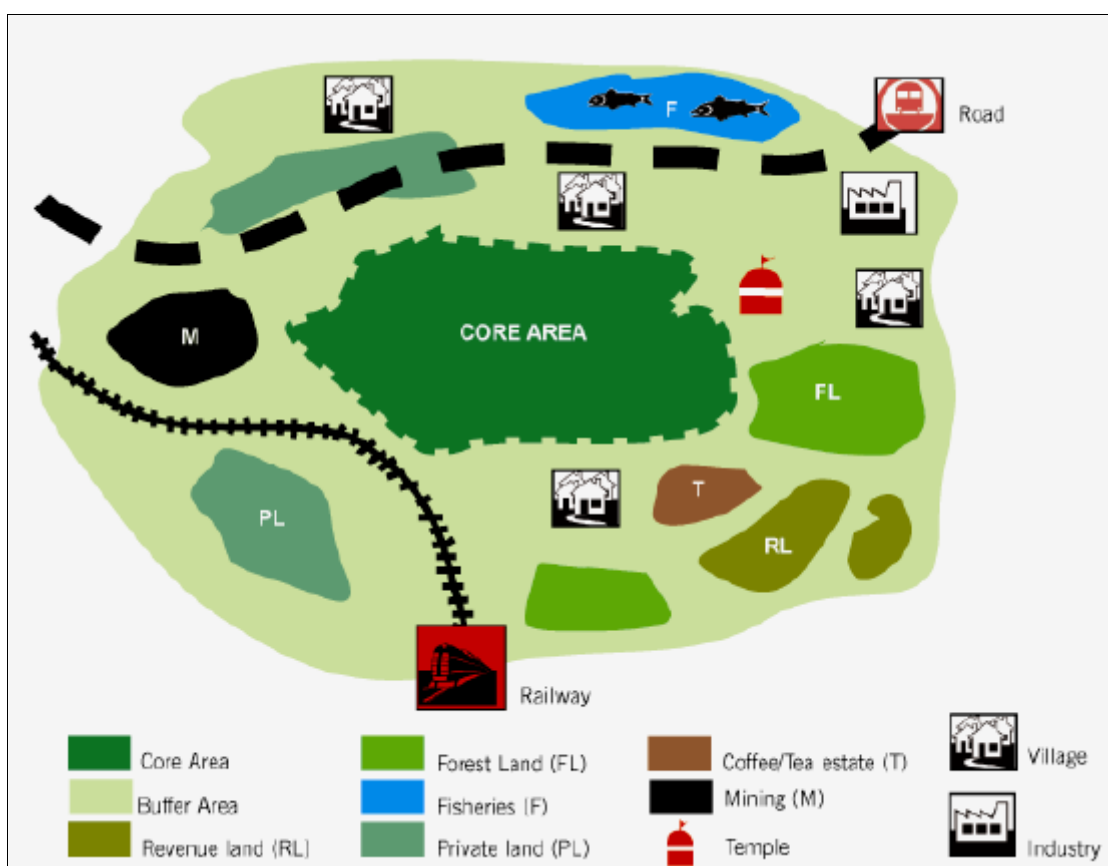
headquarter at Kokrajhar which was also the original district in Assam. In addition, it has 3 newly carved out districts namely Chirang, Udalguri and Baksa. **Under the powers conferred by Sixth Schedule of the Constitution of India, the Council has Legislative, Administrative, Executive and Financial powers over 40 subjects including Forests.** The Council formulates its own integrated plans and schemes for the development of the area. Under the BTC schemes, several amenities have been provided such as construction and rebuilding of forest infrastructure, forest village development and tree plantation schemes. Besides this, regular Plantations have also been carried out under Regeneration, Matchwood, Teakwood, Plywood, RDF, Khoir, QGS, MFP, Compensatory Afforestation and Revolving fund schemes from Government of Assam. Joint Forest Management (JFM) scheme of National Afforestation and Eco-development Board (NAEB), Government of India is a new scheme under which Plantations are currently also being carried out by the Territorial Divisions. Several other programmes under Project Elephant and Project Tiger have also been implemented from time to time.

CHAPTER FOUR

PRODUCTION SECTORS IN THE LANDSCAPE

A number of production sectors operate in the buffer area and surrounding landscape of a tiger reserve, which directly (D) or incidentally (I) affect tiger conservation (**Plate 1**). Therefore, the basic managerial strategy for the buffer area shall focus on mainstreaming wildlife concerns amongst such sectors.

Plate 1: Production Sectors in a Tiger Landscape



Following sectors shall be focussed on in the buffer areas of Manas Tiger Reserve:

4.1 Forestry (affects directly) (D*)

Forestry operations are aimed towards concurrent promotion of biodiversity conservation and meeting resource needs of and generating employment for local people. The dependence of local population in Manas is also high on forestry activities.

- i) Joint management of forests, and grasslands with formalized prior agreements for substantial sharing of usufruct, in return for direct contribution to protection and conservation.

- ii) Cultivation and/or organized collection of medicinal plants, mushrooms, other species, etc, which is compatible with other forestry objectives, especially conservation and other local interests.
- iii) Preferential and concessional availability of wood and non-wood resources to local people directly participating in conservation of forest and other resources.
- iv) Pasture improvement through weed suppression/eradication.
- v) Economic employment generation through weed suppression *e.g.* *Lantana* harvests for pulp, chipboard or basket making on small or cottage industry scale.
- vi) Providing green fodder at beginning of monsoon by hiring irrigated fields, at least during the ‘gestation period’ to enable people to take to rotational grazing/lopping and stall feeding.
- vii) Rotational lopping and promotion of goats and piggery subject to stall feeding.
- viii) Harvest of green grass and plant fodder during monsoon in designated areas (if necessary, rotational) in the ‘conservation’ and ‘extension’ buffer zones.
- ix) Harvest of grass at the end of monsoon and providing hay in return for cooperation in observance of regulated grazing/lopping.
- x) Simple water harvesting and catchment treatment works.

4.2 Agriculture (D)

- i) Improved dry farming techniques (improved seed, manure/fertilizer regimes).
- ii) Efficacious water harvesting (surface and ground water).
- iii) Soil conservation measures.
- iv) Preference to cash crops *e.g.* pulses, oil seeds, spices, cotton, medicinal plants.
- v) Agro forestry.
- vi) Sericulture and horticulture with assured employment through these on one’s own land and from other community works, in order to tide over the ‘gestation period’.
- vii) Apiculture.

4.3 Integrated Development (ecodevelopment, development through Dist. Administration) (D)

- i) Obligated to have a local orientation so that they become part of local area development and in no case upset local people’s resource equations. Appropriate compensation/alternatives to be built into project costs.
- ii) Obligated to compensate by providing inputs into site-specific packages of ecodevelopment measures *e.g.* lift irrigation along reservoir and along the river upstream and downstream.

- iii) Preferential employment to locals, if necessary after arranging education and/ or training.
- iv) Phased reduction in population of scrub livestock and improvement of breed through controlled fertilization of female stock in proper health and age with males of better local breeds, aided by sterilization of scrub bulls.
- v) Goatary and pig rearing subject to stipulations suggested under ‘ A ‘ above.
- vi) Cooperative dairying with marketing support.
- vii) Support to small scale enterprises based on meat and wool.
- viii) Piped (gravity) supply, hand pump or open wells for drinking water.

4.4 Tourism (D)

Barpeta and Baksa district receives good number of tourists every year.

- i) Obligatory use of local guides (after training) on nature trails, trekking and mountaineering routes.
- ii) Development of trekking routes in tracts which have potential for ecotourism.
- iii) Preferential employment to locals in buffer areas and tourism facilities, after education and training as necessary.
- iv) Promotion of local handicrafts as tourist souvenirs with appropriate sale outlets.

Ecotourism is being carried out locally in the buffer region and also in the core. However, an Integrated Tourism plan is currently lacking. Presently the main tourist attractions in the buffer are namely Jamduar, Ultapani, Runikhata (Gelephu in Bhutan), Kalamati, Manas National Park, Subankhata, Barnadi, and Bhairab Kunda. Most of the tourists are local as well as a few from neighboring West Bengal and also from Assam. Foreign tourist also visits the area but are presently very minimum in number. Though, tourists visit this Reserve mainly for nature tourism, they end up being picnic parties that also create a lot of disturbance to wildlife and also pollute the natural landscape. Awareness and stringent tourism rules and regulations are required.

4.5 Fisheries (D)

- i) Exclusive rights to organized cooperatives/user groups of local people in all situations, subject to observance of regulations for sustainability and optimal economic productivity- especially, closed areas/seasons and mesh size of fishing nets, and cooperation in ensuring ban on use of explosives and other forms of poaching.
- ii) Marketing support backed by cold storage and appropriate transport arrangements.

4.6 Tea Estates (affects incidentally) (I)**

There are numerous small and medium scale tea gardens situated in the fringe of the Tiger Reserve. A large area of landscape is occupied by tea gardens. The sector provides employment to large number of people. It also provides seasonal employments. The populations inside tea gardening is quite high. Many labourers of Tea Gardens are associated with illegal removal of timber, firewood, N.W.F.P.s, hunting of deer, Wild boars, hares, Jungle fowl and other birds. Tea gardens act as a barrier for easy movement of Wildlife from one forest to another especially for elephants and gaur and create lot of depredation to crop and private property. Also, the associated settlements create additional pressure on the forest in terms of fuel, firewood and NTFP collection.

4.7 Road/Rail transport (D)

The major broad guage railway and the National Highway passes through some RF areas of the buffer. This sector is still under development and provides employment to a small number of people and also affects the wildlife movements.

List of Roads: List of roads inside Forest is annexed in *Annexure-10*

4.8 Industry (D)

Cottage Industry and Handicrafts

- i) Promotion based on local skills with appropriate technological and infrastructure support.
- ii) Curing/processing of collected/cultivated products *e.g.* medicinal herbs and essential oil for value addition.
- iii) Investigation of potential plants/products by pursuing ethno botanical and ethno zoological studies and rich development for consumption/marketing.

4.9 Mining (I)

At present all the mining activities have been stopped inside the Tiger reserve. There is, however, illicit collection of surface boulder and bed material. There is a great demand for boulder for construction within Assam and neighboring states. Smuggling of MTR boulders to these parts is also in evidence. Some contractors are involved in the removal illegal boulders from river beds passing through MTR. In the landscape there is no major mineral mining activity.

4.10 Thermal power plants (I): The landscape is remotely impacted by the presence of Bongaigaon refinery and the Salakati Thermal power plant. The direct impacts are yet to be ascertained.

4.11 Irrigation projects (D) There are no large scale irrigation projects with the MTR buffer at present. However, a FIS (Flow Irrigation Scheme) namely Khairani FIS has been found set up by the irrigation department inside Subankhata RF during the year 2012-13.

4.12 Temple tourism (I)

Large number of pilgrims visit the Guru Madabdeb Satra at Barpeta which is an adjoining district to Buxa and also the Mahamaya temple at Dhubri. The tourism circuit can be developed and planned for visiting the core of MTR by pilgrims visiting these religious sites annually.

4.13 Communication projects (D) No major communication project operates in the landscape.

CHAPTER FIVE

LAND USE PATTERNS AND CONSERVATION-MANAGEMENT ISSUES

5.1 Land use classification:

5.1.1 The existing situation in the zone of influence:-

Most of the Territorial Forest Divisions especially in western part of BTC areas have a number of recognized forest villages. Many of these forest villages were known to be set up/established during the British period while many have been set up after independence also. Besides these, there are number of villages inside R.F. lands. The process of recognition of these villages remained incomplete mainly due to promulgation of Indian Forest (conservation) Act, 1980. The decision by the appropriate Authorities / Government (s) is yet to be taken. The following are the recognized Forest Villages under the buffer areas of MTR.

Sl. No.	Division	No. of RF	No. of FV	Total recorded Area (Ha)
1	Kachugaon Division	2	106	16,384.67
2	Haltugaon Division	3	20	3122.69
3	Chirang Forest Division	2	22	14094.00
4	Dhansiri Division	2	2	122.38
5	Baksa Division	1	1	197.86
Total =		10	151	33,921.60 Ha.

The population has a fairly high representation of schedule castes and Schedule Tribes and they account for more than 90% population. Most of the people living in non-Tea Estate mouza depend primarily on agriculture. Their income is also supplemented in most cases by primitive animal husbandry. Forest villagers cultivate their land and rear large number of cattle. Reduction in forest harvesting, extent of creation and maintenance of plantations mean substantial reduction in employment of both forest villagers and fringe dwellers.

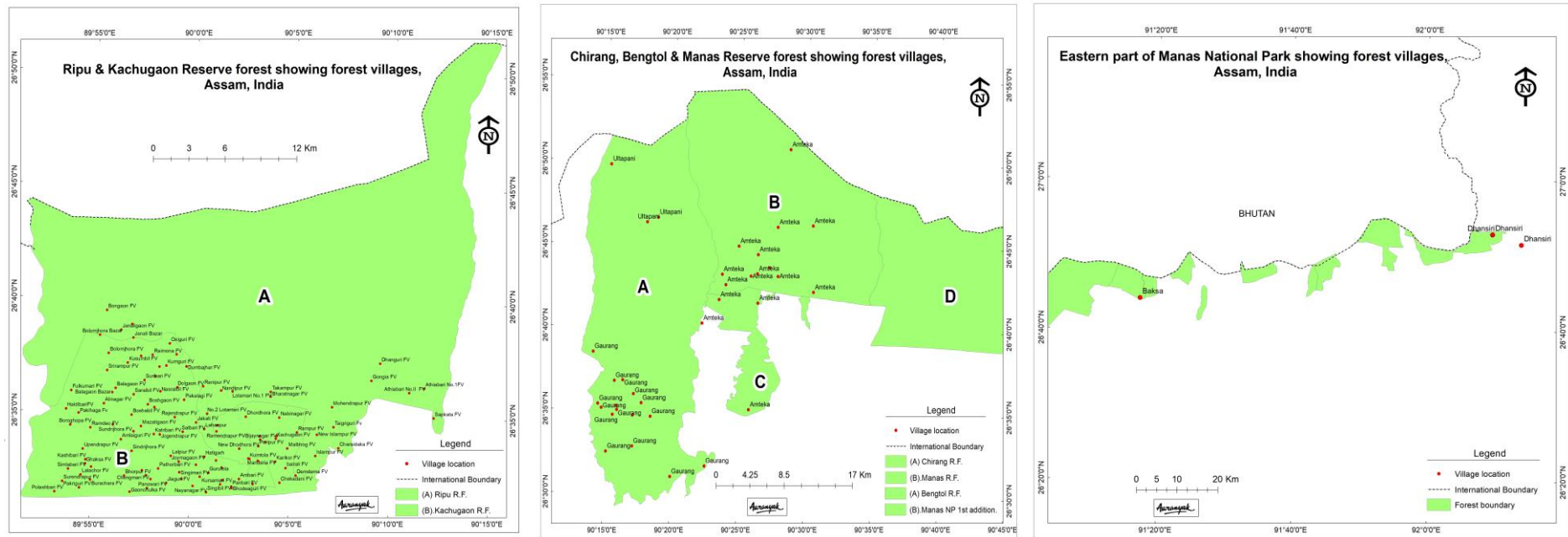


Fig 1: Settlements and Roads within MTR

5.2. Land use patterns

The use of land in the southern part of the reserve varies greatly depending on the nature of the parent material- soil, terrain, hydrological conditions, drainage, rainfall, temperature, irrigation facility etc. Lands are more fertile in south than in north as soil depth is more in south than in north. On the Northern side, there is scarcity of water and the land is less fertile. Forest clearing for sowing mustard and paddy is a common sight in encroached areas. The yield is very low in such areas and often the people move on to other areas to support their livelihood income. The village areas located at the outskirts of forest are mostly cultivated fields. There are tea gardens in between the forest areas. Agriculture is mostly rain fed. Household orchards contain jack fruit, banana, mango, areca nut, etc. Agricultural crops raised during pre-kharif are maize and jute. Millet, mustard, potato, wheat and vegetables are grown during Rabi season. Paddy is the main crop. Traditional practice is followed for agriculture but the pattern is changing gradually.

Socio-economic Profile of Villages:-

There are a total of 151 forest villages that roughly occupy an area of 339.86 sq. km. in the buffer region of MTR. Forest villages are distinct from revenue villages as they were primarily created to provide the manpower for working in the forest areas. Most of them are inhabited by people who were brought in from outside Assam state and include tribal groups such as Adivasi, Santhali and Nepali. Each forest village was allotted a certain forest area in their vicinity for agricultural purposes and in return the villagers were required to put in certain number of work hours for forestry operations. As the timber logging operations gradually diminished and also completely stopped by mid 1990s, the people of these villages took to other non-forestry occupations including encroachment of nearby forest areas, illegal logging, mining, dairy farming and commercial crop plantations. The civil strife combined with remoteness of these villages has added to the backwardness of the people. Today, about 28, 800 inhabitants live on the fringe of the core area (Project Tiger, 2001; Jhala et.al., 2011), although the figure is likely to increase if systematic surveys are done in the future. They come under the control of the District Revenue Authorities. Surrounding forests, originally tribal lands used for grazing and tree products, come under the Assam Forest Department and have been logged by the timber and paper industries for a pittance, after which, immigrant farmers have illegally purchased the cleared land. This has so alienated the tribal people that they prefer to see the jungle razed than let outsiders take it. This, and their growing numbers, has forced villagers into using the protected forests. Denial of access has caused conflict and antagonism towards the National Park. Political pressure from this growing population, driven by feelings of deprivation and neglect, has become the greatest threat to the Park (Deb Roy, 1991). However, since 2005, the Bodos have become involved in rebuilding the Park's infrastructure (UNESCO, 2005).

5.2.1. Ethnic identities of the villages:-

The people of Bodoland Territorial Council are commonly known as *bodos*, one of the largest plains tribe communities that predominantly practice agriculture. The other ethnic communities in the area include the Koch-Rajbongshis, Adivasis, Nepalis, and the Garos. Together they constitute more than 65% of the population which is around 32 lakhs (2011 census). The people of Bodoland Territorial Council have experienced a long period of turmoil and unrest in the last decade and peace has finally returned with their first democratically elected government in the year 2003. Development is however happening in such a rapid manner, that holistic and long term planning and coordination between the various implementing agencies becomes the key to the success of such initiatives.

5.2.2. Socio-economic and cultural environment:

District scenario: The socio-economic and cultural factors exert strong influence on the forest. About 90% of rural population is engaged in agriculture and allied activities and rest is in non-agricultural activities. A large number of female workers are engaged in the tea gardens and in agricultural activities. The pressure on agricultural land is increasing gradually.

5.2.3. People's economy and major employment sources:-

People residing in and around the tiger reserve are very poor. There is no industry except tea. Agriculture is the main occupation. Majority of families are small and marginal farmers and number of large farmers are very few. Huge labourers force is present. Villagers follow the traditional agricultural practices. Irrigation facilities are poor and majority of the agricultural lands are rain fed and mono cropped.

The sources of employment that used to exist earlier in forest villages included plantation works, annual felling and thinning coupes, forest buildings and road construction, soil conservation and river training works, honey and other NWFP collection, etc. Most of this is either stopped or covered under JFM and other ecodevelopment initiatives.

Vocations of people living in and around the tiger reserve are agriculture, animal husbandry and agro-based, forestry-based cottage industries. Number of regularly employed is very little. Except school teaching, there is little scope of getting a job. Few are engaged in banking service. Few people are engaged in cottage industries. Some are engaged in small scale business. In tea gardens, labourers get employment from April- November. December to April is the lean period. During this lean period, most of the tea-garden labourers cut firewood from forests.

5.3 Resource Dependence of Villages:

Traditionally, local economy is dependent on forest resources. In fact, it used to be too heavily dependent on it. Saw mills, veneer mills, furniture shops used to legally depend on forest resources until recently. Poor families depend on sale of firewood for earning their livelihood. Milk production in forest villages and Khutis depend heavily on grazing in MTR. No in-depth study report on resource dependency of local people was available for the area at the time of writing this Plan.

5.3.1. Implications of the land use and resource dependence for the conservation issues in the tiger reserve:

People have subsistence level of economy. This subsistence level of economy is changing to market economy. To augment their scarce income they illegally fell trees, cut fodder grasses and thatch, graze cattle inside the forest. This exerts tremendous pressure on the Reserve.

Flood and soil erosion from time to time cause heavy damage to vegetation and agricultural land. People (particularly forest villagers) try to compensate their agricultural land from forestland. Forest villages situated inside the forest also hold more land beyond their allotment. Human and cattle population of forest villages is also increasing. This increases pressure on wildlife habitat.

Large quantity of firewood is removed through head loads. This is sold for earning livelihood. This is degrading habitat. Grazing is reducing palatable fodder resources of the reserve affecting population dynamics of wild animals. Graziers fire forest floor and extensive area is burnt. This degrades habitat quality. A large number of people collect NWFP. Collection is controlled very little which poses grave threat of over extraction.

Man-animal conflict is increasing gradually due to human settlement, development of agriculture and tea industry. Wild animals are getting disturbed and their habitat is shrinking gradually. Wild animals, particularly elephant and gaur, occasionally come out of the forests and cause damage to the cultivated field.

Deforestation, because of biotic pressure, is not only damaging the natural flora and fauna in the region but also disturbing the local equations. Consequently, soil erosion enhanced by high rainfall and swift flowing of hilly streams is causing permanent damage to the land of these areas.

5.4. Human-wildlife conflicts:

Details of the human wildlife conflict cases in the buffer divisions of MTR are presented below.

5.4.1. Livestock killing by Wildlife:

Livestock killing is reported in MTR, although it is not a major threat in the buffer region.

5.4.2 Wildlife deaths:

5.4.2.1 Haltugaon division:

Year	Name of Wild Animal	Age /Sex	Date of Death	Date of Postmortem	Cause of Death (In detail along with history)	Laboratory investing findings	Location in where the Animals died
2009-2010	Elephant	44 Years/Male	15.04.2009	30.04.2009	Gun shot	Death by coma as a result of injury to Brain	Samukha Block, Chirang R.F.
2010-2011	Elephant	Adult	16.07.2011	17.07.2011	Probably due to Thundering (Near by the tree has been broken due to Thundering)	Died due to shock	Lungsung Block, Chirang R.F.
2011-2012	-	-	-	-	-	-	-
2012-2013	-	-	-	-	-	-	-
2013-2014	Elephant	Adult/Female	05.03.2014	05.03.2014	Edema in peritoneal and vaginal region	Due to chronic septicemia	Saralbhangha, Chirang R.F.
2014-2015	Elephant	Young/Female	21.01.2015	22.11.2015	Lacerated wound on neck region, head and left front leg	Cardiac arrest due septicemia	Ultapani F.R.
2015-2016	Elephant	15 Years approx/Male	20.08.2015	20.08.2015	Injury	Due to Traumatic shock	Gwjwnsri, Chirang R.F.
2016-2017	Bison	Calf/Male	01.01.2017	-	Injury	-	Jaregaon, Revenue village
2017-2018	Elephant	10 Years approx /Male	10.11.2017	25.11.2017	Gun Shot	Due to Traumatic shock	Lungsung Block, Chirang R.F.
2018-2019	Elephant	Juvenile/Male	25.05.2018	29.05.2018	Suspected to be poisoning	Poisoning	Saralbhangha Block, Chirang R.F.

5.4.3. Human Death and Injuries by Wildlife:**5.4.3.1** Haltugaon Division: Ex-gratia details are as below.

Sl. No.	Year	Nature of Damage			Name & Date of Deceased Person	Status
		Death	Injury	House & Crops		
1	2	3	4	5	6	7
1	2004-05	-	-	29	-	Not Sanctioned
2	2005-06	-	-	-	-	-
3	2006-07	-	-	-	-	-
4	2007-08	-	-	-	-	-
5	2008-09	1	-	46	Lt. Salen Muchahary (28.05.2008)	Not Sanctioned
6	2009-10	-	-	-	-	-
7	2010-11	-	-	02	-	Not Sanctioned
8	2011-12	-	-	-	-	-
9	2012-13	1	-	1	Lt. Basunga Basumatary (20.06.2012)	Not Sanctioned
10	2013-14	-	-	-	-	-
11	2014-15	1	-	-	Lt. Rimola Brahma (06.11.2014)	Sanctioned vide D.C., Koj. letter No.KRR.54/2004/141, dt.13.06.2016
12	2015-16	-	-	-	-	-
13	2016-17	-	-	-	-	-
14	2017-18	1	-	-	Lt. Lal Bahadur Chetry (22.05.2017)	Joint Verification is Under Process
15	2018-19	-	-	-	-	-

5.4.3.2 Chirang Division:

Year	Human death	Injury	House & Crops damage (No. of Families)
2007-08	-	-	-
2008-09	01	02	-
2009-10	01	01	-
2010-11	01	01	-
2011-12	01	-	-
2012-13	02	-	-
2013-14	-	-	35
2014-15	01	-	10
2015-16	01	-	20
2016-17	-	-	20
2017-18	Nil	02	65
2018-19	Nil	01	74

5.4.3.3 Baksa Division:

Year	Human death	Injury	House & Crops damage (No. of Families)
2010-11	2	Nil	Nil
2011-12	Nil	Nil	Nil
2012-13		Nil	Nil
2013-14	2	Nil	Nil
2014-15	1	Nil	Nil
2015-16	4	Nil	Nil
2016-17	2	Nil	Nil
2017-18	Nil	Nil	Nil
2018-19	3	12	14

5.4.3.4 Dhansiri Division: Statement showing of Elephant death/Human death /House damaged/Crops damaged by wild elephant under Dhansiri Forest Division, Udalguri for the year 2007 to 2019.

Year	Elephant Death	Human died	House damaged	Crops damaged
2007	2 nos.	3 nos.	No Record	No Record
2008	2 nos.	6 nos.	do	do
2009	10 nos.	10 nos.	4385 nos.	30 Hect.
2010	1 no.	2 nos.	73 nos.	28 Hect.
2011	4 nos.	19 nos.	747 nos.	220 Hect.
2012	9 nos.	10 nos.	655 nos.	180 Hect.
2013	10 nos.	19 nos.	1053 nos.	210 Hect.
2014	7 nos.	23 nos.	650 nos.	390 Hect.
2015	5 nos.	21 nos.	420 nos.	320 Nos.
2016	6 nos.	8 nos.	350 nos.	45 Hect.
2017	8 nos.	7 nos.	380 nos.	260 Hect
2018	4 nos.	19 nos.	270 nos.	210 Hect.
2019	1 no.	17 nos.	285 nos.	230 Hect.

Human death and injuries have been reported in MTR in areas where elephants are known to reside in the vicinity. Again, the magnitude is minimal at present.

5.4.4. Damage to agricultural crops and human properties by wildlife:

Mainly elephant, wild boar, bison and monkey's damages agricultural crops in peripheral and forest villages. Maximum damage to the crop takes place from Aug-Sept. to Dec.-Jan. They damage mainly paddy, maize, wheat, millets, etc. Elephants are involved in house/ hut damage in peripheral villages and tea garden labour lines.

5.4.5 Wildlife Rescue

Every year a large number of wild animals are displaced due to natural and man-made disturbances such as floods, poaching and destruction of habitat in MTR region. An instance of the number of animals that are found in these forests can be assessed from the rescue

records that are available with the Mobile Veterinary Service Unit-Lower Assam (MVS-LA) which indicates that more than 136 animals have been rescued from December 2005 to July 2008. This means that on an average 6-7 animals are rescued every month. The records also suggest that these animals belonged to an astounding number of 43 species several of them belonging in the Schedule-I and Schedule-II, Part-II of the Wildlife (Protection) Act, 1972.

5.4.5.1 Chirang Division:

Year	Python	Deer	Elephant Calf	Tortoise
2010-11	Nil	Nil	Nil	Nil
2011-12	Nil	Nil	Nil	Nil
2012-13	Nil	Nil	Nil	Nil
2013-14	Nil	Nil	Nil	Nil
2014-15	01	Nil	Nil	Nil
2015-16	01	Nil	Nil	Nil
2016-17	02	Nil	Nil	Nil
2017-18	01	01	Nil	Nil
2018-19	02	Nil	01	02

Table 1: Number of animals rescued by MVS-LA in BTC and adjoining districts

Species	Birds	Mammals	Reptiles	Total
Numbers	13	25	29	67

Table 2: Number of animals rescued by MVS-LA, district wise in BTC and adjoining districts

Species	Kokrajhar	Baksa	Chirang	Barpeta	Udalguri	Bongaigaon	Goalpara	Dhubri
Birds	16	5	4	6	-	2	1	1
Mammals	19	14	8	11	2	2	-	4
Reptiles	21	10	2	31	-	-	-	1
Total =	56	29	14	48	2	4	1	6

Table 3: Yearly trends of no. of wildlife rescue cases and no. of species in BTC

Year	No. of cases	No of species
2008	93	33
2009	203	50
2010	109	35
2011	61	27
2012	56	23
2013	64	26
2014	65	27
2015	66	24
2016	78	27
2017	69	22
2018	71	23

Table 4: Taxa wise no. of wildlife rescue cases and no. of species in BTC

Taxa	No. of cases	No. of species
Mammals	264	105
Birds	346	48
Reptiles	325	28

Table 5: Overall outcome of wildlife rescues since inception in BTC

Overall cases	No. of cases	Percentage
Total cases	935	
Released	681	75.58%
Died under care	193	21.42%
Dead on arrival	34	3.64%
Captive/pending	2	0.21%
Transferred	10	1.07%

5.5. Inputs from other agencies/departments:-

Manas tiger project directorate works closely with different line agencies in various capacities. Authorities of Manas Tiger Project and the BTC is prepared with a view to deal with the administrative situation arising in the jurisdiction extending over Chirang, Baksa and Barpeta districts, which has the buffer divisions of MTR. Cooperation and coordination will be maintained with the inter departmental officers, staff, civil administration, police & security personnel as well as other line departments like SSB, Army and other defence agencies. There is a close coordination with WCCB to deal with all wildlife related offences from buffer divisions.

Biweekly meeting with law enforcement agencies at local level are held to discuss different issues. High level monthly meetings are also held separately to follow up on many other crimes related cases from the region.

Besides the above mentioned agencies, MNP also interact regularly with Physical health and Engineering (PHE), Medical and Public Work Department (PWD) as and when the need arises.

The Ministry of Tribal affairs, Government of India has recognised the need to provide special incentives to tribal areas and therefore enacted the Tribal and other traditional forest dwellers (right of) Act 2005. It has also taken special initiatives such as the Forest Village development scheme that targets individual forest villages for undertaking all round development such as construction of roads, electrification, health and sanitation.

Other agencies such as Ministry of Environment and Forests, Ministry of Natural and Renewable energy, UNDP and others undertake various programmes that ultimately aim at Poverty alleviation, Alternative livelihood and sustainable development.

CHAPTER SIX

VISIONS, GOALS, OBJECTIVES AND PROBLEMS

6.1 Vision: To establish a well defined buffer area for ensuring maintenance of the dynamics of meta-population of tiger, co-predators and prey in Manas Tiger Reserve, while managing and mainstreaming of wildlife concerns, and providing appropriate livelihood options for local people by continuing sustainable ecosystem services to reduce dependency on forests.

6.2 Management Goals:

Mainstreaming of wildlife concerns through an integrated landscape and trans-boundary approach.

- Creating situation conducive to have a dynamic population of tiger, co-predators and prey.
- Correlating/upgrading the sink populations with source population of wildlife in core.
- Ensuring suitable measures in place to manage wildlife conflicts.
- Ensuring better management that includes the concept of ecological development and sustainable livelihood.
- Improving condition of fringe area people and creating awareness towards wildlife and biodiversity.
- Providing alternative livelihood options by involving local communities through sustainable ecosystem services opportunities.

6.3 Management Objectives:

- To provide suitable space to the spillover population of tiger, co-predators and prey and to link the meta-population with the core, source population through usable corridors and involvement of a trans-boundary approach.
- To maintain and improve water resources.
- To provide benefits of ecological development through sustainable collection of NTFP and promoting ecotourism in the Buffer region.
- To minimize the negative impacts of anthropogenic influence on forests by adopting the concept of ecological development.
- To take eco-development initiatives with other line departments to improve the economic condition of the fringe area population through JFMC initiatives and SHGs.
- To provide protection to the buffer habitat from illegal felling, poaching of wild animals, grazing of livestock's, collection of fuelwood by departmental staff through patrolling, other protection measures, awareness etc. and involving JFMC members.

- Forming a coordination committee for developmental activities within buffer area along with all concerned line departments.

6.4 Problems in Achieving Objectives:

- Insurgency and its aftermath. The Tiger Reserve forms a major chunk of BTAD, which is a newly constituted Autonomous Council. Ethnic clash and civil strife have marred the landscape in the past two decades, although the new democracy holds promise. Heavy loss in Forest infrastructure and low morale of forest staff during the insurgency period. Lack of recent cadastral surveys to ascertain the actual boundaries of the Reserve.
- Informal nature of trans-boundary coordination between India and Bhutan govt authorities that needs to be codified.
- Segregation of Command and lack of coordination between Core (National Park) and buffer (Territorial) forest divisions.
- Fragmented forest areas, especially in the western and eastern part of the reserve that has resulted in loss of connectivity between habitats.
- Hunting and poaching of wildlife mainly for meat and also for wildlife trade to some extent.
- Illegal expansion and forest conversion for establishing tea and rubber gardens.
- Low productivity of small land holdings and dependency on rain for cropping success. Leads to unemployment and opportunistic tree felling and hunting in the non-hunting season.
- Lack of conservation awareness and also proper orientation/capacity building of Forest Departmental staff.

6.5 Strengths – Weaknesses – Opportunities – Threats (Limitations) (SWOT) Analysis: **Strengths:-**

- Presence of large tracts of 'good' forested landscape including the connectivity with forest areas in Bhutan.
- Availability of 'good' habitat to achieve the goal of management.
- A strong core (Manas National Park) that has been steadily strengthened after the insurgency period of 1990s. Prime focus for elected leaders of BTAD and several national and international NGOs and aid agencies, including the World Heritage Site committee of UNESCO.
- Unique initiative with involvement of local youth for helping out in forest protection.

Weaknesses:-

- Area is affected by long history of insurgency and civil unrest.
- Wildlife hunting and trapping for bushmeat.
- Poaching of herbivores for local consumption.
- Presence of forest villages and their encroachment into forest areas.

- Cattle grazing, illegal collection of timber, firewood, sand, boulders and other forest produce.
- Floods and changing river courses as a result, accessibility to the interior of Reserve is restricted during the Monsoon season.
- Lack of intra-departmental and inter-departmental coordination.
- Lack of protection infrastructures in buffer area.
- Absence of a consolidated eco-tourism plan and initiative.
- Lack of marketing linkage for local/traditional produce.
- Absence of young, energetic, trained workforce and vacancies at all levels to sustain all round developmental activities.

Opportunities: -

- Willingness of people to accept to changes for betterment.
- Vast scope of ecotourism and other indigenous initiatives such as the involvement of local youth.
- Tiger Protection force for buffer area.
- Local governance system (BTAD).
- Transboundary Manas Conservation Area is a well recognized entity.
- Involvement of various conservation partners in the region.
- Low human population density as compared to other sites in northeast India.

Threats: -

- Unemployment among local youths.
- Backwardness of local area due to poor development of infrastructure etc.
- Poor socio-economic conditions of local communities and marginal farmers.
- Lack of proper co-ordinated utilization of development funds by line departments.
- Habitat fragmentation and spread of invasive species in the habitats.

CHAPTER SEVEN

MANAGEMENT STRATEGIES

7.1 Delineation of Buffer Areas and Other Zones within the Buffer Area (e.g. Eco development Zone, Forestry Zone, Production Sector zone, etc.)

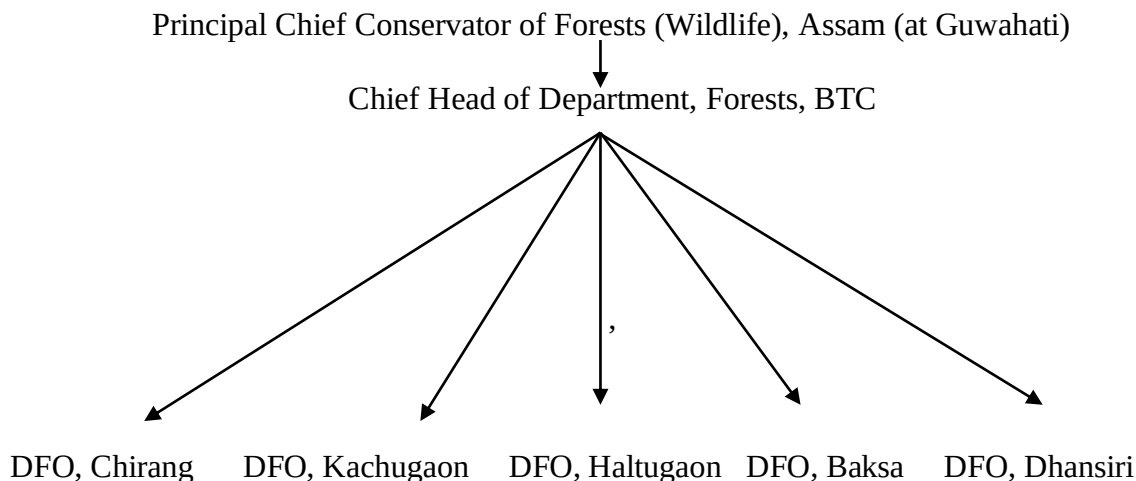
7.1.1 Delineation of Buffer Areas:-

7.1.1.1 Constitution: As per section 38V (4ii) of the Wildlife (Protection) Amendment Act – 2006, each Tiger Reserve is required to create a Buffer or Peripheral area consisting of areas peripheral to critical tiger habitat or core area, where a lesser degree of habitat protection is required to ensure the integrity of the critical tiger habitat with adequate dispersal for tiger. This area will promote the co-existence between wildlife and human activity with due recognition of the livelihood, developmental, social and cultural rights of local people. This area will have to be determined on the basis of scientific and objective criteria in consultation with the concerned Village Council Development committee *VCDC/Gram Sabha* and an expert committee constituted for the purpose.

7.1.1.2 Status: The buffer zone of a tiger reserve will not have the status of a National Park or Sanctuary. However, as a “multiple use area”, it may encompass conservation or community reserves, apart from revenue lands, private holdings, villages, towns and other production sectors. Buffer zone management should address threats to wildlife conservation emanating from regional developmental activities such as forest concessions, industrial pollution, highway development, extensive high value farming or ecologically unsustainable and intensive land uses like mining through appropriate mainstreaming in such sectors. The working plan provisions for forest areas in the buffer zone would be implemented after duly mainstreaming wildlife concerns.

7.1.1.3 Administration:

Currently, there are five designated buffer divisions within MTR, namely, Chirang, Kachugaon, Haltugaon, Baksa and Dhansiri. Each divisions is under command of Divisional Forest Officer, who are directly under the Council Head of Department (CHD), Forests, BTC. The administrative structure currently is as follows:-



However, it is recommended that the buffer zone should be placed under the unified control of the Field Director of the Tiger Reserve. The role of Deputy Directors (Buffer Zone) of a tiger reserve would be to carry out **implementation** of inputs (Forestry/Joint Forest Management/Eco-development) in forest areas, while ensuring **coordination** with other sectors.

7.1.1.4 Legal provisions for Buffer zone: The existing rights/concessions of local people would be regulated as per the legal provisions in vogue. As provided in Section 38-V of the Wild Life (Protection) Act, 1972 (as amended in 2006), the provisions of sub-section (2) of section 18, sub-sections (2), (3) and (4) of section 27, sections 30, 32 and clauses (b) and (c) of section 33 shall apply to the buffer zone of a tiger reserve, to accord protection to wildlife in the area.

7.1.1.5 Major functions of the Buffer zone: The Buffer area of a Tiger Reserve will have following major functions:

- 1) To provide habitat supplement to the spillover population of tiger and its prey from the core area, conserved with the active cooperation of stakeholder communities.
- 2) To providing site specific, need based, participatory eco-development inputs to local stakeholders for rationalizing their resource dependency on the Tiger Reserve and strengthen their livelihoods, so as to elicit their support for conservation of the area.
- 3) Mainstreaming wildlife concerns in various production sectors in the area.

7.1.2. Delineation of Other zones within the Buffer Area

The management interventions shall involve co-existence agenda in buffer / fringe areas (landscape approach/sectoral integration) with ecologically sustainable development programme for providing livelihood options to local people, with a view to reduce their resource dependency on the core. The strategy will involve reciprocal commitments with the local community on a *quid-pro-quo* basis to protect forests and wildlife, based on village level, participatory planning and implementation through EDC.

7.2 Zone and Theme Approaches to Management Strategies

The “zone” and “theme” approaches have been adopted in the proposed management strategies of MTR. Various managerial situations and needs can be taken care of by an effective combination of the “zone” and “theme” plans. Under this approach, several specific objectives and problems relevant to an identified part of the PA can be recognized as a “management zone”. This management zone would have its own measures and strategies. Furthermore, several objectives and different problems, created by a combination of factors, can be tackled by a “theme strategy” under which measures can be prescribed for the entire area.

7.3 Zone plans:-

A zone is an area of specific management category distinguishable on account of its objectives. Zonation is required to achieve the different objectives of management. The National Park and the Wildlife Sanctuary form the Core zone or Critical tiger habitat while the R.F., P.F. and USF form the buffer zone of the MTR. People living in Forest Villages, F. D. Holdings within MTR and the members of FPCs and EDCs depend on the Reserve for grazing of their cattle and collection of firewood, NWFP and small timber. Some sanctum sanctorum is absolutely necessary for the wilderness to flourish. Extensive monoculture of teak and other species within MTR need manipulation to create more favourable habitat for Wildlife. MTR attracts many tourists and picnickers. Some religious places in MTR also draw lots of devotees. The conservation/management Plan has to cater to all such visitors. Considering all these factors, the entire area of the MTR will be divided into into the following management zones.

Table 7.1 Management zonation's in MTR

Management Zone	Area (Sq. Km.)	Legal Status
I. Wilderness zone	342	National Park
II. Habitat Management Zone	180.21	Sanctuary, N.P.
III. Multiple use Zone	317.83	Reserve Forest, P.R.F.
IV. Eco-Tourism Zone	Overlapping	N.P., Sanctuary, R.F.

7.3.1 Eco-development Zone:-

- Eco-development as well as Joint Forest Management activities in the area will be implemented using a participative strategy as codified by the State, through village forest committees and EDCs.
- Site specific eco-development initiatives based on participatory village level micro plans will be carried out for the local communities for strengthening their livelihoods through a balanced approach of rationalization of resource use.
- Reciprocal commitments by the local people through specific measurable actions as per MoUs for improving protection and conservation of the area will be implemented. This may include rationalization of resource use from the forest, participation in fire protection and anti-poaching efforts.
- Implementation of eco-developmental activities will be for reducing resource dependency of local people on surrounding forests.

- Integrated development (eco-development and developmental activities of District Administration) shall be innovatively used for addressing conflicts arising on account of pressures on forest resources from local people.
- Ecotourism activities in the Buffer Area will be used as an important component of eco-development for strengthening the livelihood of the local people and the protection of the area.
- Capacity building of the eco development committee (as well as field staff) members will be undertaken on a regular basis through the Tiger Conservation Foundation. Similarly, intensive nature conservation awareness programme should be part of the buffer area management plan with a focus on different stakeholders particularly local communities.
- For areas with ongoing conflicts on account of law and order, insurgency and the like, integrated development shall be complemented by deploying native workforce and homeguards/ex-army personnel to contain the situation, as the site specific situation warrants.

7.3.2 Eco-Tourism Zone : -

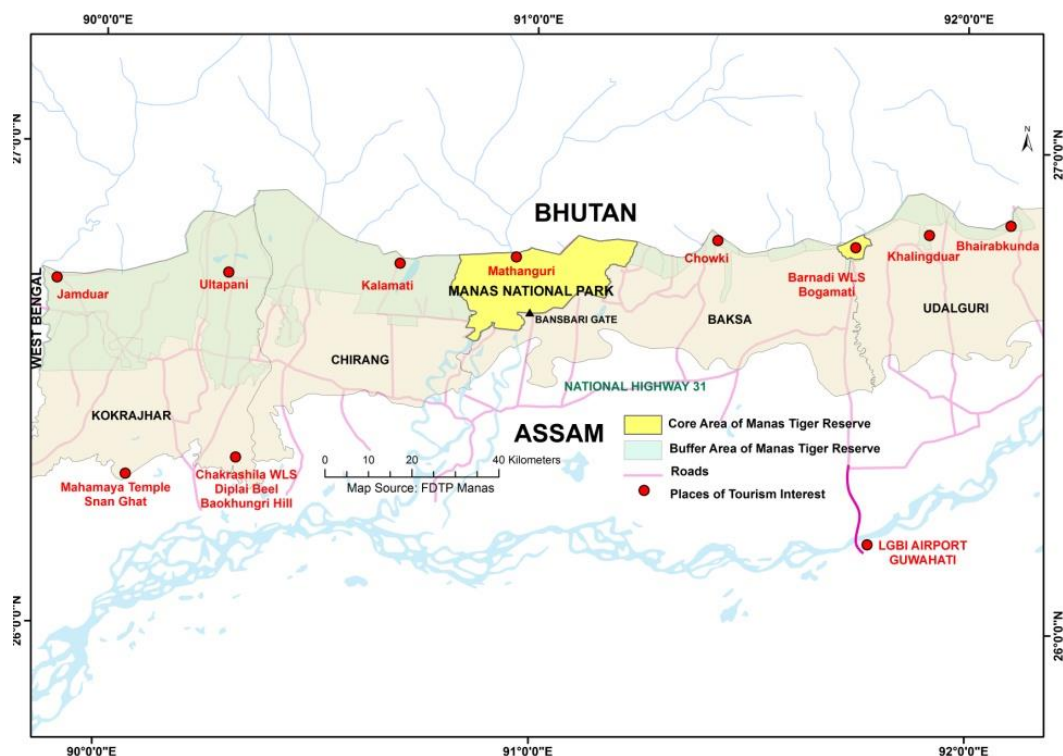
This Zone will be overlapping with the Habitat Management Zone and the Multiple Use Zone. Tourism could be a mainstay towards generation of revenue, which will in turn aid in better management measures. Though there are well demarcated tourist routes and zones in MTR, stricter regulatory measures need to be implemented to safeguard against adverse effects of tourism.

a) General constitution:- In case of buffer areas even, it is proposed to have an overlapping eco-tourism zone all along the fair-weather roads as an eco-tourism zone. The only exception to this will be the already existing set-up of Forest Inspection Bungalows as in Jamduar, Ultapani, Kalamati, Chowki (Subankhata RF) and Khalingduar areas.

b) Objectives of Management:-

- To promote eco-tourism as an alternative livelihood support for forest fringe villagers.
- To generate revenue which can in turn be ploughed back into management of the buffer areas as and when required.
- To create awareness and a sense of pride among visitors to the buffer areas using the principles of responsible tourism.

c) Strategies to be followed in this Zone:- Eco-tourism shall be regulated/ implemented as per the guidelines of the NTCA.

Map 7.2: Tourism hubs under Manas Tiger Reserve and BTAD, Assam-**7.3.3 Production Sector Zone: -**

- Mainstreaming wildlife concerns in the buffer landscape by targeting the various production sectors in the area, which directly or incidentally affect wildlife conservation, through 'Tiger Conservation Foundation', as provided in the Wildlife (Protection) Amendment Act. 2006.
- Coordination with governmental / non-governmental production sectors in the landscape for mainstreaming conservation.
- Biomass regeneration and alternatives, so that the ecological status of the area could be improved and maintained.
- Addressing man-animal conflict issues (ensuring uniform, timely compensation for human injuries and deaths due to wild animals, livestock depredation by carnivores, crop depredation by wild ungulates).

7.3.4 Eco-development Zone:-**i) General constitution:-**

All blocks and compartments not included in the Wilderness zone and the Habitat Management Zone have been included in this Zone.

ii) Objectives of Management:-

- To preserve the natural forest.

- To meet the demand of people for fuelwood, fodder, NWFP and timber, etc.
- To provide adequate employment to forest villagers and members of the FPC and JFMC through forestry works, NTFP collection and eco-development activities.
- To create congenial habitat for wildlife by planting suitable fodder and fruit trees indigenous origin and by protecting and maintaining wildlife corridors.

iv) Strategies to be followed in this Zone:-

- I. Final harvesting of matured plantations will be carried out followed by replanting of the felled area as prescribed in working plan. No felling of natural forests will be permitted.
- II. Cultural and Mechanical thinning of plantations will be carried out as per thinning schedule.
- III. Reforestation of degraded areas will be carried out.
- IV. Developmental works including road repairing, maintenance of fire lines, creation and maintenance of staff amenities, etc. will be carried out.
- V. Eco-Development activities will be carried out in forest villages, F. D. holding hamlets, FPCs and JFMCs.
- VI. Forest Villagers will be permitted to cultivate the forest land allotted to them.
- VII. Removal of boulders and bed materials from river beds will not be permitted except for the purpose of protection of forests and human habitations.
- VIII. Regulated collection of MFP will be permitted.
- IX. Rotational grazing by immunized livestock will be permitted in high forests and older plantations. Fodder plantations will be raised in selected forests on the fringe.
- X. Tourism activities will be restricted within the area falling under tourism zone.

7.3.5 Forestry Zone:-

a) General constitution:- The main areas under this zone primarily lie in the buffer areas of Manas tiger reserve.

b) Objectives of management:-

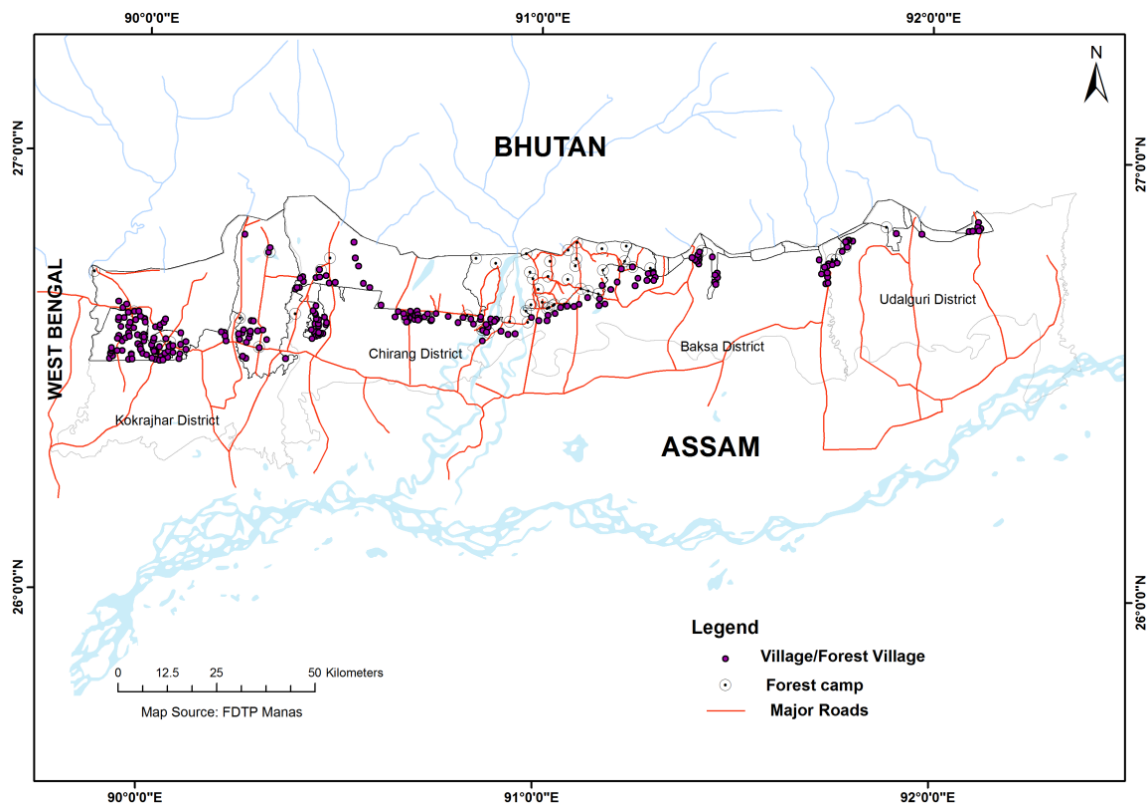
- A time bound recovery of degraded/encroached forest areas.
- To encourage evictions/village relocations as deemed necessary based on field conditions.
- To undertake plantations and reclamations of the degraded habitat.

c) Strategies to be followed in this Zone:- The habitat has a long history of disturbance owing to insurgency and related problems. Many of the ranges require restoration of the protection infrastructure (patrolling camps, wireless control rooms etc.) hence the zone plan should include such areas for time bound recovery, while reflecting the needs in the APO of the Project Tiger.

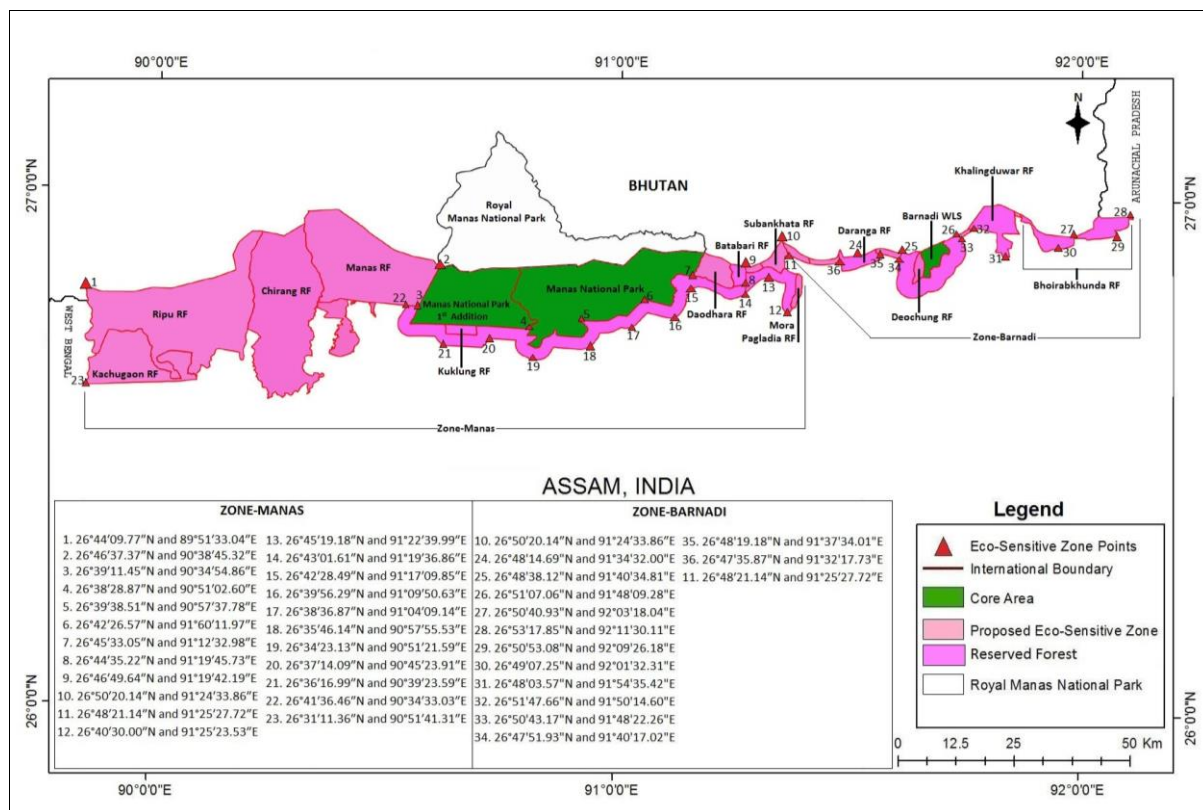
d) Promoting Joint Forest Management:-

- Eco development as well as Joint Forest Management activities in the area would be implemented using a participative strategy as codified by the State, through village forest committees and JFMCs.
- Site specific eco development initiatives based on participatory village level micro plans will be carried out for the local communities for strengthening their livelihoods through a balanced approach of rationalization of resource use
- Reciprocal commitments by the local people through specific measurable actions as per MoUs for improving protection and conservation of the area will be implemented.

This may include rationalization of resource use from the forest, participation in fire protection and anti-poaching efforts.



Map 7.1: Location of roads, forest camps and villages under Manas Tiger Reserve



Map 7.2: Eco-Sensitive Zone to be taken up for JFM/EDC and eco-tourism activities in Manas Tiger Reserve

- Implementation of eco-developmental activities would be for reducing resource dependency of local people on surrounding forests.
- Integrated development (eco-development and developmental activities of District Administration) should be innovatively used for addressing conflicts arising on account of pressures on forest resources from local people.
- Ecotourism activities in the Buffer Area will be used as an important component of eco development for strengthening the livelihood of the local people and the protection of the area.
- Capacity building of the eco development committee (as well as field staff) members will be undertaken on a regular basis through the Tiger Conservation Foundation. Similarly, intensive nature conservation awareness programme should be part of the buffer area management plan with a focus on different stakeholders particularly local communities.
- For areas with ongoing conflicts on account of law and order, insurgency and the like, integrated development should be complemented by deploying native workforce and homeguards/ex-army personnel to contain the situation, as the site specific situation warrants.

e) Promoting silvicultural operations:-

- Implementation of forestry activities would be after mainstreaming wildlife concerns.

- Addressing tiger bearing forests and fostering corridor conservation through restorative strategy in respective working plans of forest divisions, involving local communities, to arrest fragmentation of habitats.
- Habitat management and improvement activities will be carried out in the existing habitat of tiger and its prey species through active involvement of local communities. The existing silvicultural operations will be accordingly modified to promote conservation of the area and the management will be based on specific forest lands forming part of village level micro plans. Community will be involved in the overall management of the buffer area.
- Ensuring safeguards/retrofitting measures in the area in the interest of wildlife conservation.

f) Promoting Eco-development zone:-

g) Objectives of Management:-

- To preserve the natural forest.
- To meet the demand of people for fuelwood, fodder, NWFP and timber, etc.
- To provide adequate employment to forest villagers and members of the FPC and JFMC through forestry works, NTFP collection and eco-development activities.
- To create congenial habitat for wildlife by planting suitable fodder and fruit trees indigenous origin and by protecting and maintaining wildlife corridors.

ii) Strategies to be followed in this Zone:-

- I. Final harvesting of matured plantations will be carried out followed by replanting of the felled area as prescribed in working plan. No felling of natural forests will be permitted.
- II. Cultural and mechanical thinning of plantations will be carried out as per thinning schedule.
- III. Reforestation of degraded areas will be carried out.
- IV. Developmental works including road repairing, maintenance of fire lines, creation and maintenance of staff amenities, etc. will be carried out
- V. Eco-Development activities will be carried out in forest villages, F. D. holding hamlets, FPCs and EDCs
- VI. Forest Villagers will be permitted to cultivate the forest land allotted to them.
- VII. Removal of boulders and bed materials from river beds will not be permitted except for the purpose of protection of forests and human habitations.
- VIII. Regulated collection of MFP will be permitted.
- IX. Rotational grazing by immunized livestock will be permitted in high forests and older plantations. Fodder plantations will be raised in selected forests on the fringe.
- X. Tourism activities will be restricted within the area falling under tourism zone.

7.4 Theme plans: -

Management strategies, which are common to two or more Zones, will be discussed under Theme plan. The following themes have been identified under various zones.

7.4.1. Human-wildlife interface - This theme plan shall be applicable to all zones. Wild animal depredation is one of the problems in the fringe villages, tea gardens and forest villages of Manas Tiger Reserve. Depredation is mainly caused by elephant, leopard, wild pigs, rhesus macaques and water buffaloes. Formation of trained anti-depredation voluntary squad in tea garden and villages. Anti-depredation squads under JFMCs shall be formed in the forest fringe villages. Necessary training and equipments (search light, batteries, crackers, etc.) shall also be provided to each squad for the purpose of driving away wild elephants and other animals.

Timely payment of crop-damage, injury compensation and ex-gratis shall be ensured. For this purpose, Joint enquiry by Forest Deptt. and District administration will be completed immediately after depredation. In case of death, compensation will be paid most promptly.

Awareness generation programmes among people through film show, distribution of leaflets, etc. Villagers and tea gardens labourers shall be educated dealing with wild animals and how to live peacefully with them.

7.4.2. Protection and intelligence gathering: -

This shall be applicable to all zones and suitable training and infrastructure (including creation of anti-poaching camps, patrolling paths etc.) shall be undertaken under this theme. The divisional offices shall also work in coordination with police administration, Army, SSB etc to gather information on any untoward planning. Regular meetings would be held with enforcement agencies.

7.4.3 Boundary consolidation and management: -

This shall be done in consultation with SSB who are also involved in demarcating boundaries. Proper pillars would be placed to make the forest boundary known. Regular patrols would be carried out along the boundaries, both the forest and international boundary with Bhutan.

7.3.4 Fire protection:-

One of the important factors which command profound effects on forest and wildlife is fire. Forest fire has beneficial effect under control but has hazardous effect when it is wild. Fires usually do not kill a large number of animals but they do harm micro fauna and flora of the habitat. Fire destroys the organic matter, which contributes to the humus content of the substratum. Fire changes the abundance and composition of wildlife communities drastically, and a general ecological effect of fire is to reverse the natural plants succession. The fire also destroys the eggs of a number of ground-nesting birds and reptiles. The fire compels animal and bird population to abandon the habitat and migrate randomly in various directions, which may disturb the spatiotemporal utilization of a habitat. Many seeds and several plant species are completely destroyed by fire and their regeneration is affected adversely.

Specific fire protection scheme will check spreading of fire, with a system of immediate detection of fire, speedy communication, quick arrival to the fire site, immediate action to extinguish the fire on war footing scale. One of the most important fire protection measures is to get reciprocal commitments regarding control of forest fire through regular meetings with local people of the surrounding villages.

In the buffer areas of Manas Tiger Reserve, man-made surface fires occur quite frequently. Monitoring of fire incidences in buffer areas is very essential to assess the impact of fire and to formulate future strategies. Following fire record must be maintained in each Range.

- i) A fire register will be maintained in each Range Office to record the cases of forest fire in the following format.

Case No.	Date of fire	Beat	Comptt	Specific location	Area burnt in (Ha)	Damage of fauna, flora and other properties	Probable cause of fire	Action taken	After effect of fire
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)

- ii) Map of fire prone and vulnerable areas.

A map shall be prepared from the fire data collected from past incidences. Fire prone areas shall be identified. They shall be classified by degree of burning intensity.

7.3.5 Human Wildlife Interface Zone: Wild animal depredation is one of the problems in the fringe villages, tea gardens and forest villages of Manas Tiger Reserve. Depredation is mainly caused by elephant, leopard, wild pigs, rhesus macaques and water buffaloes. Formation of trained anti-depredation voluntary squad in tea garden and villages. Anti-depredation squads under JFMCs shall be formed in the forest fringe villages. Necessary training and equipments (search light, batteries, crackers, etc.) shall also be provided to each squad for the purpose of driving away wild elephants and other animals.

Timely payment of crop-damage, injury compensation and ex-gratis shall be ensured. For this purpose, Joint enquiry by Forest Deptt. and District administration will be completed immediately after depredation. In case of death, compensation will be paid most promptly.

Awareness generation programmes among people through film show, distribution of leaflets, etc. Villagers and tea gardens labourers shall be educated dealing with wild animals and how to live peacefully with them.

7.3.6 Monitoring wildlife health and diseases:

It shall be done regularly as there is danger of spread of epidemic through domestic cattle grazing in the buffer areas. Water Samples shall be regularly checked by field research Laboratories. Survey of adjacent fringed villages shall be done to know about the spread of any epidemic. Vaccination of fringe cattle against F.M.D., Anthrax, H.S.B.Q, etc. shall be done at suitable intervals by veterinary unit.

Wildlife Health interventions in Manas Tiger Reserves has been conducted through

- Prophylactic vaccinations of domestic livestock against viral disease outbreaks like FMD and bacterial diseases like HS-BQ, Anthrax in collaboration with Animal Husbandry and Veterinary Department and supported by various other Govt and Non-Governmental agencies
- Post mortem disease investigation procedures with laboratory confirmatory diagnosis in appropriate cases as a routine measure.
- Opportunistic sampling of sick and rescued wildlife and health management of captive Asian elephants.

The emergence of Elephant Endothelial Herpes Virus (EEHV) in Asian Elephants and canine distemper (CD) in large carnivores has been the biggest concern for the region as the disease has been detected in captive and wild populations in the State and the country. The park authority has been collaborating with College of Veterinary Science and other Non-Governmental Organizations on screening of all captive elephants and diagnostics of suspected cases in the wild on the emerging problem of EEHV in Asian Elephants. Canine Distemper is a highly contagious viral disease of canids, felids and viverrids and also newer families of wildlife are being reported to be infected. For surveillance of wildlife disease, especially for populations of critically endangered and endangered species in the landscape, a collaborative approach with the research institutes and agencies with capacity and manpower would be sought to address the issue. The plan proposes to strengthen the existing veterinary unit with hiring additional manpower and infrastructure with adequate logistical support, hiring of trained wildlife health experts and establishing a working laboratory in the field itself to process the basic screening. The Tiger reserve will notify a “Wildlife Health Advisory Committee” to oversee and advise on this emerging threat to the management to take up appropriate measures in a time bound manner to face the challenge in today’s changing landscape.

CHAPTER EIGHT

ECO-DEVELOPMENT AND LIVELIHOODS

Manas Tiger Reserve is dotted with numerous forest villages and is fringed by populous tea gardens and revenue villages along the periphery and thus heavily influenced by local people who are largely dependent on natural resources like fuel wood, fodder, MFP for their livelihood. This has resulted in severe biotic pressure on the Reserve especially for firewood and grazing. It is a serious problem with thousands of cattle entering the Reserve daily from the forest villages, tea gardens and surrounding revenue villages. These act as carriers of deadly zoonotic diseases, apart from competing with the wild herbivores for fodder resources.

Traditional lifestyles of these communities have become unsustainable because of the high population growth, depletion of forest resources, and the pressures of market forces. Further, the existing rural development programmes have not taken adequate notice of the issue of natural resources degradation.

As part of the confidence building measures and with a view to reduce the dependencies of the people on the forest resource a number of Forest Protection Committees / Eco-development Committees are being proposed in all the fringe villages of MTR.

Forest villages, Manas Tiger Reserve, Assam, India

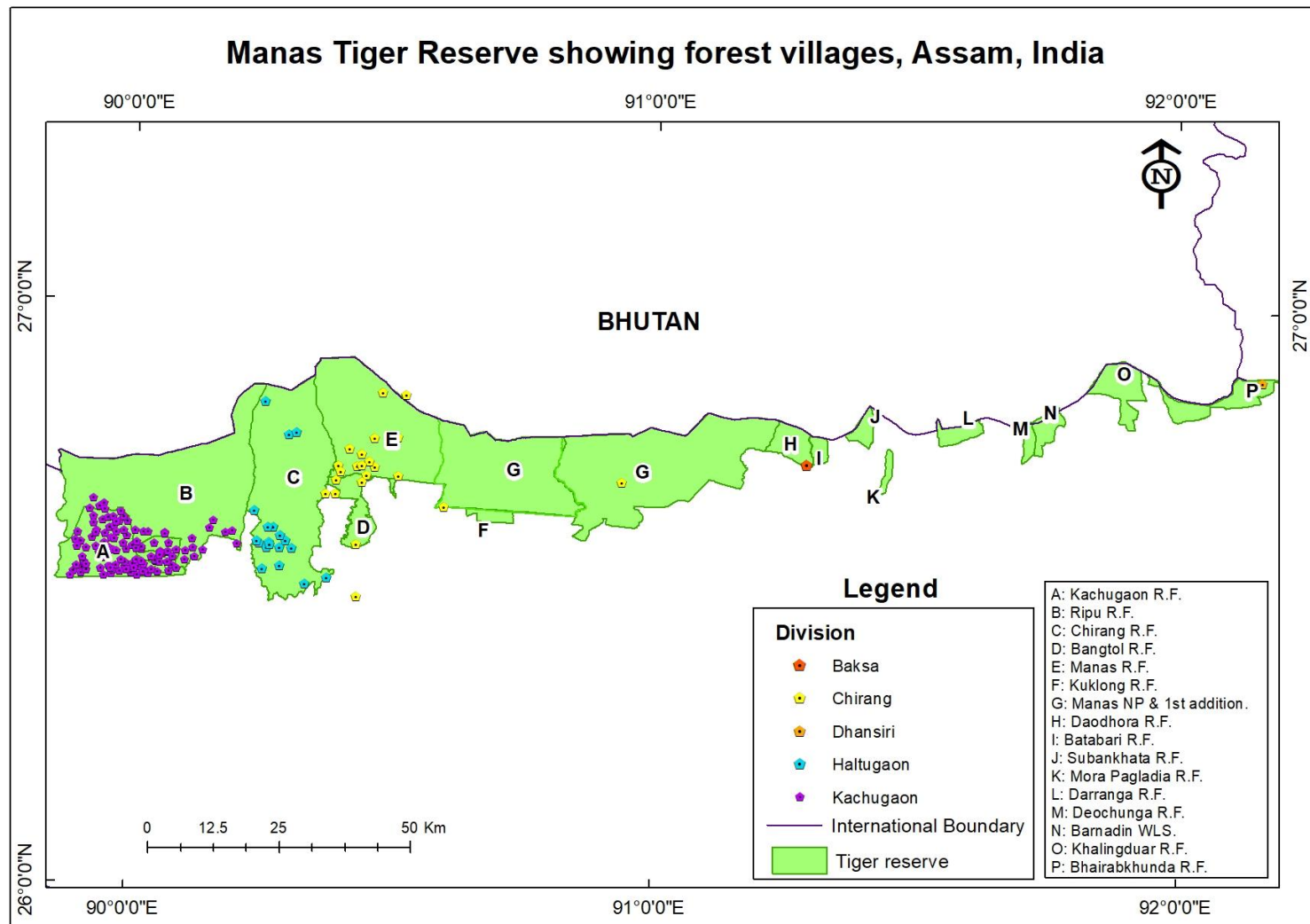
Sl. No.	Name of Range	Forest Village	Lat_Degdec	Long_Degdec
1	Ultapani	Ultapani	26.772250	90.300056
2	Ultapani	Labanyapur	26.776972	90.313639
3	Ultapani	Saralpara	26.829306	90.253806
4	Gaurang	Bishmuri	26.547556	90.285556
5	Gaurang	Mohanpur	26.577694	90.307944
6	Gaurang	Bashbari	26.590972	90.296250
7	Gaurang	Bhadranpur	26.599806	90.286444
8	Gaurang	East maligaon	26.578528	90.285444
9	Gaurang	West maligaon	26.578639	90.260444
10	Gaurang	North maligaon	26.587750	90.264972
11	Gaurang	Bhumka	26.583667	90.265750
12	Gaurang	Bhomoraguri	26.541833	90.253000
13	Gaurang	Dolijhora	26.517806	90.333722
14	Gaurang	Ouguri	26.585528	90.246500
15	Gaurang	Shyamsingkillla	26.529056	90.376250
16	Gaurang	Haltugaon	26.285590	90.173390
17	Jharbari	khasiguri	26.589500	90.242056
18	Jharbari	East mahendrapur	26.613556	90.272806
19	Jharbari	Khalashi	26.641389	90.235250
20	Jharbari	West mahendrapur	26.612833	90.262222

21	Runikhata	Simlaguri	26.749861	90.415111
22	Runikhata	Molandubi	26.720333	90.464444
23	Runikhata	Hatisar	26.847611	90.477917
24	Runikhata	Shantipur	26.741861	90.439417
25	Runikhata	Deosri	26.769667	90.463528
26	Runikhata	Ranipur	26.497000	90.433361
27	Runikhata	Duttapur	26.586361	90.430250
28	Runikhata	Birinchiguri	26.705528	90.448861
29	Runikhata	Nizlaguri	26.728806	90.454250
30	Runikhata	Bordangi	26.720111	90.430722
31	Runikhata	Salbari	26.693333	90.439778
32	Runikhata	Khagrabari	26.722500	90.438806
33	Runikhata	Amteka	26.771667	90.507500
34	Runikhata	Malivita	26.843889	90.522500
35	Runikhata	Pattabari	26.705167	90.509111
36	Runikhata	Koilamoila	26.700611	90.936944
37	Kuklong	Rangijhora	26.652911	90.596750
38	Khungring	Bhurpara	26.672028	90.370472
39	Khungring	Aminpara	26.695972	90.391333
40	Khungring	Dakhingaon	26.721444	90.394750
41	Khungring	Hatidhura	26.672556	90.389972
42	Khungring	Khungring	26.711056	90.399556
43	Mazbat	Sikaridanga	26.881694	92.159250
44	Mazbat	Boscobari	26.858694	92.230306
45	Batabari	Bongaon	26.735294	91.289500
46	Central range	Takampur FV	26.600717	90.066747
47	Central range	Bamunijhora FV	26.546164	90.005397
48	Central range	Salbari FV	26.570119	89.993786
49	Central range	Jakati FV	26.577114	90.004758
50	Central range	Nandipur FV	26.600931	90.025142
51	Central range	Singibil FV	26.526286	90.014378
52	Central range	Madhyanagar FV	26.540486	89.991717
53	Central range	Joymagaon FV	26.548125	89.991058
54	Central range	Nayanagar FV	26.530631	90.003028
55	Central range	Mazatigaon FV	26.573508	89.958686
56	Central range	Lalpiur FV	26.552336	89.984289
57	Central range	Borobadha FV	26.535642	89.993686
58	Central range	Katribari FV	26.567903	89.969578
59	Central range	Hatigarh	26.552200	90.012317
60	Central range	Ramendrapur FV	26.570947	90.022028
61	Central range	New Khagrabari	26.535525	90.027914
62	Central range	Gurufela	26.540606	90.015972
63	Central range	Joleswari FV	26.575414	90.022703
64	Central range	Rajendrapur FV	26.580614	89.986867
65	Central range	ContractorpattyFv	26.568208	90.058097
66	Central range	Kumtola FV	26.551328	90.050183
67	Central range	Lotamari No.1 FV	26.600503	90.034742
68	Central range	Pakalagi FV	26.593486	89.994411

69	Central range	Mandaria FV	26.551719	90.049058
70	Central range	Old Khagrabari	26.544578	90.027044
71	Western range Raimana	Choraigaon FV	26.648000	89.949500
72	Western range Raimana	Janaligaon FV	26.643583	89.940444
73	Western range Raimana	Bongaon FV	26.657833	89.928250
74	Western range Raimana	Bolomjhora FV	26.626361	89.930417
75	Western range Raimana	Kusumbil FV	26.619667	89.946556
76	Western range Raimana	Srirampur FV	26.613806	89.929361
77	Western range Raimana	Balagaon FV	26.601000	89.936778
78	Western range Raimana	Alinagar FV	26.589611	89.927250
79	Western range Raimana	Lakriguri FV	26.582139	89.088083
80	Western range Raimana	Horinagar FV	26.574222	89.935306
81	Western range Raimana	Ramdeo FV	26.571667	89.916500
82	Western range Raimana	Lalachor FV	26.537111	89.909139
83	Western range Raimana	Pakriguri FV	26.527556	89.908000
84	Western range Raimana	Surendrapur FV	26.532056	89.893861
85	Western range Raimana	Polasguri FV	26.524444	89.887583
86	Western range Raimana	Simlabari FV	26.541222	89.898611
87	Western range Raimana	Ghaksa FV	26.545250	89.912722
88	Western range Raimana	Kashibari FV	26.548333	89.912889
89	Western range Raimana	Upendrapur FV	26.556111	89.910500
90	Western range Raimana	PakihagaFv	26.582361	89.906361
91	Western range Raimana	Fulkumari FV	26.598667	89.899722
92	Western range Raimana	HaldibariFV	26.585056	89.895750
93	Western range Raimana	Boroghopa FV	26.573472	89.899639
94	Western range Raimana	Burachara FV	26.533583	89.917111
95	Western range Raimana	Bhorpur FV	26.536972	89.945500
96	Western range Raimana	Gaonchulka FV	26.525417	89.950500
97	Western range Raimana	Panowari FV	26.528333	89.964944
98	Western range Raimana	Chengmari FV	26.534972	89.967806
99	Western range Raimana	Boshabil FV	26.581667	89.950694
100	Western range Raimana	Saraibil FV	26.596583	89.952000
101	Western range Raimana	Suribari FV	26.607194	89.960917
102	Western range Raimana	Bangtijhora FV	26.624778	89.957583
103	Western range Raimana	Mothanbil FV	26.610139	89.969750
104	Western range Raimana	Raimona FV	26.625806	89.967306
105	Western range Raimana	Kumguri FV	26.618167	89.978833
106	Western range Raimana	Jiaguri FV	26.532361	89.980833
107	Western range Raimana	Pathorbari (Patabari) FV	26.542778	89.973972
108	Western range Raimana	Jambuguri FV	26.541278	89.960389
109	Western range Raimana	Sindrijhora FV	26.555194	89.951417
110	Western range Raimana	Amlaiguri FV	26.563528	89.942167
111	Western range Raimana	Sundrijhora FV	26.569667	89.952611
112	Western range Raimana	Dolgaon FV	26.602472	89.988667
113	Western range Raimana	Nasraibil FV	26.599333	89.974306
114	Western range Raimana	Boshgaon FV	26.589611	89.964083
115	Western range Raimana	Ranipur FV	26.603667	90.010083

116	Western range Raimana	Dumbajhar FV	26.617944	89.995722
117	Western range Raimana	Amritpur FV	26.626556	89.987278
118	Western range Raimana	Oxiguri FV	26.634417	89.981306
119	Western range Raimana	Jogendrapur FV	26.567806	89.974722
120	Sanfan Range, Kachugaon	Raikhumbhari FV	26.563944	90.063111
121	Sanfan Range, Kachugaon	Panbari FV	26.530806	90.035500
122	Sanfan Range, Kachugaon	No.2 Thapljahora FV	26.550028	90.057139
123	Sanfan Range, Kachugaon	No.1 Thapljahora FV	26.533083	90.053139
124	Sanfan Range, Kachugaon	Chekadani FV	26.534528	90.075611
125	Sanfan Range, Kachugaon	bairali FV	26.545306	90.080389
126	Sanfan Range, Kachugaon	Singimari FV	26.537611	90.008917
127	Sanfan Range, Kachugaon	Kursamari FV	26.532278	90.026167
128	Sanfan Range, Kachugaon	Bhodeaguri FV	26.529778	90.035806
129	Sanfan Range, Kachugaon	Ambari FV	26.536611	90.041722
130	Sanfan Range, Kachugaon	Karikor FV	26.549833	90.071611
131	Sanfan Range, Kachugaon	Demdema FV	26.540000	90.089000
132	Sanfan Range, Kachugaon	Kachugaon FV	26.566639	90.071750
133	Sanfan Range, Kachugaon	Kachugaion Bazar FV	26.568667	90.072611
134	Sanfan Range, Kachugaon	Nabinagar FV	26.582111	90.074306
135	Sanfan Range, Kachugaon	Bharatnagar FV	26.597306	90.066861
136	Sanfan Range, Kachugaon	Gongia FV	26.610500	90.150722
137	Sanfan Range, Kachugaon	Mohendrapur FV	26.590500	90.118278
138	Sanfan Range, Kachugaon	New Islampur FV	26.570222	90.106111
139	Sanfan Range, Kachugaon	Islampur FV	26.554694	90.105111
140	Sanfan Range, Kachugaon	Charaidaka FV	26.560639	90.124278
141	Sanfan Range, Kachugaon	Malbhog FV	26.559667	90.081583
142	Eastern range, Athiabari	Athiabari No.1FV	26.605667	90.195167
143	Eastern range, Athiabari	AthiabariNo.II FV	26.602167	90.182611
144	Eastern range, Athiabari	Debergaon FV	26.571500	90.140000
145	Eastern range, Athiabari	Sapkata FV	26.584083	90.203500
146	Tramway range, Kachugaon	No.2 Lotamari FV	26.583722	90.013889
147	Tramway range, Kachugaon	Dhordhora FV	26.582194	90.046222
148	Tramway range, Kachugaon	Bijaynagar FV	26.565556	90.058806
149	Tramway range, Kachugaon	Pachadabri FV	26.549694	90.022111
150	Tramway range, Kachugaon	Rampur FV	26.571639	90.089361
151	Tramway range, Kachugaon	Peripur FV	26.560861	90.057333

Map of forest village-



8.1 Policy and Institutional Framework

Eco-development is a strategy for protecting the ecologically valuable areas from the pressure of unsustainable use of natural resources by the people living in and around the protected area. Conservation of the MTR started in 1973 as it came under Project Tiger. Regarding forest management there exist several tiers of managing institutions. the following structure is currently proposed (Fig 1) At the level of government at the top, there is a Field Director (FD) under the Principal Chief Conservator of Forest and Wild Life Warden of Assam. Under the purview of Field Director, there is currently one Deputy Field Director (DFD) and one ACF who are in charge of Forest Ranges. Forest Range officers control ‘Beat Offices’ and under their purview lie villages in the protected area of the forest. At the level of people’s participation there exists either a Forest Protection Committee (FPC) or an Eco-Development Committee (EDC), each carrying out participatory management in a village (sometimes in two or three) either directly or indirectly through SHGs.

Fig 1: Pictorial representation of Governance model proposed for Manas Tiger Reserve

Principal Chief Conservator of Forest and Chief Wildlife Warden			
Council Head of Department (CHD), Forests & Tourism, BTAD			
Field Director (FD), Manas TR			
Deputy Field Director (Buffer), Manas TR	DFOs (Territorial Divisions)	DFO (Social Forestry)	Incharge (Eco-Tourism)
ACF	ACF	ACF	
Range Officer(s) Wildlife	Range Officer(s) Territorial	Range Officer(s) SF	
Beat Officer(s) Wildlife	Beat Officer(s) Territorial	Beat Officer(s) SF	
EDCs	JFMCs		
Conservation Volunteers, SHGs, Eco-tourism groups, AFBN etc. at ground level.			



Eco-development at MTR will attempt to do this by the following means.

- (i) By identifying, establishing and developing sustainable alternatives to the bio-mass resources use and to the incomes that are presently being obtained from the protected area.
- (ii) By increasingly involving the people living in and around the PA into conservation planning and implementation in management of the area.
- (iii) By raising the levels of awareness among local community for the value and conservation needs of the PA.

8.1.1 Objectives:-

8.1.1.1 Broad objectives:

- To conserve the bio-diversity of the area through increased local participation and empowering local people to reduce negative impacts of PA on people.
- To reduce negative impacts of local people on bio-diversity and to get increased support of local people for Conservation through appropriate eco-development programme.
- To incorporate PA concerns into regional planning through identification and assessment of existing and proposed activities outside the scope of the project that might potentially undermine effective bio-diversity conservation the PA or undermine implementation of eco-development strategy in and around the PA.

8.1.1.2 Specific Objectives:-

- To involve local people actively in PA planning and protection.
- To generate employment opportunity in PA through various silvicultural activities and improved PA management.
- To generate alternate employment to change traditional forest dependent mode of livelihood of people through vocational training and other inputs.
- To reduce grazing pressure on PA.
- To reduce fuel wood collection from PA.
- To generate awareness among people through conservation education and publicity.
- To reduce man-animal conflicts and to improve Park-people relationship.
- To relocate voluntarily the forest villages which are in the interior and are occupying key habitats.
- To generate employment opportunity outside the PA/ To improve Socio-economic condition of the people to change their traditional forest dependent mode.
- To reduce NTFP collection from key areas and critical habitats of the PA.
- To integrate PA concerns into regional planning.

8.1.2 Specific issues:-

The main issue in conserving bio-diversity in this Reserve is the protection of existing forests as well as repairs of the damage already caused to the habitat.

The following issues and constraints are easily identifiable: -

- The local resentment for curtailment of income and employment through establishment of protected area and stoppage of annual forest felling. Existence of a very large cattle population within the protected area and in its interface which graze in P.A. Villagers are still apathetic to rearing of better breed of cattle and adapting stall feeding

- Dearth of basic facilities at the village level for health care and education. Doubts among the field staff regarding usefulness of such programmes.
 - Lack of interdepartmental linkages.
 - Tea gardens are not supplying fuel wood to their labourers who in turn meet their fuel wood demand from the Reserve.
 - Tea gardens labourers, forest and revenue villagers in fringes damage forest through illicit felling.
 - Increasing trend of depredation by elephant.
 - Most of people in and around the Tiger Reserve depend on fuel wood for cooking. No alternate use of fuel wood is in vogue.
 - Illiteracy and lack, of environmental awareness among people living in and around the P.A.
-

8.1.3 Broad Strategies :-

- Introducing improved agricultural practices.
- Introducing mechanical farming.
- Improving minor irrigation facility and putting the agricultural lands under multiple cropping.
- Encouraging and motivating people for the use of alternatives of fuel wood like use of bio-gas, coal, coal briquettes, cooking gas, use of fuel shaving chullahs.
- Increasing the scope of fodder cultivation in private/panchayet lands and encouraging stall feeding to reduce grazing pressure on PA.
- Motivating people for cattle improvement by A.I. of Cows and castration of useless bulls thereby reducing the surrounding cattle number.
- Encouraging people for non-forest dependent occupations like Agriculture, Horticulture, Apiculture, Sericulture, Pisciculture, Poultry, Piggery, Handlooms and Handicrafts.
- Increasing the scope of health care and primary education among villagers particularly in forest villagers.
- Improving the drinking water facilities in villages through tube wells, ring wells or deep bore wells.
- Increasing the availability firewood and small timber to villagers through farm forestry /social forestry.
- Trying to reduce man-animal conflict through people's awareness and education and erecting electric fencing where feasible.
- Developing alternate employment generation programme for fringe people to improve their occupation and providing needful training to them.
- Awareness generation through education and publicity.
- Training and orientation of staff regarding effectiveness of Eco-development project.

- Integration with other Govt. Deptts. and NGOs for smooth implementation of Eco-development project.
- Maintaining the orange orchards in the hilly areas of the PA as community assets through the involvement of local EDC members.
- Increasing the scope of work in the PA through improved PA management activities like canopy opening, plantation in degraded areas, maintenance of roads and fire lines, thinning of older plantations outside wilderness zone.
- Integration of PA concerns into regional planning.
- Voluntary relocation of some of the forest villagers which are in the interior and occupying key habitats.
- Site specific, need based and participatory selection of work programmes and implementation thereof adopting appropriate technologies.
- Education programme about family planning for the villages in collaboration with Health Department and Family Planning Association of India (FPAI), Kalchini.

8.2 Livelihood support initiatives through village micro-plans

Alternative employment generation can be achieved through Mushroom culture, Poultry, Duckery, Piggery, Pisciculture, Horticulture (cultivation of Arecanut, Coconut, Papaya, Banana, Jack fruit, Zinger, etc.), Sericulture, Apiculture, Sewing and Knitting machine, Bamboo mattings, Cultivation of citronella grass private land and selling it to MFP division, raising plantation of Matchwood/ plywood Spp. Like Kadam, Simul, etc. on private land and selling it to plyboard industries. Setting up of fruit processing cottage units can be done which will also generate some employment.

The village oriented site specific alternative employment generation activities will be decided through participatory **micro-planning**. Marketing is a vital part of the strategy. Department should provide necessary technical expertise. Training is yet another important component. Department should provide it.

Vocational training: It is proposed to provide vocational training to interested FPC/EDC members with the help of Khadi and Distric Industries Centre (DIC), ITI, NGOs and other concerned agencies in respect of various trades and vocations. The objective is to expose the villagers, particularly the unemployed youth, to the employment opportunities commensurate with their background and surroundings and to encourage them to be self reliant. No material /financial support other then training and counseling is proposed to be given. The beneficiaries will be put in touch with banks and other institutions, which may provide them with necessary assistance.

To make the members of the committees economically stable Self Help Groups (SHGs) with upgradation of their skills in carpet weaving, cloth sewing, Jute and Bamboo Handicrafts along with Honey manufacturing, Vegetables etc are being formed. Already about 400 such groups have been formed and are doing well. Detailed list of SHGs in MTR is given in Annexure-8.2

8.3 Integration of rural development programmes

Financing forest management-related activities is a key area. In this context, the Central Government's Swarnajayanti Gram Swarajgar Yojana (SGSY), or Rural Self-employment Generating Scheme (which began in April 1999) is playing a significant role. Under this scheme a District Rural Development Cell (DRDC) provides cash credit (a part of this being subsidy) to SHGs from BPL households to finance 50% of a project cost. Since 1998, the Forest Department in our study area in collaboration with FPCs and EDCs and some reputed NGOs has been taking the initiative to form SHGs. FPCs/EDCs assign their various forest management-related actions to those SHGs (mostly constituted by women members with group size varying from 10 to 14). Principally those actions of SHGs are being financed by (i) group's self-generated and self-rotated fund, (ii) DRDC funds routed directly to the SHG from a bank or indirectly through FPC/ EDC. Forest department is also utilizing the services of local people for different works utilizing the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS).

8.4 Monitoring and evaluation

Monitoring and evaluation is an extremely important component for the successful implementation of the Eco-development programme. This will highlight the strengths and weakness of the system and suggest midterm corrective measures.

The following records have to be maintained for monitoring and evaluation.

- 1) Resolution of formation of FPC/EDCs
- 2) Minutes of meetings in FPC/EDCs
- 3) Village register
- 4) Bimonthly account of FPC/EDCs with Assets /Activity Register
- 5) Annual audit register
- 6) Monitoring and evaluation remarks

In addition to the self review of FPC/EDCs the functioning of village Eco-development will be reviewed by the TR management (Chief Wildlife Warden, Field Director and Dy. Field Director), the funding agency and an independent agency selected by them. Tiger Reserve management will carry out suitable monitoring and evaluation from time to time.

Indicators of Success:-

The following indicators are identified for monitoring the success of the scheme-

- 1) Better natural regeneration in areas identified to be protected through EDC/FPCs.
- 2) Reduction in no. of illicit felling, fuel wood collection and illegal N.W.E.P. collection and poaching cases

- 3) Reduction in no. of fire incidences in the specified area of villages
- 4) Reduction in grazing incidences in the assigned PA areas
- 5) Better peoples participation in forest protection and better dialogue with PA staff
- 6) Improvement of the economic condition of the village people
- 7) Adoption of alternatives (alternative of fuel wood as well as alternate employment) and change in resource use pattern
- 8) Increase in literacy and health care
- 9) Reduction in incidence of crop depredation by wild animals
- 10) No. of offence cases detected through the help of committee members

Means of Verification:-

The following means of verification is proposed:-

- 1) Sample survey of PA and the villages at an interval of 6 months with the involvement of EDC/FPCs, NGO and PA staff
- 2) Interview with the villagers and field staff at a suitable interval
- 3) Study of village register and forest records
- 4) Offence register in Range office

Other indicators, sampling tools, sampling intervals and assessment criteria for project activities relating to different P.A. values, disturbances, socio economies values etc. can be suitably chosen.

CHAPTER NINE

IMPLEMENTATION STRATEGY

9.1 State level Monitoring Committee

“State Level Steering Committee” for the Biosphere Reserves of Assam shall be constituted with the following members:

1. Chief Secretary	: Chairman.
2. Commissioner & Secretary, Forest Department	: Member.
3. Principal Chief Conservator of Forest	: Member.
4. Representative of Ministry of Environment & Forests, Government of India	: Member.
5. Representative of Z.S.I. (Zoological Survey of India)	: Member.
6. Representative of B.S.I. (Botanical Survey of India)	: Member.
7. Commissioner, Upper Assam Division, Jorhat	: Member.
8. Commissioner, Lower Assam Division, Guwahati	: Member.
9. Deputy Commissioner, Tinsukia	: Member.
10. Deputy Commissioner, Dibrugarh	: Member.
11. Deputy Commissioner, Barpeta	: Member.
12. Deputy Commissioner, Bongaigaon	: Member.
13. Director, Panchayat & Rural Development, Assam	: Member.
14. Chief Conservator of Forests (Wildlife)	: Member Secretary.

The following will be permanent special invitee:-

1. Field Director, Manas Tiger Project, Barpeta Road.
2. Divisional Forest Officer (Wildlife), Tinsukia.

In addition, officials from Department & Works P.H.E., P.W.D., etc. may also be invited as necessary.

The committee will advise on policy and programme formulation for Biosphere Reserve Programme in the State.

- Advise on policy/programs for the Biosphere Reserves.
- Lay down guidelines for the preparation of the Management Action Plan for the Biosphere Reserve.
- Approve the Management Action Plans.
- Oversee the implementation of the Management Action Plan including monitoring and evaluation.

- Suggest priority areas for management and Scientific Research evaluation of Research proposals for funding, monitoring of the progress of Scientific Research and integration of Scientific findings with the management activities.
- Develop criteria for selecting new sites for Biosphere Reserves.
- Approve and recommend the Govt. of India proposals for setting up of new Biosphere Reserves.
- Carry out any other function/activity which may be necessary from time to time under the Biosphere Reserves proposal.

The Committee should sit at least once a year.

9.2 Tiger Conservation Foundation and District Level Coordination Committee

9.2.1 Tiger Conservation Foundation

The Wild Life (Protection) Amendment Act, 2006 (Section 38X provides for establishment of a Tiger Conservation Foundation in each tiger reserve, to facilitate and support management, apart from taking initiatives for involving people in conservation. The Foundation is a new institutional framework which can complement the tiger reserve management and liaison with various eco-development committees and their confederations apart from production sectors in the landscape. The Foundation should be registered under the relevant rules of the State as a Trust, and as prescribed in the guidelines, will have a State Level Governing Body, apart from a field level executive committee under the Chairmanship of the Field Director with representatives of the eco-development committees as nominated by the Governing Body. The Foundation would act as a “non profit center” and as a “development agency” by increasing local participation. It can secure the tiger reserve from financial constraints by providing funding support through various sources: recycling of gate receipts, service charges, donations and the like. The Foundation, may undertake various activities related to mainstreaming of conservation: eco-development, staff welfare, visitor regulation, field research, facilitating eco-development committees for market access, conducting capacity building programs, ecotourism and Joint Forest Management.

9.2.2 District level Coordination Committee

This shall comprise of:-

(i) District Collector -	<i>Chairman</i>
(ii) CEO -	<i>Member</i>
(iii) Representative officials from: - PWD, Social Welfare, Tribal Department, Health Department, Agriculture Department, Education Department, Power and Irrigation Departments	<i>Members</i>
(iv) Representatives of various - Government/ private production sectors	<i>Members</i>

(v) Field or Deputy Director of the -
Tiger Reserve

Member Secretary

9.3 Formation of Eco-development Committees (EDCs), Confederation of EDCs and Other Supporting Institutions like Self Help Groups (SHGs) and Nature Clubs

9.3.1 EDCs , Forest protection Committees (FPCs) and Self Help Groups (SHGs)

At the level of people's participation there exists either a Forest Protection Committee (FPC) or an Eco-Development Committee (EDC), each carrying out participatory management in a village (sometimes in two or three) either directly or indirectly through SHGs. Several conservation programmes are managed by FPCs/EDCs or SHGs induced by such committees. The executive body of both FPCs and EDCs is constituted by members elected for four years by general members in an annual general meeting. In the co-management model, both FPCs and EDCs are entrusted with carrying out the government's conservation programme. In some minor cases they can change the Forest Department's conservation plan, subject to government approval. However, one village cannot have both an EDC and an FPC. EDCs for MTR were created from a State Government order (3841-For/FR/6/11M-7/95) in June 1996 (Annexure-11).

There is a government order (vide resolution no. 5062-For/D/IS-16/88) dated 27th July, 1990), dealing with meeting protocol for forest protection committees which is as follows:

- The Forest Protection Committee shall hold a general body meeting once every year where activities of the Committee as well as details of distribution of usufructary benefits are to be discussed, besides electing representatives of the beneficiaries to the Executive Committee.
- The forest Protection Committee shall maintain a minute's book where in proceedings of the meetings of the Executive Committee held from time to time as well as the proceedings of the Annual General Meeting of the Forest Protection Committee will be recorded under the signature of the President of the Committee and such minutes duly attested shall be sent to the concerned Range Officer for record.

The SHGs are groups that come together under the Central government's self-employment generation programme, which encourage the development of micro-entrepreneurship among low-income groups.

9.3.2 How to set up a village level committee/group

The entire village shall be gathered for an initial planning meeting. The purpose of this meeting shall be to decide in general terms what a village level committee is about and what will be its function and purpose.

1. Define the purpose for which the village committee's is being set up.

This concern might be forest conservation and livelihoods security, mental illness, loss, disability, addiction, family issue, or other life experience that one shares with others. (Examples include AIDS, depression, unemployment, autism, gambling, adoption and breast feeding.)

2. Decide the structure of the committee.

At the beginning, at least one member of each HH shall be included as a member. From among these 8-10 core committee members will be selected by the group. 50% of member shall be women on this core committee. Few members like VCDC, JFM committee person shall be invited to also join the core committee.

3. Establish the group's initial focus.

Consider focusing on only one or two activities at first. Here are some suggestions to choose from:

✓	Share the feelings and experiences.
✓	Exchange information and resources.
✓	Discuss new ways to solve old problems.
✓	Find ways to reduce stress and anxiety.
✓	Allow your group to develop slowly.

4. Rules and regulations of the committee

1. Schedule of meetings: Once a month
2. Quorum: all major decisions with the entire committee members and not just core committee
3. All meetings minutes to be kept. At least 2/3rds of the core and general committee members to be present in the meetings.
4. Membership fee to be taken per HH.
5. Accounts to be maintained by core committee and shared with the entire committee quarterly.

5. Pick a name. As per purpose or area of interest.

6. Define relationship with outsiders/professionals.

Members of a local level committee are often told that they cannot run their group without a professional "expert". The real experts are the people who have the problem. They become more powerful and healthy by learning how to help each other as well as themselves. Do some trainings and capacity building of group members.

7. *Prepare a list of possible activities.*

Activities may include reviewing village roads, sanitation, visit to nearby NGOS, a field trip to Market etc.

8. *Think "Mutual-Help" from the Start.*

Every new member will be given the opportunity to contribute to the group and feel appreciated from the beginning. Pick a location where people will feel comfortable in sharing feelings and experiences. Some groups meet in village ground, schools, gram sabha bhavan. Other groups rotate their meetings in members' homes. When selecting a meeting place, look for the following:

- Central locations those are easy to find.
- Long-term availability.
- Access for people with disabilities.
- Access to public transportation.

Some problems may include:

- Monopolizers who talk forever. Set up guidelines for discussions. Some groups sit in a circle, allowing each member in turn to talk or pass. A specific time limit can also help. Also ensure the chair or leader of the group gives everyone his or her own turn.
- Not enough active listening. People respond positively when others genuinely listen to and care about what they say. Consider having "active listening" training sessions to help members improve their verbal and nonverbal communication skills.
- Too much negativity. Refocus the group from negative to positive. Give members a task, such as listing common and unusual ways of solving shared problems.
- Leader burn-out. Encourage shared leadership.

Re-evaluate periodically. Be sure that the programs, meeting place, time and frequency continue to match the needs of group members.

9. Registration:

- ❖ Committee to register themselves as a society /trust/cooperative as appropriate looking at its functioning and state legal structure.
- ❖ Legal opinion from a competent lawyer to be obtained to decide on appropriate legal structure for registration

9.3.3 Steps to set up and run a village community fund

The village committee after its registration will open a bank account.

- All members will pay a token amount of registration fee to the committee.
- This money to be deposited in the bank account.

- This fund to be entirely financed by community contributions equivalent to 10% of the cost of project interventions on livelihood support activities.
- Contributions in kind from the very poor households to be monetized and taken as their equivalent contribution.
- Level of these contributions to be reviewed after one year of implementation.
- The VCF to be further augmented through a range of landscape specific diversified menu of options:
 - interest received on loan extended to SHGs,
 - penalties charged by committee,
 - interest amount on bank deposits and the money made available to the local institution by sectoral line agencies in return for services rendered.
 - Payment for services to FD For example where fire or anti-poaching protection is done in a participatory manner with the forest department from interior patrol camps by VFC/ EDC members, 5% of wages could go the VCF.
- The VCF generated as above to be used to leverage more money especially from from PRIs/ DRDAs and used for development of community assets as well as for livelihood support activities. Such leveraging of funds through CONVERGENCE will be useful in enhancement of VCF and will be in conformity with the landscape approach.
- Of the total funds generated under the VFC with the local level institutions, (authorized for project implementation by Gram Sabha) 50% to be extended as loans for micro financing and remaining 50% to be for investment for community purpose.
- VCF to leverage funds from schemes like NREGA and take up community development and conservation work

9.4 Livelihood Support Initiatives through Village Micro Plans

9.4.1 Phases in micro-planning:-

The entire village level planning exercise can be divided into three phases:

Phase I Pre-Planning:

This is basically an environment-building phase both at the level of the community as well as that of the implementing agency. It is also likely that during this phase when a number of questions and doubts that the community has about the project will be raised and will need to be addressed by the Local level CBO or NBO (can be called Gram Mitra). Hence communicating about the project becomes an important function in the pre-planning phase of the micro planning exercise.

Step1: Environment Building-Establishing contact with the community:
 Communicating about the project: At the outset it is necessary to make unequivocal, reliable information available to all stakeholders, particularly local communities at the village level. The project design provides for communications expertise within the PFU, which needs to be optimally used to thoroughly inform the community about the precise provisions of the

project. The high profile nature of such projects and the lag time between project preparation and implementation are conditions that often provide opportunity for rumors and incomplete information to proliferate within the project area.

The micro planning process to be preceded (and accompanied) by a clear and sharp communication strategy that dispels myths and makes authentic information available to the primary stakeholders.

- Identify key people in the village including potential leaders as change agents.
- Collect baseline information (on Natural and Human resource base, livelihoods practiced, biodiversity dependencies, services, markets etc) using a few PRA tools like transect walk, timeline, and discussions with some key informants, group meetings etc.
- Collect of secondary information from the Block office and from official data sources like the census, district statistical handbook
- Look at existing micro-plans (if any) to identify the activities and areas they address. In case there are any sectoral micro-plans that have convergence with BCRLIP objectives, it should be taken note of and cross linkages established with such plan.

The planning and implementing team to interact with some key functionaries of relevant line departments like forest, agriculture, panchayat and rural development, animal husbandry, WCD, health, education etc to get an idea of their ongoing programmes and interventions as well as to inform them about BCRLIP and bring in a larger ownership of such agencies.

Step 2: Including the excluded: This is an all-important step and requires making a special effort to include the dalits, women, landless, disabled, tribals, people below the poverty line and the minorities. If required, holding separate meetings with these groups to explain the process of micro planning and the importance of their participation in this process.

Step 3: Consultation and Orientation Meeting: The objective of this meeting is to arrive at a common understanding on micro planning with a focus on conservation and livelihoods. The participants in this meeting will be representatives from all sections of the village community, local level government functionaries from the relevant line departments and elected representatives of VCDC/PRIs (Panchayati Raj Institutions)

Several such meetings to be conducted in each landscape in accordance with the units of intervention that have been identified for each landscape (such as clusters and so on). These will cover the following:

What is Biodiversity and why ecosystem conservation is critical?

How such conservation is beneficial for securing the productivity of farms and livestock besides affording other bio-resource needs and allied livelihoods?

How does the project define livelihoods?

How different livelihood choices affect biodiversity?

How to reach a balance between addressing the issue of poverty and conservation?

What is Micro planning?

Understanding the tools of Micro planning

How to develop a micro-plan

Finalizing a team to develop the micro-plan. This will involve building a role for the Gram Sabha and short-listing of potential team members from within the community.

Finalizing the timeline for the process

Phase II Planning

Step 4 Identifying problems and solutions: Each landscape will have its specific set of problems related to conservation. This step will involve the use of various tools like problem tree analysis, discussions, analysing timelines (if already developed under step 1)- all this with the objective of developing a deeper understanding of the various problems, the associated issues and challenges and then arriving at possible ways to tackle the same. At the end of this step the team would have clarity on the root cause of a problem, the impact it is having and what are the possible ways of mitigating the same. Typically in the landscapes that form a part of the BCRLIP, the likely problems can be:

- Related to management of resources:
- Unsustainable harvesting of NTFP
- Crop raiding by wild animals leading to human wild life conflict
- Grazing pressure or lack of adequate grazing land.
- Related to livelihood options:
- Lack of adequate employment opportunities
- High dependence on wage labour
- Head-loading
- Poor agricultural productivity
- Problem of water for protective irrigation and in some cases for drinking

Related to access to services: A word of caution may be added here - it may appear that the problems are politically neutral. We would like to emphasize that there is no such thing as political neutrality especially when we are talking of Natural resource management. The access and control regimes have political basis as well as political ramifications. The team has to incorporate this understanding both at the time of problem identification as well as at the time of arriving at solutions. Tools like social mapping, relationship matrix, stakeholder analysis, resource mapping, service mapping etc may be used to develop a clear understanding of the situation on the ground.

Step 5 Developing a village level micro-plan: With the understanding arrived at in step 4 the base for preparing a village level Micro-plan is ready.

Once the village micro plan is ready, a Gram Sabha would have to be conducted in order to;

- ❖ Revisit the solutions of identified problems
- ❖ Prioritise the solutions: since resources will be limited the GS will have to prioritise the solutions using an acceptable criterion. This criterion can be working first with the households that have unsustainable dependence on natural resources of the area.
- ❖ Identify solution and strategies: On the basis of the PRA baseline data, the problems prioritised, the solutions and strategies will have to be listed
- ❖ Identification of resource base: the various sources of financial and human resources required to implement the plan will have to be listed against the resources available. The different ways to mobilise additional resources using the convergence route will also have to be debated and worked out.

Step 6: Getting the Gram Sabha to ratify the Micro-plan: The final village level micro-plan to be presented in the gram sabha for ratification. The VCC to also look at the advantage of holding a separate gram sabha of women to elicit their inputs before taking the plan to the full gram sabha for ratification.

Phase III Post planning implementation and Review

Step 7: How to implement the village level Micro-plan

- ❖ Fixing responsibilities
- ❖ Owning responsibilities
- ❖ Setting systems for flow of funds
- ❖ Setting systems for flow of Information and monitoring and Evaluation
- ❖ Fixing responsibilities for technical and handholding support

Step 8: Review and monitoring: The agency anchoring the process at the village level will have to set a time frame for periodic meetings with the Gram sabha. In these meetings:

- The goal and objective of the micro-plan will be revisited
- The people present will run through the micro plan to see what took place as planned and what evolved during the implementation cycle
- Review what needs to be done less/more/ differently

The anchoring agency publicly acknowledges the contributions of the community and others. The agency also uses the media to publicize good practices

9.4.2 Planning and implementing any livelihood interventions

A: Factors which influence livelihood choices

INTERNAL

- People, whose livelihoods are to be promoted: These aspects are to be studied:--
 1. What is the livelihood pattern of the people,
 2. Existing mix of activities in which different members of a household are engaged in,
 3. Seasonal cycle of activities in a year
 4. HH capacity
 - ❖ Household number of people
 - ❖ Cultural and social conditions
 - ❖ Skill sets and knowledge of the people
 - ❖ Shortfalls in a household's income and buffers from which these are met.
 - ❖ Opportunities accessible to them as well as barriers posed by the social and cultural conditions.
 - ❖ Finance, including credit available through out the year, to make investments as well as to even out cash-flows at different seasons
 5. HH Preference
- Organization/Agency/Authority which is going to promote/ support livelihoods. Assess the following to choose/select the organization and also judge its capabilities:-
 1. Purpose of the agency
 2. Organization's core competency
 3. Legality of the organization
 4. Source and duration of capital
 5. Duration of engagement in the field
 6. Strategies for withdrawal/exit strategies

EXTERNAL

- Factor Conditions
- Demand Conditions
- Industry Conditions
- Institutional Condition.

Factor conditions:

Natural resources

Land : terrain, quantum, quality, distribution and uses
 Water : annual rainfall, groundwater levels, sources of irrigation
 Humidity
 Forests : quantum, tree species and usage
 Livestock
 Mineral wealth
 Energy sources
Are there any environmental threats to these natural resources?

B. Physical resources

Irrigation infrastructure: Tanks, Canals, Borewells
 Shandies, *Haats*, Market yards
 Warehouses
 Electricity
 Roads, Railway lines
 Transport facilities
 Post Office, Banks
 Health facilities

C. Human resources

Population
 No. of households and family size
 No. of earning members per family
 Labor availability and skill levels – manual, craft, service and knowledge base
 Entrepreneurial ability of various communities in the population
 Education profile of population
 Health profile of population
 Gender division of all the above

D. Social resources

Relationships of trust and reciprocity within and between communities
 Gender relations
 Caste relations
 Agrarian relationships

E. Financial resources

Available sources of credit – formal and informal
 Interest rates and collateral requirements on different credit sources
 Credit requirements of different income/occupational groups of people
 Savings mechanisms
 Other financial services

For a factor condition to actually enable livelihood opportunities, it must have the 4-A's:

- **Asset:** The asset, physical or otherwise must exist.
- **Awareness:** People must be aware that such an asset exists.
- **Ability:** People must have the ability to use that asset.
- **Access:** People must have access to the asset.

Unless these are also present with the resources, they are not useful for any livelihood intervention effort.

Demand conditions: Whatever be the chosen livelihood activity, there is some output of goods / services. These goods / services are bought by some people that constitute the demand for them.

It is very important to carry out a survey to assess the market and demand of any intervention: who is demanding them? Is it local, what has been the status past few years increasing, decreasing or stagnant?

Industry conditions: The third element of this external context is the nature and status of the industry, of which, the livelihoods activity is a part. Here we use the word 'industry' in a broader sense, to include all economic activities. For example, production of paddy is a part of cereal food industry.

Thus, it is important to assess what is the status of the industry, in which we are going to promote livelihoods. Is it growing and vibrant? Is it stagnant and dying? Are there other related and supporting industries that extend services? These related and support industries often play a critical role in the chosen livelihood activity. Their presence or absence creates conditions for making one livelihood intervention more effective than the other.

Institutional conditions: Local institutions, state policies, tax laws, local norms and social arrangements all influence the choice and functioning of livelihood activities. These together define the Institutional Condition of the livelihood choice.

B: Steps for analyzing and designing any livelihood intervention's:

- **Objective of the intervention** state the objectives clearly. This gives the whole purpose of any intervention: some of these could be:
 - Enhancing income
 - Creating assets or wealth
 - Increasing food and livelihood security
 - Reducing pressures on forests
 - Reducing variances in income
 - Reducing rural to urban migration
 - Establishing linkages with government schemes

- **Nature of the intervention**

- **The sector in which we intervene:** Do we want to improve on an existing livelihood activity or promote a new one?

- **The point of intervention:**

Which part of the value-addition chain will we focus on? Will we provide one missing input, such as technology development or credit, integrate the delivery of inputs, or intervene at multiple points providing several services?

- **The instrument of intervention:** What is the tool of intervention? Do we want to train the people to make the necessary changes?

Do we want to change some policy to bring about changes that help people?

Phases in a Livelihood Intervention:

- *The pilot phase:* when we are still testing out a new idea to see if it works on a small scale.
- *The development phase:* the pilot phase has proved successful and we are now developing a model, with the expectation of scaling it up or replicating it.
- *The scaling up or replication phase:* we now have a model, which works and we go to scale by expanding or replicating the business.

(i) Design of the livelihood activity. Should incorporate the following

- HH level or Village level or federation
- Ownership??
- Management
- Size/scale
- Benefit sharing
- Trade offs
- Institutional mechanisms
- Funding : Grant or loan

C: Steps to plan a livelihood intervention

The basic steps to be carried out for any livelihood intervention are:

Stage I: Observing and Understanding the Local Economy

Step 1: Getting to Know the People: Understanding their diversified livelihood portfolio

Step 2: Assessing Factor Conditions

Step 3: Understanding Local Demand Condition:

- Identify enterprises existing in the area...

- Mapping all the products and services that go out and come in

Stage II: Selecting Livelihood Activities Suitable for the Poor in the Area

Step 1: Triangulation: Putting the information on people, the factor and demand conditions together

Step 2: Understanding the Demand Condition of the short-listed activities better

Stage III: Deciding on intervention

Step 1: Exercise for feasibility assessment, market studies, cost benefit analysis and development of business plan to be carried out.

Step 2: Overlaying Organizational Competence

The Sustainable Livelihood Framework also helps us look at some of these factor conditions.

Information Sources for data collection

Sl. No.	Particulars	Information Needed	Sources
1	District Background	• Location • Rainfall • Climate	• District Economic Census: District Statistical Office/ Planning Office in some districts • District Potential Link Plan (published by NABARD for every district) • District Credit Plan (published by the lead bank of every district)
2	Population	• Rural - male, female • Urban - male, female • Computed Annualised Growth Rate - Rural, Urban	• District Census Data: District Statistical Office/Planning Office in some districts
3	Literacy Rate	• Rural - male, female • Urban - male, female • Computed Annualised Growth Rate - Rural, Urban	• District Census Data: District Statistical Office/Planning Office in some districts

Sl. No.	Particulars	Information Needed	Sources
4	Workers Participation Rate	- Rural - male, female - Urban - male female - Computed Annualised Growth Rate - Rural, Urban - Workers Classification as per NIC	District Census Data: District Statistical Office/Planning Office in some districts
5	Land	- Land Use Classification - Cultivable Land Classification: small, marginal, medium, etc. both acre-wise and landholding-wise	Seasonal Crop Report: ICAR
6	Agriculture	- Cultivable Lands: Net, Gross and trend - Reasons, for changes, if any	Seasonal Crop Report
	(Compare data with adjacent district or state averages)	- Major food crops: cultivable area, productivity and trends - Major Non-food crops: cultivable area, productivity and trends - Availability of Market Infrastructure - Constraints in agriculture production and marketing	- NABARD: District Potential Link Plan - LEAD Bank: Annual Credit Plan - APMAC - Discussion with Stakeholders
7	Water	- Irrigated Land: Net, Gross, trend - Sources of Irrigating Water	Seasonal Crop Report

Sl. No.	Particulars	Information Needed	Sources
8	Animal Husbandry	- Major animals reared: Population, products production - Infrastructure for value addition and marketing trends - Marketing Trends and Constraints	- Census of Animal Husbandry - NABARD: District Potential Credit Link Plan - Discussion with Stakeholders
9	Forestry	- Coverage, type and trend - Forest Produce - kinds and in Rs and trends - Participation of JFM - Scope for income generation	- Seasonal Crop Report - NABARD: District Potential Link Plan - Directorate of Economics and Statistics - Discussion with Stakeholders
10	Mining and Quarrying	- Major elements mined/quarried - Production - kinds and in Rs - Employment opportunities: Scope	- Directorate of Economic and Statistics - Discussion with Stakeholders
11	Manufacturing	- Units as per NIC 2 digit classification, - Persons employed - Employment opportunities: Scope	- DIC - Discussion with Stakeholders
12	Services	- Identify potential activities by assessing current employment, - employment absorption capacity by calculating Computed Annualised Growth Rate, etc	Random survey in at least five market areas

Sl. No.	Particulars	Information Needed	Sources
13	Financial Services	- Scheduled commercial Banks: Loan outstanding sector-wise: accounts and amounts - Portfolio Analysis	- NABARD: District Potential Credit Link Plan - Lead Bank: Annual Report; RBI: Banking Statistics - Discussion with LEAD Bank
14	Government Schemes	Performance status: Various development schemes	Discussion with DRDA, Govt. departments

9.5 Integration of Rural Development Programmes-

Eco-development/Rural development programs can be made more effective by integrating it with other departments of the district and interested NGOs.

Following deptts. Should be involved for development of forest and fringe villages:-

(1) Agriculture deptt.	(2) Animal husbandary/A.R.D.D
(3) Irrigation deptt.	(4) Rural development deptt.
(5) Education deptt.	(6) Health deptt.
(7) Tribal welfare deptt.	(8) Public Health Engineering
(9) Horticulture deptt.	(10) Fishery deptt.
(11) Sericulture deptt.	(12) Electricity Board
(13) Cottage Industry deptt.	(14) Cultural affairs deptt.
(15) Tourism deptt.	(16) Relief deptt.
(17) Public Works deptt.	(18) Non-Conventional energy deptt.
(19) I.C.D.S.	(20) F.P.A.I.

NGOs should also be involved in village eco-developmental activities and awareness activities. The different Govt. schemes, specially for BPL families like National Rural Employment Guarantee Scheme (NREGS), Indira Awas Yojna etc. may be utilized.

9.6 Monitoring and Evaluation

Monitoring and evaluation is an extremely important component for the successful implementation of the Eco-development programme. This will highlight the strengths and weakness of the system and suggest midterm corrective measures.

The following records have to be maintained for monitoring and evaluation.

- 1) Resolution of formation of FPC/EDCs
- 2) Minutes of meetings in FPC/EDCs
- 3) Village register

- 4) Bimonthly account of FPC/EDCs with Assets /Activity Register.
- 5) Annual audit register
- 6) Monitoring and evaluation remarks.

In addition to the self review of FPC/EDCs the functioning of village Eco-development will be reviewed by the TR management (Chief Wildlife Warden, Field Director and Dy. Field Directors), the funding agency and an independent agency selected by them. Tiger Reserve management will carry out suitable monitoring and evaluation from time to time.

Indicators of Success:-

The following indicators are identified for monitoring the success of the scheme --

- 1) Better natural regeneration in areas identified to be protected through EDC/FPCs.
- 2) Reduction in no. of illicit felling, fuel wood collection and illegal N.W.E.P. collection and poaching cases.
- 3) Reduction in no. of fire incidences in the specified area of villages.
- 4) Reduction in grazing incidences in the assigned PA areas.
- 5) Better peoples participation in forest protection and better dialogue with PA staff.
- 6) Improvement of the economic condition of the village people.
- 7) Adoption of alternatives (alternative of fuel wood as well as alternate employment) and change in resource use pattern.
- 8) Increase in literacy and health care.
- 9) Reduction in incidence of crop depredation by wild animals.
- 10) No. of offence cases detected through the help of committee members.

Means of Verification :-

The following means of verification is proposed:-

- 1) Sample survey of PA and the villages at an interval of 6 months with the involvement of EDC/FPCs, NGO and PA staff.
- 2) Interview with the villagers and field staff at a suitable interval.
- 3) Study of village register and forest records.
- 4) Offence register in Range office.

Other indicators, sampling tools, sampling intervals and assessment criteria for project activities relating to different P.A. values, disturbances, socio economies values etc. can be suitably chosen.

9.7. Formation of Manas Forest Development Agency:- Manas Forest Development was registered under the societies Registration Act on 28.05.2015 (Fig 9.1). In the initial stages it has been decided to take up rapport building and microplanning in 64 fringe villages of the Manas National Park. It is pertinent to point out that, JFMCs under Territorial FDA s are already being operationalised in the buffer areas. The main purpose of Manas FDA would be to foster eco-development activities. As per guidelines of the Manas Tiger Conservation Fund, thirty percent of the Foundation funds are earmarked for EDC activities in the fringe areas.

Table 9.1: Eco-development villages under Manas FDA (First Phase)-

Panbari Range (District Chirang)	Bansbari and Kahitema Range (District Baksa)	Bhuyapara Range (District Baksa)
1. Lakhijhora No. 1. 2. Dailong No. 1. 3. Barpathar No. 1. 4. Saurang No. 1 5. Saurang No. 2. 6. Saurang No. 4. 7. Kachubeel No. 1. 8. Kachubeel No. 2 9. Thaisobari No. 1. 10. Thaisobari No. 2. 11. Burisuta No. 1. 12. Garabdara No. 1. 13. GarabdaraNo. 2. 14. Bogidora. 15. Bhatarmari.	1. Kahitama N.C. 2. Kahitama. 3. Kahitama Pathar. 4. Chamthaibari. 5. Oxyguri. 6. Labdanguri. 7. Labdanguri Pathar. 8. Bhalaguri Pathar. 9. Bhalaguri. 10. Bispani. 11. Elengamari. 12. Kuthrijhar. 13. Khagrabari N.C. 14. Narayanguri. 15. Giati Gaon. 16. Raghabeel. 17. Barengabari. 18. Mayangpara. 19. Madrijhora. 20. Kahibari. 21. Palsiguri. 22. Kamalabari. 23. Gohair Bhitha. 24. Rajabeel. 25. Katajhar.	1. Bamunkhal (Kumguri). 2. Bhuyanpara. 3. Koroibari. 4. Khusratari (Dongpar). 5. Borgaon. 6. Kalibari.N.C. 7. Sale Gaon. 8. Sarukhagra N.C. 9. Kurobaha N.C. 10. Kali Gaon N.C. 11. Borghagra. 12. Karankata N.C 13. Karankata. 14. Naba Dihira. 15. Bar Gaon N.C. 16. Bar Gaon. 17. Garumara. 18. Kamardaisa. 19. Kokilabari.N.C. 20. Kokilabari No. 5. 21. Daodhara.

Fig 9.1 : Copy of Registration certificate of Manas Forest Development Agency-

Memo No. RFS/129/2009/1743 Dated Guwahati the 29/8/2009.

0290

This Registration however does not make the Registrar liable for any default/liability on loan from Banks Private Societies, Govt. and Semi Govt. Sources of payment of I. T. and Sales Taxes, as the case may be created by the society.

Financial Institutions, Govt. and Semi Govt. Depts. extending financial Grants-in aids etc. to the Society shall sent copies of such sanctions of the Registrar for his record.


सत्यमेव जयते



CERTIFICATE OF REGISTRATION OF SOCIETIES

ACT XXI OF 1860

No. Rs. BAR/ 237/ L/ 66 of 2009.

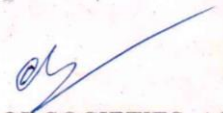
I hereby Certify that "MANAS TIGER CONSERVATION FOUNDATION"
Office of the Field Director, Manas Tiger
Reserve, Barpeta Road, Dist-Barpeta, Assam, Pin-781315.

has this day, been registered under the Societies Registration Act. XXI of 1860.

Given under my hand at Guwahati
 this Twenty Seventh day of August
Two thousand Nine,

VALID-UP TO 26/08/2012.

VALIDITY EXTENDED UP-TO


 REGISTRAR OF SOCIETIES, ASSAM.
 GUWAHATI.

N. B. - Registered number of Societies should not be stated as Government registered. It is registered under S. R. *** Act. XXI of 1860.

Please read carefully the rules written overleaf.

9.8. Memorandum of Association and guidelines under Manas FDA

MEMORANDUM OF ASSOCIATION

FEES Rs. 50.00

(Registration Under Societies Registration Act XXI of 1860)

1. The name of the Society :- Forest Development Agency Society,
Manas Tiger Project, Barpeta Road, Assam.
2. The Office of the Society is
Situating in the provinces/State :- Office of the Field Director, Manas Tiger Project
Barpeta Road, Assam.
3. The objects for which the society is established are :-
(The objects must be scientific, Charitable, literary etc.)

The Manas Forest Development Agency Society shall function as an autonomous body for implementation of specialized schemes like national Afforestation Project (N.A.P) or any other scheme of Centrally Sponsored/Central Sector or State Govt. or any agencies as per terms and conditions laid down by the Govt. of Assam.

Primarily, the F.D.A Society will focus on carrying out activities under the project 'N.A.P' presently as per the guidelines issued vide National Afforestation and Eco-development Board through respective JFMCs/EDCs.

Short term objectives:-

- Stakeholdership and pride in conserving and protecting the wild flora and fauna.
- Regeneration and Eco-development of degraded forest and adjoining areas on a watershed basis by developing modern nursery and plantation techniques.
- To promote and regulate eco-tourism activities in and around the Protected Area.
- Augmentation of availability of fuel wood, fodder and grasses from the regenerated areas.
- Securing people's participation in planning and regeneration efforts to ensure sustainability and equitable distribution of forest products from the regenerated lands, and to promote the partnership concept in the management and administration of forest and common property resources.
- Promote Agro-forestry and development of Common Property Resources.
- Promotion of fuel saving devices to encourage efficient use of fuel wood and to reduce the drudgery of rural women involved in collection of wood, as also to improve the environment.
- Conservation and improvement of non-timber forest produce such as bamboo, cane and medicinal plants.
- Encourage production of non-timber products such as wax, honey, fruits and nuts from the re-generated areas.

- Taking up soil conservation measures especially in the downstream catchment areas of rivers emanating from the Protected Area.
- Develop water resources through plantation and water harvesting programme.
- To minimize the extent of livestock grazing and promote high yielding varieties and alternate livelihood support through piggy and fisheries.
- To create awareness and extend environment education and participation in the children and youth of fringe villagers.

Long term objectives:-

- Overall protection and conservation of the Protected Area Landscape along with its wild flora and fauna.
 - Protection, conservation of natural resources through active involvement of the people including ecotourism in and around the Protected Area landscape.
 - Checking and degradation, deforestation and loss of Bio-diversity.
 - Ecological restoration and environmental conservation in conformity with Eco-sensitive zonation and landuse planning.
 - Evolving village level people's organizations which can manage the natural resources in an around villages in a sustainable manner.
 - Fulfillment of the broader objectives of productivity, equity and sustainability for the general good of the people.
 - Improve quality of life and self-sustenance aspect of people living in an around forest areas.
 - Capability endowment and skill enhancement for improving employability of the rural people.
4. The name, address and designation of the present members of the Executive Committee (or Governing Body) are :-

Sl. No.	Name if Full	Address, Occupation and Designation
1		Field Director, Manas Tiger Project
2		Deputy Director, Manas Tiger Project
3	Ex-officio members	Deputy Commissioner, Buxa
4		Deputy Commissioner, Chirang
5		Project Director, DRDA Buxa
6		Project Director, Chirang
7		District Agricultural Officer, Buxa
8		District Agricultural Officer, Chirang
9		District Animal Husbandry and Veterinary Officer, Buxa
10		Executive Engineer, P.H.E.Division, Buxa
11		District Elementary Education Officer, Buxa
12		District Elementary Education Officer, Chirang
13		Programme Manager, Aaranyak
14		Manas Ever Welfare Society

15		President Manas Maozegendri ecotourism Society
16		President Kahitema Ever Welfare Society
	15 Nominees from the EDCs	

RULES AND REGULATIONS:-

- 1. The name of the Society** :- Forest Development Agency Society,
Manas Tiger Project,
Barpeta Road, Assam.
- 2. Address of the main office of this Society** :- Office of the Field Director,
Manas Tiger Project,
Barpeta Road, Assam.
- 3. Area of operation :-**
(Area of operation and the area of Activity)

Throughout the Forest areas and EDC areas of Manas Tiger Project, Barpeta Road.

4. Objects:-

The forest Development Agency Society shall function as an autonomous body for implementation of specialized schemes like National Afforestation Project (N.A.P) or any other scheme of Centrally Sponsored/Central Sector or State Govt. or any agencies as per terms and conditions laid down by the Govt. of Assam.

Primarily, the F.D.A Society will focus on carrying out activities under the project 'N.A.P' presently as per the guidelines issued vide National Afforestation and Eco-Development Board through respective JFMCs/EDCs.

Short term objectives:-

- Stakeholdership and pride in conserving and protecting the wild flora and fauna.
- Regeneration and Eco-development of degraded forest and adjoining areas on a watershed basis by developing modern nursery and plantation techniques.
- To promote and regulate eco-tourism activities in and around the Protected Area.
- Augmentation of availability of fuel wood, fodder and grasses from the regenerated areas.
- Securing people's participation in planning and regeneration efforts to ensure sustainability and equitable distribution of forest products from the regenerated lands, and to promote the partnership concept in the management and administration of forest and common property resources.
- Promote Agro-forestry and development of Common Property Resources.
- Promotion of fuel saving devices to encourage efficient use of fuel wood and to reduce the drudgery of rural women involved in collection of wood, as also to improve the environment.

- Conservation and improvement of non-timber forest produce such as bamboo, cane and medicinal plants.
- Encourage production of non-timber products such as wax, honey, fruits and nuts from the re-generated areas.
- Taking up soil conservation measures especially in the downstream catchment areas of rivers emanating from the Protected Area.
- Develop water resources through plantation and water harvesting programme.
- To minimize the extent of livestock grazing and promote high yielding varieties and alternate livelihood support through piggy and fisheries.
- To create awareness and extend environment education and participation in the children and youth of fringe villagers.

Long term objectives:-

- Overall protection and conservation of the Protected Area Landscape along with its wild flora and fauna.
- Protection, conservation of natural resources through active involvement of the people including ecotourism in and around the Protected Area landscape.
- Checking and degradation, deforestation and loss of Bio-diversity.
- Ecological restoration and environmental conservation in conformity with Eco-sensitive zonation and landuse planning.
- Evolving village level people's organizations which can manage the natural resources in an around villages in a sustainable manner.
- Fulfillment of the broader objectives of productivity, equity and sustainability for the general good of the people.
- Improve quality of life and self-sustenance aspect of people living in an around forest areas.
- Capability endowment and skill enhancement for improving employability of the rural people.

Short term objectives:-

- Regeneration and Eco-development of degraded forest and adjoining areas on a watershed basis.
- Augmentation of availability of fuel wood, fodder and grasses from the regenerated areas.
- Security people's participation in planning and regeneration efforts to ensure sustainability and equitable distribution of forest products from the regenerated lands, and to promote the partnership concept in the management and administration of forest and common property resources.
- Promote Agro-forestry and development Common Property Resources.
- Promotion of fuel saving devices to encourage efficient use of fuel wood and to reduce the drudgery of rural women involved in collection of wood, as also to improve the environment.

- Conservation and improvement of non-timber forest produce such as bamboo, cane and medicinal plants.
- Encourage production of non-timber products such as wax, honey, fruits and nuts from the re-generated areas.
- Raising coastal shelter belts to mitigate the adverse impacts of cyclonic winds.
- Develop water resources through plantation and water harvesting programme.
- Development and extension of improved technologies such as clonal propagation and use of root trainers for raising seedlings mycorrhizal inoculations etc.
- Employment generation for the dis-advantaged sections of society particularly women, Schedule Caste/Schedule Tribes and land less rural labourers inhabiting the forest and adjoining areas.

Long term objectives:-

- Protection, conservation of natural resources through active involvement of the people.
- Checking and degradation, deforestation and loss of Bio-diversity.
- Ecological restoration and environmental conservation and Eco-development.
- Evolving village level people's organizations which can manages the natural resources in an around villages in a sustainable manner.
- Fulfillment of the broader objectives of productivity, equity and sustainability for the general good of the people.
- Improve quality of life and self-sustenance aspect of people living in an around forest areas.
- Capability endowment and skill enhancement for improving employability of the rural people.

Membership:-

- (a) Qualification to become members:- as per stipulation in the guideline as per Annexure- 'A'.
- (b) Subscription, Donation etc:- Nil.
- (c) Collection of fund:- fund will be made available by the Government of India under Central Sector Schemes such as 'National Afforestation Project (NAP), Project Tiger and the Manas Tiger Conservation Foundation.
- (d) Control of fund:- Control of the fund will be done by Forest Development Agency Society by ensuring stipulated flow of fund to Joint Forestry Management Committee (JFMC)/ Eco-development Committee (EDC) signature at FDA level as per Guideline and the same will be audited from time to time.

Detailed Mechanism on flow of fund is provided with the Memorandum of Association & Rules of business of FDA Society appended herewith.

5. Procedure of the General meeting:- (how many times in a year the General meeting will be held)

The Executive body or the Governing body will meet at least once in three months and the General Body will meet at least once in a year.

6. Quorum of the General meeting:- (How many of the total members of the General body are required to be present to form quorum of the General Body meeting)

One half of the members will form the quorum. However quorum in the adjourned meetings will not be required.

7. Election procedure of the Executive Committee/Governing body/Managing Committee: - Chairperson & Member Secretary of the Executive Committee is fixed by department and so are the ex-officio members (without voting rights). However out of the nominees from the JFMC/EDC, a member will be selected either by considers or by electing by respective JFMCs/EDCs.

A person who has served on the General Body would be eligible for re-nomination of the 2 years of the expiry of this previous term.

In case the forest division falls in more than one district, representation of all concerned is trust will be nominated to function on the Executive Body.

A member who does not allowed 3 consecutive meeting of the Executive Body should be disqualified from the Executive Body.

8. Short Description of the Executive body:- (this description must tally with the list given in the item 4 of the memorandum copy).

The Chairman of the Executive Body will be the Conservator of Forests and the Chief Executive Officer cum Member Secretary will be the Divisional Forest Officer having jurisdiction over the Forest Development Agency. Other member details are furnished in item 4 of the Memorandum of understanding.

9. The term of the Executive body:- Executive Body is affixed body of Chairman & Members by designation, however if a member does not attend three consecutive meeting of the Executive Body, the member will be disqualified from the Executive Body.
10. Produce of Re-election of the members of the Executive Body:- A per who has served on the General Body would be eligible for re-nomination after two(2) years, which is the re-election period.
11. Produce of the meeting of the Executive Body:- (how many time in a year or month the meeting of the Executive body will be held). Executive body will meet at once in three months.
12. Quorum of the meeting of the Executive Body:- (How many of the total members of the Executive Body are required to be present to form quorum of the meeting of the Executive Body):-

One half of member will form the quorum. However quorum in the adjourned meeting will not be required.

13. Explosion of undesirable member:- Any member who goes against the Rules and Regulation of the organization may be expelled from the organization may be expelled from the Organisation.

14. Auditor:- A qualified auditor will be appointed by the Executive body who shall audit the accounts of the Society at least once in a year and annual audit report will be submitted to the Register of Societies regularly.
15. Legal Procedure:- According to the provision laid down in the Section 6 of the Societies Registration Act XXI of 1860 the Society may sue or may be sued in the name of the President or Secretary of the Society.
16. Dissolution:- If necessary the Society may be dissolved and the properties remained after desolution may be handed over according to the provision laid down in the Section 13 and 14 of the Societies Registration Act. XXI of 1860.

Certified to be true copy of the Rules & Regulation of Forest Development Agency Society, Manas Tiger Project, Barpeta Road, Assam.

Signature of the three executive members

Counter Sign
(Field Director/Deputy Director, Manas Tiger Project)
Barpeta Road, Assam.

9.9. Microplanning guidelines and the road map ahead under Manas FDA:-

Since it is a newly registered FDA, the microplanning is still in its infancy stages and it is expected to speed up in the coming years. The generic guidelines being followed for microplanning have been described in the following pages.

Formation of Eco-Development Committees among the forest fringe villagers of Manas Tiger Reserve-

1. List out the villages within a radius of 3 kms.
2. Group the villages into some clusters based on their geographical locations, access to infrastructure, road, natural resources.
3. Collect primary data on population, literacy, landholding pattern, livestock population, livelihood and access to government schemes and services.
4. Identification of facilitators, youth, community leaders and provide them the basic orientation to assist in the entire process like primary data collection, situation analysis & in micro planning.
5. Situation analysis through PRA/PLA.
6. SWOT analysis.
7. Understand the social systems, customs, traditions, cultural & religious belief, social institutions, women groups, youth group, SHGs, CBOs, PRIs, VCDC etc.
8. Focus on motivation, involvement of local community in decision making and planning process.
9. Capacity building, skill development and participatory monitoring are key in entire process.

CHAPTER TEN

MAINSTREAMING STRATEGY WITH VARIOUS PRODUCTION SECTORS

Mainstreaming

Mainstreaming of wildlife concerns should be understood as a process to integrate wildlife conservation in various production sectors of the buffer zone where the primary emphasis is not conservation. This would safeguard wildlife interests by ensuring habitat supplements in outer areas beyond the core for tiger spatial land tenure dynamics. Further, it would also strengthen conservation by reducing the possible interface conflicts between various production sectors and conservation, which otherwise leads to wild animals earning a 'pest value' and eventually getting eliminated from the area. Thus, mainstreaming of wildlife concerns in the outer buffer landscape is essential to prevent such area from turning into '*ecological sinks*'.

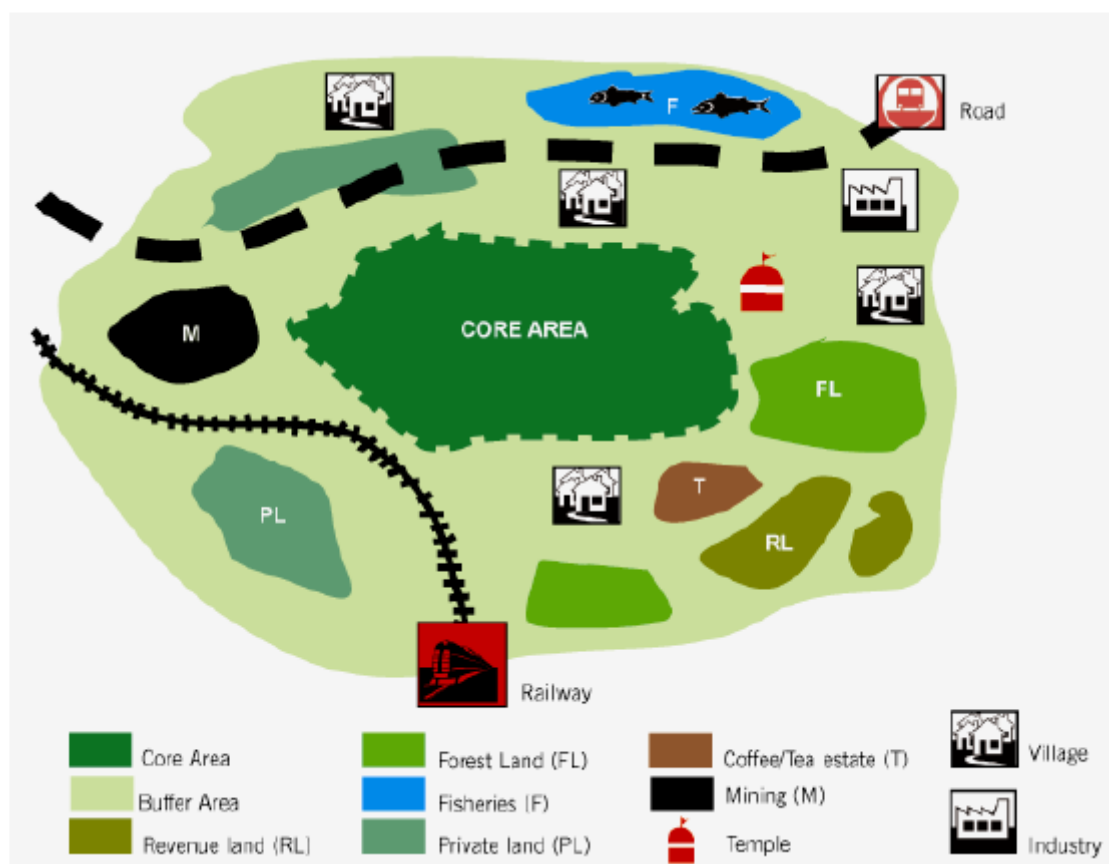
Process of mainstreaming

Mainstreaming tiger (wildlife) conservation concerns in various production sectors is imperative for the buffer zone to be viable and fulfill its objectives. This would involve modification of developmental activities /practices in the key production sectors to make them more 'conservation friendly'.

The process is sector as well as landscape specific. However, some generic suggestions based on guidelines issued by the Ministry of Environment and Forests for developmental projects in different sectors are given below.

A number of production sectors operate in the buffer area of a tiger reserve, which directly (D) or incidentally (I) affect tiger conservation (**Plate 1**). Therefore, the basic managerial strategy for the buffer area should focus on mainstreaming wildlife concerns amongst such sectors. Some of the common production sectors in the buffer areas are:

- a) Forestry (D)
- b) Agriculture (D)
- c) Integrated Development (eco-development, development through District Administration) (D)
- d) Tourism (D)
- e) Fisheries (D)
- f) Tea/Coffee Estates (I)
- g) Road / Rail transport (D)
- h) Industry (D)
- i) Mining (I)
- j) Thermal power plants (I)
- k) Irrigation projects (D)
- l) Temple tourism (I)
- m) Communication projects (D)

Plate 1: Production Sectors in a Tiger Landscape

Of the aforementioned production sector, following sectors would be relevant for buffer areas of Manas Tiger Reserve. The basic managerial strategy for the buffer area shall focus on mainstreaming wildlife concerns amongst such sectors:

- a) Forestry (D)
- b) Agriculture (D)
- c) Integrated Development (eco-development, development through District Administration) (D)
- d) Tourism (D)
- e) Fisheries (D)
- f) Tea Estates (I)

Main strategies for the different Production Sectors in the buffer areas are as follows:-

10.1 Forestry

- monitoring wildlife/tiger presence in standardized formats on a daily basis in all the buffer divisions
- foot patrolling by staff to ensure protection within the buffer ranges
- exchange of tiger/wildlife presence data with Royal Manas National Park, Bhutan

- monitoring of carnivore kills in the fringe villages
- monitoring of water points within buffer areas of MTR
- timely payment of compensation for livestock depredation by wild carnivores
- payment of compensation for crop damage by wild animals
- review of wildlife status in the meetings of Forest Development Agency
- regulating collection of Non Timber Forest Produce
- monitoring village cattle for disease
- maintenance of village level wildlife crime dossier
- retention of old/dead trees

10.2 Agriculture

- adoption of ‘eco-agriculture’ as a land use to produce food as well as to conserve wildlife
- discouraging sudden change in cropping patterns (viz lure crops) to avoid accentuating man-wild animal conflicts in buffer areas.
- maintaining a habitat mosaic
- promoting soil conservation
- providing economic incentives for safeguarding wildlife concerns
- providing incentive for carbon, water and other environmental services to local communities
- compensating losses due to wildlife
- fostering use of green manure and discourage use of chemical manures and pesticides
- facilitating marketing of local products through the Tiger Conservation Foundation
- fostering eco tourism

10.3 Integrated Development

10.3.1 Eco-development

- participatory village level planning and preparation of village level micro plans for eco-development
- providing inputs for resource substitution, income generation, community welfare, ecotourism for reducing the resource dependency of local people on surrounding forests
- ensuring reciprocal commitments with the local people through respective eco-development committees, forming part of a MoU in the micro plan for safeguarding wildlife interests

10.3.2 Development through District Administration

This involves a multiplicity of sectors operating in the MTR landscape, where wildlife concerns have to be integrated through formal contracts/ agreements between the Tiger Conservation Foundation, district authorities and eco-development committees. The

responsibilities of various parties shall be spelt out in the contract/agreements for safeguarding wildlife concerns along with reciprocal commitments. Normally, such contracts/agreements shall discourage any detrimental practice and assign responsibility to the community for carrying out some interventions. All EDCs and JFMCs functioning at MTR shall be involved in the process.

10.4 Tourism

- facilitating wildlife ecotourism involving local host communities
- obtaining contributions from private commercial tour operators and lodge owners for local community development
- obtaining contributions from tour operators for maintaining tourist facilities, staff welfare
- recycling of tourist gate receipts for community welfare through the Tiger Conservation Foundation

10.5 Fisheries

- regulation through the Tiger Conservation Foundation
- MoU with EDCs for safeguarding nesting sites, breeding areas
- reciprocal commitments for patrolling, fire protection etc
- facilitating marketing through the Tiger Conservation Foundation

10.6 Tea plantations

- facilitating marketing through Tiger Conservation Foundation
- providing livelihood options, relief to displaced workers through EDCs
- fostering ecotourism through the Tiger Conservation Foundation in the impounded area
- assisting the management in patrolling the water body

CHAPTER ELEVEN

RESEARCH, MONITORING, TRAINING AND WILDLIFE HEALTH

11.1 Research Priorities, Main projects and Implementation:-

Several records pertaining to the region existed, especially for the Indian Manas TR as this was an important region for establishing colonial forestry (that dates back to 1875). Ripu-Chirang Reserved Forests (RF) were once the largest RF in Asia and the forests had been silviculturally manipulated to obtain high quality timber from Sal (*Shorea robusta*) that grew profusely in the region. Similarly, Manas National Park was known to harbor the country's highest number of protected endangered and endemic species (22 of India's Schedule I mammals and at least 33 animals listed as threatened occur) at the time of its inscription as a World Heritage Site in 1985. Royal Manas has also been the favored hunting ground for the royalty in Bhutan, and anecdotes and records of rare animals hunted are likely to be available. The authenticity of these past records however needs to be reestablished, as the biodiversity and habitat has significantly changed following the decade-long turbulent political period in the 1990s (Mazumdar, 2005).

For contiguity purposes, this plan takes the cut-off date of 2005 and discusses the status of research that has been undertaken in the region since the formation of BTAD (an autonomous tribal council government popularly known as the Bodoland Territorial Council or BTC) in Assam, India.

Several projects of varying duration have been undertaken for Manas National Park in recent years, including a study on the population and distribution status of Elephants (Lahkar *et.al.*, 2007 & 2009), Bengal florican (Brahma 2009), swamp deer (Das *et.al.*, 2009), and golden langurs (Ghosh, 2009). Rhino reintroduction (Barman *et.al.*, 2009), grassland and fire mapping (Sarma *et.al.*, 2008; Tahakata *et.al.*, 2009). Camera-trapping and sign-based studies for tigers and their prey (Goswami and Ganesh, 2008; Sinha, 2009) has significantly increased the baseline information available for the Park. For example it is now known that the Elephant population and Golden langur population in MTR is 1443 and 5141 respectively. There are currently 5 rhinos relocated to Manas, and at least 13 nesting pairs of Bengal florican that visit the eastern part of the Park. Besides these, rapid assessment of biodiversity and surveys have also been undertaken by reputed agencies (FSI, 2006; Mathur *et.al.*, 2007; UNESCO, 2008). Spatial analysis of tiger habitat and its suitability using remote sensing and GIS tools is currently being investigated under a doctoral study (Ghosh, 2013).

In the buffer region, very few comprehensive studies have been undertaken. Only recently, the rapid survey report for prioritizing biodiversity areas (Menon *et.al.*, 2008), a Golden langur and elephant population census (Ghosh, 2008; 2009), a checklist for birds (Nath *et.al.*, 2008) and butterfly status (Choudhury, 2010) have been compiled. Administrative boundary delineation and spatial mapping of select megafauna has also been achieved to some extent (Lahkar *et.al.*, 2010). All this, along with community conservation works (Horwich *et.al.*, 2010), have provided a strong base to carry forward the case for scientific management of the MTR for positive effect.

11.1.1 Objectives:

Strategies:

- a) Infrastructure Development: Establishment of Field Research Station

- b) Posting of a Research advisor with office and financial support.
- c) Co-ordination of Research activities.
- d) Funding of research activities.
- e) Establishment of Computerized data storage and retrieval system:
- f) Enriching MTR library through purchasing some relevant Journals and Books.

11.1.2 Proposed projects for departmental/collaborative Research:-

- Occupancy surveys and population assessment for tigers and their prey for the entire MTR.
- Study on Impact of Cattle grazing in Sanctuary and National Park and mitigation measures.
- Population-Habitat viability analysis of Tiger and their Prey.
- Study to identify actual tiger niche, their distribution, seasonal variability, food habit and population dynamics.
- Study on enumeration of wild animal, their distribution pattern, seasonal movement and habitat use behavior, etc.
- Study on institution development, participation and empowerment of social organizations and financial sustainability of village institutions.
- Study on river systems in MTR and Environmental Impact Assessment (EIA) of boulder extraction from river beds.
- Identification of fragile ecosystem and habitats or niches and means for their conservation.
- Study on Inventory, Status and distribution of lesser cats in MTR:
- Poaching and illegal wildlife trade-Problems and mitigation measures:
- Inventory, Status and distribution of arboreal mammals other than lesser cats :
- Study on prospects and strategy for Eco-tourism
- Population dynamics and feeding behavior of ungulates
- Documentation of flora of MTR
- Impact of habitat changes on population of wildlife
- Study on wildlife health and diseases:
- Population status and habitat suitability of endangered mammalian species such as Golden Langur, Pygmy hog, Hispid Hare, Crab-eating mongoose, Hog badger, gaur, wild buffalo, Swamp deer, Chinese pangolin etc.
- Current distribution status of herpetofauna.
- Current status of invertebrates and fishes.
- Impact assessment of dependency of local people on MTR

- Study on effect of fire incidences on flora and fauna of MTR and mitigation measures.
- Use of RS/GIS technology for habitat assessment and monitoring.
- Trans-boundary movement of wild animals into Bhutan and identification of large mammal corridors.

11.2 Monitoring framework:-

Eco-systems are dynamic. Monitoring of impacts of management interventions is necessary. It enables the management to analyze and evaluate the effect of changes. Continuous monitoring and recording of data are proposed to be done through an elaborate, systematic and management-oriented monitoring mechanism.

The Park Management shall continue to ensure that the monitoring of biological resources form a basic routine activity in protected area management, and it is the principal way in which the management can identify trends or changes, and so gauge the effectiveness of its managerial inputs. Though it may sound an unplanned and subjective procedure, it is easy to collect useful biological information in a simple, systematic and scientific manner. The management shall strive to include a number of useful monitoring activities in the routine duties of the staff, as well as regular annual estimation of wildlife, counts and other activities. All such data shall be incorporated in the MIS in a routine manner.

11.2.1 Monitoring physical changes:-

Monitoring of physical changes, mainly air and water qualities, is essential. Monitoring the water quality of streams and rivers passing through the Tiger Reserve particularly with reference to pesticides is very important as some water sources passes through tea gardens which use pesticide heavily.

11.2.2 Monitoring changes in vegetation-

Vegetation changes will be monitored in different vegetation types, both natural and man-made. Information shall be collected every year for changes in pattern of succession, species composition, effect of grazing and fire on vegetation, etc. It shall be recorded systematically and analysed through computer. Some permanent vegetation plot (50 m X 40 m) shall be laid out for this purpose.

Some plots shall be laid out in riparian area. Similarly some plots shall be laid in fringe area. Study of density and frequency of species shall be done by Point centred Quarter (PCQ) method and ground cover by Area Sampling or point sampling method.

11.2.3 Monitoring Changes in wildlife population:

This can be done,

- (a) By regular recording of animal sighting in different compotts. When staff go for patrolling:

A register will be maintained in each Beat and weekly data will be sent to Range Office in a following prescribed proforma and from there data will be sent to Division office for consolidation and analysis to get information about seasonal movement, habitat utilization, etc. Tiger monitoring shall be done by regular tracing of pugmarks to know the population dynamics, movement pattern, and identification of individual and sex ratio, etc.

- (b) by conducting periodical census operation:

Herbivore census by King's method and Tiger/ Leopard Census by pugmark method shall be conducted every two year's interval. For conducting census the entire area of Tiger Reserve shall be converted into a no. of smaller blocks called census unit. The existing census units shall be followed for conducting census operation.

11.2.4 Monitoring wildlife health and diseases:

It shall be done regularly as there is danger of spread of epidemic through domestic cattle grazing in the Reserve. Water Samples shall be regularly checked by field research Laboratories. Survey of adjacent fringed villages shall be done to know about the spread of any epidemic. Vaccination of fringe cattle against F.M.D., Anthrax, H.S.B.Q, etc. shall be done at suitable intervals by veterinary unit.

Wildlife Health interventions in Manas Tiger Reserves has been conducted through

- Prophylactic vaccinations of domestic livestock against viral disease outbreaks like FMD and bacterial diseases like HS-BQ, Anthrax in collaboration with Animal Husbandry and Veterinary Department and supported by various other Govt and Non-Governmental agencies
- Post mortem disease investigation procedures with laboratory confirmatory diagnosis in appropriate cases as a routine measure.
- Opportunistic sampling of sick and rescued wildlife and health management of captive Asian elephants.

The risk of emerging and re-emerging diseases in wildlife during the past decade or so has been a matter of serious concern for the management of wildlife population (*Kock et al* 2019). The plan propose to take up “wildlife health surveillance” as a tool for understanding the dynamics of host pathogen relation in the landscape as a holistic approach to the subject rather than a piecemeal approach. The emergence of Elephant Endothelial Herpes Virus (EEHV) in Asian Elephants and canine distemper (CD) in large carnivores has been the biggest concern for the region as the disease has been detected in captive and wild populations in the State and the country. The park authority has been collaborating with College of Veterinary Science and other Non-Governmental Organizations on screening of all captive elephants and diagnostics of suspected cases in the wild on the emerging problem of EEHV in Asian Elephants. Canine Distemper is a highly contagious viral disease of canids, felids and viverids and also newer families of wildlife are being reported to be infected. For surveillance of wildlife disease, especially for populations of critically endangered and endangered species in the landscape, a collaborative approach with the research institutes and agencies with capacity and manpower would be sought to address the issue. The current strength of the wildlife health unit consist of a Veterinary Officer and one assistant is grossly inadequate to even conduct the day to day health care needs of captive wildlife and veterinary emergencies in the Tiger Reserve. The plan proposes to strengthen the existing veterinary unit with hiring additional manpower and infrastructure with adequate logistical support, hiring of trained wildlife health experts and establishing a working laboratory in the field itself to process the basic screening. The Tiger reserve will notify a “Wildlife Health Advisory Committee” to oversee and advise on this emerging threat to the management to take up appropriate measures in a time bound manner to face the challenge in today's changing landscape.

11.2.5 Monitoring the Impact of management practices initiated in and around MTR:

Management interventions impact human population in and around MTR Monitoring of such impacts is necessary. Its socio-economic impact is especially important. Cultural

impacts can also be not neglected. Management intervention only with congenial impacts is sustainable over a long period of time.

11.2.6 Monitoring the impact of Tourism:

Tourism impacts P.A. and people. It impacts them socio-economically. It also impacts them culturally. Tourism has both positive and negative impacts on PA and people. Monitoring of impacts of tourism is necessary to know sustainability of tourism in MTR.

11.3 Training needs assessment:

Training forms an important area for all levels in the administration which results in generation of better and innovative ideas leading to enhanced conservation and managerial measures. There is a lack of intensive training in almost all the strata which will address important practical and day-to-day issues facing the frontline men in particular.

Training is essential to increase the managerial capability and technical skill of the staff. Present days PA planning and management is a highly technical science bringing together the theory of several diverse disciplines, i.e., ecology, forestry, geography, wildlife

Training shall be carried out in an organised and structured manner in order to achieve optimum result. It shall be organised for the different levels of staff. It shall address the specific needs, duties and responsibilities carried out by the staff.

In order to increase the managerial capability of MTR staff and managers following training are important.

11.3.1 On the job training:

This informal training shall be organised at the proposed Nature Interpretation cum training centre at Bansbari for Conservation volunteers, DR/ Forests, Forest Guards, Mahuts and Grass cutters during the close period of the park (June – September). Experienced A.C.F., D.C.F., C.F., experts of other organised Institutes and NGO, legal experts/ public prosecutors, Police personnel, Research Officer, Veterinary Surgeon, Ecologist and Sociologists etc. will be resource person.

Training subjects shall be as follows:-

- (1) Protection duties including identification of vulnerable areas, anti-poaching measures, use of firearms, and target practice of firearms, conducting raids, wireless set operation.
- (2) Survey and demarcation
- (3) Fire fighting
- (4) Tourism management, interpretation and conservation awareness among people, extension and motivation methodology
- (5) JFM and interaction with fringe people, Microplanning and PRA.
- (6) Wildlife biology, ecology, habitat management including census of wild animals, grass lands ecology and management, monitoring of animal signs and evidences, (including scats and kills), monitoring of animal diseases, movement pattern and habitat utilization, identification of diseased animal and monitoring of treated animals.

- (7) Tranquilization including use of tranquilizing gun, doses of drugs, treatment of animal; Rescue of straying wild animals, veterinary care of rescued and captive elephants and their management and other wildlife health care.
- (8) Cattle improvement works like A. I., castration and immunisation.
- (9) Training on Nursery and plantation techniques.
- (10) Erection and maintenance of energised fencing.
- (11) Application of laws and regulations including knowledge about different Act, provisions and implementation of Act, booking of offenders, proper documentation of P.O.R., building up intelligence networks and dealing with informers.
- (12) Training to some staff to combat Malaria, Diarrhoea, etc. in MTR.
- (13) Training on river rafting to some staff.

It is to be noted that all the training shall be field oriented. All the staff need not be trained at a time. It must be done in rotation. Training shall be arranged in each year to ensure that staff is trained in all required subjects.

11.3.2 Formal Training Courses:

Formal training is generally conducted by recognised Institutes on national, International level. Wildlife Institute of India (W.I.I.) Dehradun organises a large no. of training courses under Govt. of India assistance or with the collaboration of International organizations.

11.3.3 Establishing PA as a learning Centre (Extension and Education Programme):

Any training activity is not an end in itself. Besides its specific inputs, the role of training is to launch support and maintain the process of learning with objectivity, ultimately leading to the enhancement of management capability.

People residing in and around MTR are only little aware about nature conservation and wildlife protection. A massive extension and education programme has to be taken up to make the people conscious about nature conservation. Following strategy is suggested.

(1) Nature and environmental education programme for local people:

Such education programme is aimed at enlisting support of local people mainly forest villagers, fringe villagers and Tea garden labourers. To focus on the issues that are crucial with local people who live in and around MTR, the nature and environmental education plan is to be based on the biological importance of the area. The following programs shall be organized in the area –

- (v) Nature and Wildlife education camps are to be organized for villagers. A few camps would be organized every year for the people living in and around MTR. The value of MTR eco-system, its special features and the negative impact of its misuse by local people and other groups shall be highlighted.
- (vi) PRA training including training on rural resource development would be imparted as per prescription and requirement of the eco-development project. Staff and NGO would be involved to conduct PRA exercise in the villages.

- (vii) The process of extension work in MTR may involve holding slide and film show in villages, holding discussion with the villagers to resolve conflicts, encouraging discussion among villagers on critical issues related to management, establishing demonstration model for village eco-development.

(2) Study Tours:

Field study tours for local people, and Staffs have been prescribed in the eco-development project. Such tours would be organised within the State/ in other State as per requirement of target group.

(3) Training to Tourist Guides:

Tourist guides are to be trained so that they can develop skills to impart adequate information to tourists. It has been observed that local youth working as nature guides at the various eco-tourism centres do not yet fully developed skills to communicate with visitors. These shortcomings are to be removed by selecting proper persons and imparting them suitable training at the Nature Interpretation Centre at Bansbari. There is a need to involve appropriate institutes or tourism experts to conduct such training programme.

(4) Workshop/ Seminar:

A seminar is a good tool to obtain broad agreement with local people, other stakeholder groups, administrators, scientists and nature lovers on the issues related to management of MTR and implementation of the eco-development plan. Frequent meeting with the FPC/EDC is needed occasional meeting (at least one meeting in each Gram panchayat/year) shall be conducted involving panchayats and NGOs to make them aware about this project and for reminding them their duties and responsibilities in respect of MTR's natural resource management.

Every year workshop and field study shall be organized at MTR level to share the experience gain during the field works and disseminate the new knowledge and practices being used in other PAs. Some of the topic for workshop and field study may be -

1. Wildlife and its habitat monitoring and understanding the objective of data collection during regular patrolling.
2. Wildlife census and field techniques
3. Anti poaching, Legal proceeding and forensics
4. Micro planning for eco-development in surrounding villages
5. Fire protection training
6. EDC Account keeping
7. Environmental Education and Awareness
8. PA planning workshop
9. Regional planning workshop
10. PA management plan finalization workshop

During these types of workshop and field training regular interactions/ discussions between officers and field staff would also add to the understanding of new perspectives relating to wildlife management.

11.4 HRD plan:-

Along with monitoring and need-based training, HR measures shall include more activities directed towards better management and also towards welfare of the staffs of buffer area. Welfare schemes like subsidized availability of ration, literacy drives for the children of staff, and formation of women self-help groups will be encouraged. More long term plans shall include encouragement of small scale cottage industries based on the traditional knowledge, proper marketing as well as setting up of sale and distribution centers.

Wildlife management is a specialized branch, which need special orientation, skill and knowledge. Training makes a technocrat and field staffs perfect in his/her profession. Exposure of good efforts done in the *Par excellence* site develops a feeling of motivation to achieve the goal to the same degree or sometimes higher also. Not only this, tremendous degree of confidence is also developed if the initiative done is appreciated by others. Hence it is nice to initiate effort to impart special training to all level of staff in various relevant fields.

11.5 Training programs These has been described in section 11.3 above. However, for staffs deployed in buffer areas shall benefit from following:

11.5.1 On the job training:

This informal training shall be organised for Conservation volunteers, DR/ Forests, Forest Guards, Mahuts and Grass cutters in division offices of buffer areas.

Training subjects shall be as follows:-

- (1) Protection duties including identification of vulnerable areas, anti-poaching measures, use of firearms, and target practice of firearms, conducting raids, wireless set operation.
- (2) Wildlife survey
- (3) Fire fighting
- (4) Wildlife biology, ecology, habitat management including census of wild animals, grass lands ecology and management, monitoring of animal signs and evidences, (including scats and kills), monitoring of animal diseases, movement pattern and habitat utilization, identification of diseased animal and monitoring of treated animals.
- (5) Application of laws and regulations including knowledge about different Act, provisions and implementation of Act, booking of offenders, proper documentation of P.O.R., building up intelligence networks and dealing with informers.
- (6) Training on river rafting to some staff.

It is to be noted that all the training shall be field oriented. All the staff need not be trained at a time. It must be done in rotation. Training shall be arranged in each year to ensure that staff is trained in all required subjects.

11.5.2 Study Tours: Field study tours for staffs have been prescribed in the eco-development project. Such tours shall be organised within the State/in other State as per requirement of target group.

11.5.3 Workshop/ Seminar: Every year workshop and field study shall be organized at MTR level to share the experience gain during the field works and disseminate the new knowledge and practices being used in other PAs. Some of the topic for workshop and field study may be -

1. Wildlife and its habitat monitoring and understanding the objective of data collection during regular patrolling.
2. Wildlife census and field techniques
3. Anti poaching, Legal proceeding and forensics
4. Fire protection training
5. Environmental Education and Awareness

During these types of workshop and field training regular interactions/ discussions between officers and field staff would also add to the understanding of new perspectives relating to wildlife management.

11.6 Staff Amenities:

The Staff amenities presently provided are far from satisfactory. A large number of the buffer field staff are living deep in the forests. They keep their family either in adjoining town or with their parents for educating their children. This is also done to get medical facilities for their family. Thus they maintain double establishment. This causes financial hardships. Following basic amenities to staff are proposed:-

11.6.1 Housing facility:

Because of lack of education and health facilities within the area, housing has to be seen from two different perspectives i.e. in situ housing at camp sites and housing for families at some stations where basic education and health facilities for kith and kin of staff are available. The buildings are to be maintained in such a way that they have toilets, non-leaking roofs, mosquito net protection, white washed etc so they are livable. Re-organization of a few divisions within Manas Tiger Reserve were done without developing the infrastructure. Even the past infrastructure was completely destroyed at several places during the insurgency period and this is taking a lot of time and money to be rebuild. Existing residential accommodations are inadequate. It is proposed that buildings will be modern Assam type and also multiple storey in some cases.

11.6.2 Field Equipments:-

Necessary camp and field equipments for the protection of staff shall be provided. The other necessary equipment helpful in carrying out field work e.g. water bottles, measuring tapes, compass, pedometers, field forms and diaries, small axe, fire arms, tiger tracers, plaster of Paris etc shall be provided as and when needed.

11.6.3 Uniforms and protective gears:-

Timely supply of good quality uniforms as per provisions shall be ensured every year along with other items such as caps, belts, boots, hunter shoes, winter wears, raincoats etc. Protective gears like wooden canes, helmets etc shall also be provided specially to the personnel deputed on Bordering areas.

11.6.4 Education facility to the Children of Staff:

Efforts will be made to tie-up with existing govt schools for ready admission and special concessions to children belonging to wildlife staff.

11.6.5 Provision for Difficult Area Allowance:

It is desirable to reward staff posted in interior localities adequately. Govt. may be requested to consider possibility of declaring certain places of posting as difficult areas. Process shall be initiated to provide difficult area allowance for staff posted in such locations.

11.6.6 Provision of drinking water facility in staff locations:

A large number of staff locations in MTR suffer from drinking water scarcity. Within the terai shallow tubewell with high yield is possible while in the bhabar area, deep bore well or tapping of surface water is the only answer. The facility shall be provided in a phased manner within the first half of the plan period.

11.6.7 Provision of Medical facility:

Manas Tiger Reserve is a malaria prone area. Health centers are far away from staff locations. Conveyance to reach them is not readily available. Preventive measures shall get priority. Free supply of malaria and other medicines shall be made. Forest villagers also suffer from malaria and gastrointestinal problems.

Regular health camps shall be organized for health checkups of staff. Some hospitals could be contracted for complete checkup and treatment of staff and their immediate family. This will ensure better health and will in turn result into better output from staff and will have great value. One mobile medical unit with medical officer for MTR staff and forest villagers is proposed. In severe cases Range vehicle shall be used to shift patients to nearby hospitals.

11.6.8 Insurance scheme for staff:-

Possibilities of Health insurance for staff and field assistants living in interior areas shall be explored with insurance company and take up the scheme.

11.6.9 Electrification of Staff Compound:

In large number of staff locations electric supply is not available. Electrification of staff locations shall be taken up on priority. The matter may be taken up with Zilla Parishad for assistance in their rural electrification scheme. Where electrification is not possible, solar lantern and solar street light shall be provided.

11.6.10 Rotational transfer from difficult area to better place:

Since some locations are difficult, all the staff shall be posted rotationally in interior and non-interior locations. In difficult areas staff will be compulsorily posted for two years then they shall be transferred to better place of posting.

11.6.11 Safety and improvement of Staff compound:

Staff locations shall be provided with basic facilities such as a hand pump, clean kitchen and toilet area.

11.6.12 Reward for good works and Punishment for bad works:

Staff shall be rewarded for performing good works by giving medal, certificate or some money with certificate to boost up their morale.

Following rewards shall be considered for introduction:-

- a) Best worker for Wildlife Protection.
- b) Best worker for raising plantation.
- c) Best worker for Eco-development programme implementation.

d) Best worker against Wildlife depredation.

On the other hand, staff may be penalized as per law for incompetence and non performance.

11.7 Wildlife Health Monitoring

Monitoring of wildlife health forms an important component of the managerial measures and can give vital and timely knowledge about possible outbreak of diseases, incidences of poaching, etc.

While the staff are told to keep a regular eye on any signs of abnormal health during their daily patrolling routines, some enhanced measures can be thought of regarding better monitoring:-

- Deployment of more than one trained veterinary surgeon and vet assistants for MTR.
- Design of simple pictorial information material aiding detection of diseased animals in the field
- Training and sharing of information regarding some common diseases of wild animals specially ungulates.
- Swift communication of information in case some abnormality is observed.
- Intensive following and monitoring of a diseased animal.

11.7.1 Disease surveillance and Prophylactic Immunization:

Protected areas are established with an aim to conserve components of biodiversity to maintain their status in the natural ecosystem to protect the species from premature extinction. Outbreak of fatal diseases among the population of wild animals has lost considerable wild fauna in the past. Large-scale mortality of Gaur in South India during (1968 and 1975) and Kaziranga National Park (1981) by Rinderpest and by Foot and Mouth Disease (FMD) in 1952 had been reported in the past. Dissemination of a number of diseases, like; Rinderpest, FMD, Anthrax, TB and Rabies are common in wild animals. In order to maintain the good health status of the wild animals, efforts for disease surveillance is extremely important in the Protected Areas.

There is a great competition of survival among wild ungulates and cattle for both forage and water. The domestic animals come in contact with wild animals, particularly ungulates at common grazing fields and at waterholes. Due to this, chances of the transmission of various fatal infectious diseases from livestock, to wild animals, namely Rinderpest (RP), Anthrax, Foot and Mouth Disease (FMD), Haemorrhagic Septicaemia (HS) etc., are extremely high. It is also known that there are few diseases which are communicable to carnivores from diseased ungulates; e.g. Rabies, Anthrax, Hydatidosis and Trypanosomiasis (Arora, 1994)

Free-ranging wild animals are as susceptible to diseases as any other living beings. Diseases have been a major cause of local extirpation of a number of wild animal species in India. With the increasing interaction between wild and domestic animals, the chances of disease transmission amongst them are high. Therefore, similar to the attempts made for recording the occurrence of disease outbreaks in wild animals of protected regions, efforts

shall also be made to know the occurrence of specific infectious and contagious diseases in domestic animals at the periphery of the protected wildlife areas. Until and unless different epizootiological cycles of various parasitic and infectious diseases are delineated, it will not be possible to plan out measures to eradicate these diseases from free ranging wild animals.

For maintenance of health of wild animals, it is essential to monitor and survey the parasitic and infectious diseases periodically so that necessary actions could be taken to prevent disease outbreaks and control large-scale mortality. Surveillance programs will be a major aid in the implementation of long-term health management plan on the appropriate measures to maintain healthy population of wild animals and guarding them against the risk of sudden and heavy mortality or morbidity in Protected Areas. This can be best achieved by preventing transmission of diseases between wild and domestic and in-between wild animals by manipulating the factors involved in the transmission. Establishing the database for forecasting the diseases by performing epizootiological studies in and around the Protected Areas round the year is of utmost importance and needs attention.

In free ranging Wild animals, only a fraction of mortalities due to diseases are visible at a time, except during epizootics, when the mortality exceeds the rate of predation and scavenging. Hence, the impact of diseases visible in these animals is far lesser than the actual scenario. Therefore it is essential to understand the magnitude of disease problem in free-ranging wild animals. More recent investigations by conservation agencies have shown that diseases and parasites are a decimating factor affecting population dynamics of wild animals.

It is of utmost importance to carry out epizootiological studies covering at least 3 complete years so as to generate information on prevalence of infectious and parasitic diseases and various climatic factors influencing the rate of infection. This will help in proper mapping and developing a forecasting system on various infections among native wild animals. This contribution will be a major aid in the implementation of long-term health management plan and guarding the wild animals from the risk of sudden and heavy mortality or morbidity. To achieve the above objective need of establishing a well-equipped field veterinary laboratory is of utmost importance along with the trained staff.

(A) Prophylactic Immunization:

Some diseases which are common to this area and are epidemic in nature and spread by both wild and domestic animals, preventive treatment against these diseases by the means of prophylactic immunization to the domestic animals be given. Domestic cattle, which may transmit the disease among wild fauna, can be vaccinated to prevent the occurrence of FMD, Rinderpest, BQ and HS. Prophylactic immunization to cover FMD, BQ and HS are regularly carried out with the help of Veterinary Department every year, to reduce the chances of spread of disease from cattle to the wildlife.

(B) Disease Surveillance:

A quick disease reporting detection treatment system only can achieve proper disease surveillance. In the case of wild animals, detection of disease is only based on observation on animal behaviour and their day to day activities. Concept of landscape epidemiology that associates the occurrence of a certain disease with the existing landscape may also be kept in the mind. The knowledge of animal species typical to the given area and particular disease maintained and spread by them may be extremely useful in disease detection and treatment. If

such a disease is detected, its prophylactic treatment by immunization, water hole treatment or aerosol immunization can be done. To protect and maintain wildlife in PA with good health, it is necessary to achieve disease surveillance of –

- (i) Native wild population
- (ii) Domestic cattle of adjoining villages

Parameters for the monitoring of wild animals health –

1. General examination
 - i. Physical examination
 - ii. Clinical observation
2. Laboratory investigations
 - i. Fecal examination
 - ii. Hematological examination
 - iii. Serological examination
3. Study of kill/Mortality
4. Detailed post-mortem examination
5. Collection of material for laboratory examination

The detail about the general examination, Laboratory investigation, study of kill/mortality, Post mortem examination and collection of material of laboratory examination is given in **Annexure No.-**

11.7.2 Care of rescued animals

Strategies: -

- Establish a wild animal rescue 24 hrs hotline (a dedicated mobile number accessible by the general public for passing information regarding any wild animal that needs to be rescued)
- Constitution of wildlife rescue team of 10-15 of trained forest personnel and 4-5 veterinary doctors in every division of MTR to handle emergency rescue operations.
- Provisioning of an all terrain vehicle for the rescue operation.
- Provisioning of rescue equipment such as cages, nets, ropes and tranquilizing equipment with the wildlife divisions.
- Provisioning of wireless equipment, night vision cameras, first aid kit etc with the wildlife rescue team.
- Construction of an emergency rescue and relief centre with basic facilities of housing and treatment.
- Only the doctor shall prescribe the diet of each animal in the rescue centre and also enforce quality control.
- Health record of each captive animal shall be maintained.

- Deer and other herbivores shall not be kept in captivity for long – but shall be released in the sanctuary as soon as they are fit to fend for themselves.
- Leopard and other carnivores shall not be kept in captivity for long. All trapped adult carnivores may be released in suitable habitat as per the IUCN rescue and release protocol.

11.7.3 Rescue Centre

There is a rescue centre cum transit facility in Kokrajhar that was established in 2009. Main objective to develop rescue centre is:-

- i) To rescue and take care of captured wild animals from the sanctuary or outside the sanctuary.
- ii) Treatment of small herbivores, etc and then release in the wild.

Similar rescue centers/transit facilities can be developed in every Division of MTR region after following stringent guidelines of Central Zoo Authority.

11.8 Mortality survey:-

This shall be continued every six months. The camp staff shall be suitably instructed to collect all mandibles/ skulls from the habitat for an assessment of species specific/ age – specific mortality. Death of every endangered animal and carnivores must be immediately recorded and reported to higher authorities for onward necessary action.

CHAPTER TWELVE

TIGER POPULATION AND HABITAT ASSESSMENT

Tiger is a territorial animal, which advertises its presence in an area and maintains a territory. It is a well known fact that partial overlaps of resident male territories in an area do occur. However, the degree of overlap increases lethal internecine combats. Several female territories do occur in an overlapping manner within the territory of a male tiger. The tiger land tenure dynamics ensures presence of prime adults in a habitat which act as source populations, periodically replacing old males by young adults from nearby forest areas.

The ongoing studies and analysis of available research data on tiger ecology indicate, that the minimum population of tigresses in breeding age, which are needed to maintain a viable population of 80-100 tigers (in and around core areas) require an inviolate space of 800 -1000 sq km. Tiger being an “umbrella species”, this will also ensure viable populations of other wild animals (co-predators, prey) and forest, thereby ensuring the ecological viability of the entire area / habitat. Therefore, buffer areas with forest connectivity are imperative for tiger dynamics, since such areas foster sub adults, young adults, transients and old members of the population. The young adults periodically replace the resident ageing males and females from the source population area.

The buffer area absorbs the “shock” of poaching pressure on populations of tiger and other wild animals. In case of severe habitat depletion in buffer areas, the source population would get targeted and eventually decimate.

12.1 Patrolling Strategy including Joint Patrolling:-

Each Tiger Reserve must have one or more Special Strike Forces deployed in the field. The deployment should be at locations where the strike force should be able to reach a given area within a reasonable amount of time to take charge of any crisis. In most situations, a Strike Force is best deployed along the periphery in the Code Red Zone. This will be in response to a threat perception.

The Special Tiger Protection Force should be preferably used as a Strike Force and deployed as such. Detailed guidelines on the establishment and use of the Tiger Protection Force are being issued separately by the NTCA.

Strike Teams should carry out regular mock drills to test their level of preparedness and their response time. Their visibility will also send out a strong psychological message to any intended poachers etc.

12.2 Planning a Patrol:-

Based on the availability of field staff and the Special Tiger Protection Force (STPF), planning for foot as well as vehicular/elephant or boat patrolling can be carried out. The element of surprise is always very important in the patrol plans.

Foot Patrols are the best and most effective way of establishing command over an area. Foot Patrols must be regularly deployed. Each patrol must have a clear objective, which should be made clear to all staff by the designated Patrol Leader before the beginning of the patrol. Each patrol should be debriefed at the end of the patrol so as to record what was observed during the patrol. Each Range must have Patrolling Plan which should aim to cover

the entire area of the Range atleast once every fortnight. Care should be taken to ensure that patrols should not fall into the routine of covering only the most convenient routes and that they should not follow a predetermined pattern or route.

A Patrol Party should ideally be atleast 4 persons with a minimum of two firearms and wireless sets. Patrols in an area should generally be a mix of short (1-2 days) and long term patrols (upto 6-7 days). Such patrols comprised of groups of staff drawn from different areas of the TR also bring about bonding and integration amongst the large number of staff in the TR.

Wherever possible, use of GPS by patrol parties should be encouraged. If plotted on a GIS domain, this can throw up interesting information on gaps in areas covered by patrols.

The use of Electronic eye, Deep Search Metal Detectors (DSMDs), camera traps and any other modern technology should be encouraged. In areas which have a large water body, patrolling by motor boats or rubber dinghies should also be part of the patrolling plan.

Elephants in PAs are mostly used for tourism duties. However, occasionally, and especially during monsoons, elephants must be pressed into patrol duties as these can be the best All Terrain Vehicles in a forest.

Senior officials should also join foot patrols and other patrols periodically. This will give them a firsthand experience of the area under their charge, as also to give a high degree of motivation to their first line of defence.

12.3. Daily Monitoring protocol:-

Day to day monitoring of wild life is one of the most important task of the camping staff. All the information on signs and direct sightings will be recorded in the camp register daily by the patrolling party. For a low tiger density area such as MTR, it is very important that all the signs encountered are properly documented. These records will give valuable information about the movement pattern, an idea about their abundance, habitat use as well as evidence of ongoing breeding. To monitor the trends, a weekly tiger monitoring mechanism is already in place in the potential areas of MTR. However, to increase the coverage and accuracy of detection, daily monitoring routines shall be set up which will include the following steps to be taken:

12.3.1. Identification of monitoring/patrolling routes:-

In each block/beat, monitoring trails or paths shall be identified for the daily monitoring schedule. These trails shall be demarcated in consultation with the past records of signs in the area, recent encounter of signs/sightings, easy detection capability (nature of the substratum) and sufficient coverage of the potential patches.

12.3.2. Design of simple data sheets to properly document observations:-

Simple data sheets shall be designed to properly document all the resultant observations. (see annexure) Care shall be taken to ensure that all the relevant information are gathered in easy formats without being too technical or complicated. If possible, GPS locations of the tiger signs shall be collected.

12.3.3. Identification of monitoring personnel:-

In each beat/block, young and energetic forest personnel shall be identified who would carry out the monitoring schedules in an enthusiastic fashion.

12.3.4. Compilation of observations:-

Each month, all the resultant data and observations shall be compiled according to the ranges/ blocks. The existent signs/sightings shall be plotted on the maps to demarcate vital habitat patches for tigers. Records shall be exchanged between all the ranges to monitor possible movement patterns. Utmost care is to be taken to prevent duplication of data.

It is proposed here that a special “Tiger Monitoring Team” be formed from select young, energetic and enthusiastic personnel across all the ranges. The team shall be responsible for solely intensive field surveys to locate tiger use and movement pattern and shall be based in the field itself, all over the reserve. The TMT shall need to camp and monitor an area for long stretches of time if such a need arises. Apart from providing vital information about occurrence of tigers, the designated team will also generate a database of other carnivore presence, signs of disturbance and can aid the other staff with timely detection of emergency situations. The monitoring and survey schedule for the special monitoring team can be established based on the observations of the daily patrolling parties.

12.4. Tiger Population Estimation and Monitoring Framework (Phase I, II and III):-

For designing implementing and evaluating the success of any conservation program for an endangered species, it is imperative to monitor the status, distribution and trends in the population of the target species. The monitoring program shall be transparent in approach and holistic, addressing an array of parameters related to the survival of the species by using the blend of the best available science and technology. In case of the tiger the, only form of countrywide monitoring was based on the pugmark system, which depend on identifying individual tiger by experts. The system generated a total count of tigers, but gave no indication of spatial occupancy, population extent and limits, connectivity between population, habitat and prey conditions. Realizing the shortfalls of the pugmark monitoring system, Project Tiger directorate evolved a program "Monitoring Tiger, co-predators, Prey and their Habitats" in collaboration with wildlife Institute of India and State Forest Departments. This program is based on a four-stage approach.

Phase-I: Spatial mapping and monitoring of tigers, prey and habitat:-

For estimating the distribution, extent and relative abundances of tigers, other carnivores, and ungulates data will be collected in simple formats on carnivore signs and ungulate sightings and on indices of human disturbance and habitat parameters. For this data collection beat will be taken as a unit. All the concern staff must be trained in the data collection protocol.

The detailed methodological approach for sampling carnivore signs, ungulate encounter rates, pellet/dung counts, habitat and anthropogenic pressures is as follows:-

1. Sampling for Tiger, Leopard, and Other Carnivore Sign Encounter Rate-

To obtain data on the presence, absence and intensity of use of a beat by tigers and other carnivores, we shall quantify the relative abundance of tiger, leopard, and carnivore signs in an area. The following procedure needs to be followed for data collection:

- A beat will be considered as a sampling unit.

- Areas within the beat that have the maximum potential for tiger occupancy will be intensively searched.
- Since tigers and leopards have a tendency of using dirt roads, trails, foot paths, river beds and nullahs, these landscape features within the beat need to be searched intensively (Figure- 1).
- One to three persons who know the terrain and habitat features of the beat shall conduct the search for tiger sign.
- There should be 3-5 separate searches (in different compartments within the beat and/or at different times 1-5 days apart) each search covering about 4-6 km distance in areas having the best potential for tiger presence. It is important to record the distance covered and the time spent during each search separately (in the data sheet-1) and accurately. If time is spent resting or in other activities while conducting the search, this duration should be reported separately. If possible the GPS coordinate of the beginning point of each search path should be recorded.
- The total minimum distance covered while searching for tiger and other carnivore sign should be 15 km per beat.
- Tiger and leopard signs should be classified into the following categories 1) Pugmark trails, 2) Scats (Old: dry with hair and bones visible; Fresh: dry but intact with shiny surface; Very Fresh: soft, moist, and smelly, 3) Scrapes, 4) Scent marks (spray, rolling), 5) Rake marks on trunks, 6) Actual sighting, 7) Roaring (vocalization), 8) Kills (Predation on wild prey).
- A brief description of the topography and forest type is to be recorded for each sign.
- In case of pugmark trails, each trail set is considered as one sign (not each pugmark as one sign). In case a tiger (or other carnivore) continues to walk along a dirt road for a long distance (say 1 km), then this should be considered as one sign, and a comment recorded in the remarks section of the data regarding distance covered by a pugmark trail of a single tiger.
- Tiger and leopard signs if encountered outside of the sampling route should also be recorded with GPS coordinates (if available) and with appropriate comments.
- Special emphasis should be given to sign of tigress and leopards with cubs, and any authentic evidence of tiger cubs (sightings of cubs, lactating tigress, tracks, etc.) obtained within the past twelve months should be mentioned in the data sheet.
- While sampling for tiger and leopard signs, record should also be kept for signs of any other carnivore that are encountered.
- The number of livestock that are killed by predators within the past three months needs to be recorded in the questionnaire following the data sheet.
- It is important to report data sincerely. It is likely that there may be reliable information that tiger/leopard is present in the beat being sampled, but no tiger/leopard signs are recorded during the intensive search survey. In such cases, mention should be made in the remarks column of the data sheets. However, failure in obtaining tiger sign from a beat is equally important as recording tiger/leopard signs and for appropriate analysis of this data the actual data should be reported.

Phase-II: Spatial and attribute data: -

The spatial and spatial data that are likely to influence tiger occupancy of a landscape will be used for modelling in a GIS domain. The vegetation map, terrain model, night light satellite data, drainage, transportation network, forest cover, climate data, Normalised Difference Vegetation Index, livestock abundance, human density, socio-economic parameters, etc will be used for modelling habitat condition and tiger occupancy. Beat-wise vegetation sampling will be done to generate broad vegetation map. Part of this component will be done in collaboration with Forest Survey of India (FSI) and Survey of India. This modelling helped in determining current spatial distribution of tigers, potential habitats, threats to crucial linkages between occupied landscapes and conservation planning.

Phase-III: Estimating the population of tigers and its prey: -

Phase-III of the methodology will have the answers of the questions of how many tigers and ungulates are there. Teams of researchers will be deployed for estimating tiger density and ungulate densities within stratified sampling units. The double sampling approach of Pollock et al (2002) by sampling the entire landscape for occupancy and relative abundance related indices along with other covariates (human disturbance and habitat quality - Phase I & II data) and a sub sample for estimating absolute density will be used. Indices were then will be calibrated against known absolute densities for extrapolation in that landscape (Conn et al. 2004, Pollock et al 2002, Skalski and Robson, 1992, Williams et al 2002).

1. Estimating tiger numbers: - After stratifying landscape into tiger sign abundance classes of high, medium, low and no tiger sign at the beat and larger spatial resolution (100 km²). In each of these strata within a landscape estimated actual tiger density in 3-5 replicates of sufficient size (100-200 km²). Primarily depended on remote camera traps to identify individual tigers based on stripe patterns, population estimates based on mark-recapture framework were done using CAPTURE, CARE 2 and Density 4 (Carbone et al 2001, Chao & Yang 2003, Efford 2007, Karanth 1995 and 1998, Karanth and Nichols 1998, 2000 and 2002, Karanth et al 2004, Pollock et al 1990, Per Wegge et al 2004 and Rextad & Burnham 1991). These densities were then extrapolated for the areas under various density classes within the landscape to arrive at a tiger population estimate. We do realise that these population estimates have high variances, but since these estimates are not be used for monitoring trends (which is proposed to be done through the site occupancy and relative abundance data), they should suffice the need for converting a relevant ecological index to a more comprehensible concept of numbers. The tiger population reported throughout the report are tigers above 1.5 years of age and captures of cubs for population and density estimation as this age group is under represented in camera trap studies is not considered.

2. Estimating Tiger prey: - Phase-I of the protocol would be reporting encounter rates on line transects (Buckland et al 1993); these would suffice for monitoring trends in ungulate population and site-specific occupancies as the same transects would be sampled during subsequent surveys. To convert encounter rates to density, an estimate of the effective strip width of these transects would be essential. The effective strip width of a transect primarily depends on the visibility (vegetation and terrain type), ability to detect ungulates by different observers and animal behaviour response (Buckland et al 1993). Effective strip widths determined from the model and actual sighting of ungulates for different vegetation types. However ungulate response is likely to play a important role in disturbed area in determining

effective strip width. The habitat and terrain specific effective stripe width will be determined by actual sampling and by modelling. These estimates of effective stripe width will be used for converting encounter rates of ungulates to density estimate by modelling detection probabilities. A team of researchers sampled the beat transects in each habitat type using distance sampling technique (Buckland et al. 1993). Pellet group counts on transects would serve as an index to the presence and relative abundance of ungulates.

Phase-IV: Intensive monitoring of source populations: -

The following methodology is prescribed for this monitoring: -

1. Photo registration of tigers: - Pictures of individual tigers obtained by camera traps or by regular cameras should be maintained in the form of a photo identity album. Records should be kept on the location, condition (breeding status, injury, etc) and associated tigers whenever a tiger is sighted. This will provide crude data on ranging patterns, demography and mortality.
2. Tiger pugmark and other signs: - Regular monitoring of tiger signs (pugmark tracings, plaster casts, etc) should be undertaken in every beat at a weekly interval with monthly compilation of data. With experience and exposure to the resident tigers and their pugmarks, the forest staff may be able to identify individual tigers from their track set characteristics (Panwar 1979, Smith et al 1999 and Sharma 2001). Sign surveys and individual tiger monitoring should become a regular task for every guard. The monthly data should be mapped and maintained to analyse trends.
3. Monitoring by telemetry in select areas: Use modern technology of VHF, GPS and satellite telemetry to study and monitor aspects of demography, metapopulation dynamics (dispersal, ranging patterns), mortality, predation ecology and behaviour. In all source populations, tiger abundance and density should be estimated using camera traps, digital images of pugmarks and/or DNA profile from non-invasive methods biannually.

CHAPTER THIRTEEN

PROTECTION AND INTELLIGENCE GATHERING

The key to conservation success in a Tiger Reserve is the level of security enjoyed by the tiger and all other species that inhabit the area. Even if every other factor remains very favourable, lack of security can lead to irrevocable and sudden losses of the biodiversity wealth of the area. The case of Sariska Tiger Reserve losing all its tigers in a short span of time due to poaching is a grim case in point. Given that a forest area has its own unique characteristics, it is important that any plan to address its security must comprehensively address these unique challenges presented by the terrain and other related factors.

MTR faces immense pressure from the surrounding fringe population as well as the forest villages located inside the Reserve. Apart from this its proximity to the international borders i.e. Bhutan, Nepal and Bangladesh renders it highly vulnerable both as a poaching route and as a poaching destination. In the past also, parts the Reserve have suffered from insurgency problems. In view of all these existing and potential threats the maintenance of roads, fire lines, bridges, vehicles communication, and arms etc. play a vital role.

13.1. Deployment of native workforce:-

Local people or the native population in and around the Tiger Reserves are a wealth of information on local conditions, geography, wildlife and other issues, specially at the ground level and as such worthy of being tapped for conservation work, specially the Service Providers (SP). Lower level staff are best selected locally. Protected Areas are usually understaffed specially for field level wildlife crime prevention activities. Local competent people can also fill-in the gaps on temporary basis from time to time and on specific issues. Besides, involving the local populace in conservation work also gives them a sense of belonging, bringing in goodwill and participation for conservation work. Some of the areas where native work force may be deployed are in infrastructure work (maintenance of fire lines, roads etc.), habitat improvement work (water holes, grassland management etc.), as fire watchers in fire protection, animal rescue operations in flood prone areas after proper training, human-wildlife conflict resolution, protection etc. In protection and intelligence gathering, the native work force may be utilized for, amongst others:-

- Manning patrolling camps
- As part of Defence squads which can assist the PA staff in protection and intelligence gathering
- As informants for reporting illegal activities and for setting up of informant network with support of locals
- Maintenance of fire lines
- Maintenance of road network for better communication.

13.2. Patrolling Strategy including Joint Patrolling:-

Each Tiger Reserve must have one or more Special Strike Forces deployed in the field. The deployment should be at locations where the strike force should be able to reach a

given area within a reasonable amount of time to take charge of any crisis. In most situations, a Strike Force is best deployed along the periphery in the Code Red Zone. This will be in response to a threat perception.

The Special Tiger Protection Force should be preferably used as a Strike Force and deployed as such. Detailed guidelines on the establishment and use of the Tiger Protection Force are being issued separately by the NTCA.

Strike Teams should carry out regular mock drills to test their level of preparedness and their response time. Their visibility will also send out a strong psychological message to any intended poachers etc.

13.2.1. Planning a Patrol:-

Based on the availability of field staff and the Special Tiger Protection Force (STPF), planning for foot as well as vehicular/elephant or boat patrolling can be carried out. The element of surprise is always very important in the patrol plans.

Foot Patrols are the best and most effective way of establishing command over an area. Foot Patrols must be regularly deployed. Each patrol must have a clear objective, which should be made clear to all staff by the designated Patrol Leader before the beginning of the patrol. Each patrol should be debriefed at the end of the patrol so as to record what was observed during the patrol. Each Range must have Patrolling Plan which should aim to cover the entire area of the Range at least once every fortnight. Care should be taken to ensure that patrols should not fall into the routine of covering only the most convenient routes and that they should not follow a predetermined pattern or route.

A Patrol Party should ideally be at least 4 persons with a minimum of two firearms and wireless sets. Patrols in an area should generally be a mix of short (1-2 days) and long term patrols (upto 6-7 days). Such patrols comprised of groups of staff drawn from different areas of the TR also bring about bonding and integration amongst the large number of staff in the TR.

Wherever possible, use of GPS by patrol parties should be encouraged. If plotted on a GIS domain, this can throw up interesting information on gaps in areas covered by patrols.

The use of Electronic eye, Deep Search Metal Detectors (DSMDs), camera traps and any other modern technology should be encouraged. In areas which have a large water body, patrolling by motor boats or rubber dinghies should also be part of the patrolling plan.

Elephants in PAs are mostly used for tourism duties. However, occasionally, and especially during monsoons, elephants must be pressed into patrol duties as these can be the best All Terrain Vehicles in a forest.

Senior officials should also join foot patrols and other patrols periodically. This will give them a firsthand experience of the area under their charge, as also to give a high degree of motivation to their first line of defence.

13.2.2. What to look for:-

Patrols must actively look for signs of human presence which should ideally not be there. They must learn the art of moving slowly and silently in the forest, without advertising

signs of their presence by smoking cigarettes or biris or walking on a hill crest with their silhouettes against the sky. They must check for human signs around waterholes or other water bodies, slat licks, forest trails, deserted camp sites etc.

The party should be equipped with pH or Litmus paper to check for poisoning of water bodies by urea. They should also look for machans on trees and ground hides near waterholes. If found the area near machans/hides should be searched for empty cartridges/percussion aps or If any such trail or sign is seen, they must carefully trace and follow the same and try to surprise the infiltrators at their camp. Scan the hill sides and tall trees for any look outs/scouts who may be placed there to keep an eye on any approaching patrol. Surprise and swift action is the key in dealing with such situations. If it is assessed that the number of persons and their firepower is of an order that cannot be handled independently by the patrolling party, additional help should be summoned using the wireless, all the time keeping an eye of the offenders.

Full moon nights are generally known to be favoured by poachers. On and around such dates, special vigil must be mounted, especially around water holes and other water bodies. The units manning protection huts on elevated places must immediately report even the slightest flicker of light or any unusual tiger call at night.

Patrolling should be intensive during full moon bracket (5 days before and after full moon. During this time the patrolling party should look for these particular signs.

If there are signs of the animal track being closed or narrowed down using twigs and branches or distractions in the form of cloth/flags being hung on branches. If there are series of twin pits (one of 20+ cm diameter and another less than 10 cm diameter but 2-3 feet deep) on bridle paths indicating spring traps being set up and removed. Patrolling party should also keep a close watch on kills made by tigers.

Field staff regularly patrolling the forest areas should be aware of the presence and movement patterns of major species such as Tigers, Leopards and Elephants in such areas. They should actively look for direct and indirect evidences of such species' presence on a regular basis. Any inconsistencies should be immediately investigated.

Water bodies should be examined for signs of poisoning or of attempts of snaring or trapping around it. Sometimes, fishes are killed using chemical additives. This can be detected by telltale signs of small fish floating dead on the surface. Signs of poison such as sulphur and other chemicals ground on rocks near the water are also a pointer to such criminal activity.

The flight distance of animals and birds and their general demeanour in human presence is also an indicator of disturbance. In areas where hunting is common, animals are generally wary and keep a larger distance between them and humans. This is also true for areas which have a more frequent human visitation and such these need to be factored in also. Thus, animals in the relatively undisturbed "Core Zone" of a Protected Area generally have a larger flight distance than those in the "Tourism Zone". An entire Forest Range must be comprehensively covered once a month by such patrols.

A comprehensive Patrolling Plan will lay out the key areas to be patrolled, routes to be followed, and persons responsible for leading the patrols and those for debriefing them, frequency of such patrols and any other significant facts related to the patrol. A copy will be available at each Range HQ and the Range Officer will be responsible for random deployment of Patrols within his/her Range so that the area is effectively covered. Trans Range Patrols should be organised periodically.

Cattle kill evidences are important signs to be observed. Sometimes, the aggrieved villagers retaliate by poisoning the kill, hence resulting in the poaching of wild animals. Professional poachers also keep an eye on cattle kills for ascertaining presence of carnivores. Where ex-gratia schemes are in place, speedy disbursement of such money is the first step towards preventing retaliatory killings. When a tiger or leopard is located at such a kill, it should not be disturbed but allowed to feed on it as otherwise it will only go away to make another kill. Driving away the animal from such a kill only leads to another conflict situation at some other point in time and space.

Certain areas are prone to a particular modus operandi for poaching like snares, traps, use of hunting dogs, poisoning of kills and water holes, electrocution, shooting etc. Based on the crime/poaching history. Patrolling parties should be aware of such local variations in poaching techniques and especially look out for these during patrols.

13.3. Maintenance of Village level Crime Dossiers:-

All TRs must maintain records of persons with a history of poaching and/or wildlife trade in their locality. This will include details about physical appearance, identification marks/signs, employment, family, key associates, criminal history, convictions if any, pending cases etc. Sudden and long absences of such persons from their normal place of stay must be investigated. Sudden acquisition of movable and immovable assets must also be investigated for possible sources of such transactions.

Photographic dossiers can be very useful in investigation. Maintenance of crime dossiers at the State level is very important. These dossiers can be collated with other states on a need base. In case of TRs located near international borders, such dossiers should have information about poachers from both sides of the border who are known to be active in the area. In every case, the link of old crime to new offenders and old offenders to new crime should be regularly analyzed.

13.4. Fire protection:-

One of the important factors which command profound effects on forest and wildlife is fire. Forest fire has beneficial effect under control but has hazardous effect when it is wild. Fires usually do not kill a large number of animals but they do harm micro fauna and flora of the habitat. Fire destroys the organic matter, which contributes to the humus content of the substratum. Fire changes the abundance and composition of wildlife communities drastically, and a general ecological effect of fire is to reverse the natural plants succession. The fire also destroys the eggs of a number of ground-nesting birds and reptiles. The fire compels animal and bird population to abandon the habitat and migrate randomly in various directions, which may disturb the spatiotemporal utilization of a habitat. Many seeds and several plant species are completely destroyed by fire and their regeneration is affected adversely.

Specific fire protection scheme would certainly check spreading of fire, with a system of immediate detection of fire, speedy communication, quick arrival to the fire site, immediate action to extinguish the fire on war footing scale. One of the most important fire protection measures is to get reciprocal commitments regarding control of forest fire through regular meetings with local people of the surrounding villages.

In Manas Tiger Reserve man-made surface fires occur quite frequently. History of fire, causes of fire, extent of fire damage, etc. have been dealt in details in Part A of Core

Plan. Monitoring of fire incidences in MTR is very essential to assess the impact of fire and to formulate future strategies. Following fire record must be maintained in each Range.

- j) A fire register will be maintained in each Range Office to record the cases of forest fire in the following format.

Case No.	Date of fire	Beat	Comptt	Specific location	Area burnt in (Ha)	Damage of fauna, flora and other properties	Probable cause of fire	Action taken	After effect of fire
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)

- ii) Map of fire prone and vulnerable areas:-

A map should be prepared from the fire data collected from past incidences. Fire prone areas should be identified. They should be classified by degree of burning intensity.

While there are no major instances of forest fires resulting into heavy losses in MTR, enhanced preventive measures need to be implemented which might include the following:-

13.5. Intelligence gathering and coordination:-

Establishment of an appropriate communication system with informers is extremely important. Direct contact with sources is the thumb rule. When a direct contact is not possible, telephonic or communication through letters may be resorted. In case of the telephone the source should always talk to the officer directly.

On direct contact emphasis should be on secrecy and anonymity. The source could meet the officer at his residence under cover of darkness or at a lonely place. Payment to a source should be done directly. A system of should be also evolved to meet the source in emergency situations. A source should be briefed and debriefed suitably. It would be appropriate if a questionnaire is prepared before each briefing and debriefing. A separate file for each source should be maintained for the periodic review. Handing over and taking over of sources should be systematised, otherwise they will dry up. Proper introduction of the source to the new officer should take place.

13.5.1. Flow chart for intelligence gathering:-

Collection - Evaluation - Classification and Collation - Analysis - Reporting - Dissemination and use - Re-evaluation.

13.5.2. Running an Informer Network:-

Careful selection should be done for posting of personnel in the sensitive areas of the PA as these are the persons on whom the mantle of security of the Tiger Reserve vests. They will also inspire confidence in people who want to provide information. The motivation of persons providing intelligence information could be varied and needs to be treated accordingly. Usually, such persons respond best to contact with one person. This sometimes becomes a challenge in Govt. systems where length of an individual's tenure at a station may be limited. Sometimes the person providing the information chooses to remain anonymous and establishes contact on his own choice randomly. On several occasions such anonymous tip offs can be extremely valuable. Also, persons with a past history of indulging in poaching can also be motivated to turn informers.

In order to receive good information, the following must be ensured:-

- The address/Telephone contact numbers on which such information can be provided must be widely publicized and monitored regularly. This should be regularly verified by random checks by senior officers.
- All information received must be screened and acted upon without delay
- Identity of the informer must be concealed if so desired by him
- Resources MUST be available readily to buy the information/ provide reward whenever required
- A covert watch should be kept on the activities of known poachers and their key accomplices. If found missing from their normal place of residence, an alarm should be raised.
- Liquor vendors in the vicinity should be monitored regularly.
- Outlets for pesticide sales need to be monitored periodically.
- Please note that for undercover operations, disbursement of advances must be generally discouraged as it has the potential to actually encourage poaching in certain situations.
- Individuals and NGOs running undercover operations in and around a TR should be encouraged to keep atleast one link in the official enforcement hierarchy broadly informed of their role.

And finally, even the best of Intelligence, will be useful only if it brings about appropriate decisions. Thus, information from intelligence sources must be regularly checked, cross checked and ultimately acted upon within reasonable time, to have any meaningful impact.

13.5.3. Establishing a Criminal Profile Directory:-

All TRs must maintain records of persons with a history of poaching and/or wildlife trade in their locality. This will include details about physical appearance, identification marks/signs, employment, family, key associates, criminal history, convictions if any, pending cases etc. Sudden and long absences of such persons from their normal place of stay must be investigated. Sudden acquisition of movable and immovable assets must also be investigated for possible sources of such transactions.

Photographic dossiers can be very useful in investigation. Maintenance of crime dossiers at the State level is very important. These dossiers can be collated with other states on a need base. In case of TRs located near international borders, such dossiers should have information about poachers from both sides of the border who are known to be active in the area. In every case, the link of old crime to new offenders and old offenders to new crime should be regularly analysed. Regular updation of Wildlife Crime Control Bureau (WCCB) database shall be done.

13.6. Wireless Communication:-

A dedicated wireless system is the backbone of security in a forest environment. In the present day, many forest areas are covered under the GSM or CDMA mobile telephony network of Govt. and private service operators and there is an increasing trend of

communicating with field staff on mobile phones. Yet, the importance of wireless connectivity, especially in times of crisis cannot be over emphasized.

A list of wireless stations which have access to dedicated power supply and are working round the clock is to be maintained. Similarly, a list of other wireless stations and their working hours needs to be maintained. Call signs, preferably in code, should be given to key officials of the TR (eg. Alpha for Field Director, Delta for Deputy Director etc.)

The tendency of using wireless stations to primarily share information related to tourism and for visitor movement needs to be checked. This is primarily an enforcement tool and should be used as such. All wireless stations should convey a report, preferably twice a day at a predetermined interval, about activities in their area of command to a designated Control Room. This could include information about:-

- Patrols conducted and Areas covered on that date
- Any signs of presence or movement of suspected poachers etc.
- Sighting or signs of wildlife such as tigers etc.
- Any wildlife mortality/kills etc.
- General welfare of staff

Even where there is nothing significant to report, the station should contact the Control Room with a Nothing to Report (NTR) message. If a station is not responding for a period of time, this should trigger a visit to the site to find about the welfare of local staff and possible reasons for the break in communications.

Use of modern gadgets like satellite phones and mobile phones etc may be explored for the purposes of communication. However, it is important that all such communication must be formally recorded/logged.

13.7. Use and upkeep of Firearms:-

Several TRs provide official weapons such as rifles, double barrel guns, pistols and revolvers to field staff for discharge of their official duties in the protection of forests and wildlife. In many states, the use of such firearms is codified, clearly laying down conditions of use of such arms while in many other states, the use of such arms is under the general umbrella of “self defence”. In such situations, if any person is injured or killed due to use of firearms by staff while on duty, there may be situations where such use of firearms could lead to criminal proceedings against the concerned Government official. This leads to a general reluctance of staff to carry, maintain or use guns, even in case where they are made available.

Field Directors and other senior officials of the TR should be able to explain to Field Staff, the conditions that govern the use of the official firearms provided to them. In case the regulations need to be modified, the matter may be taken up with the respective Forest Department Headquarters and the State Home department under intimation to the National Tiger Conservation Authority.

In the forest, cartridges are perishable commodities as they are exposed to the elements of nature all the time. As such, they must not be stored for long but should be fired occasionally to test the working conditions of the guns. All weapons in the field must be well oiled and cleaned regularly. Gun oil and cleaning rods etc. should be made available at all Patrolling Camps. If senior officials make it a point to check the general state of weapons with their field staff while on tour, they will be doing protection of the PA a huge service.

All field staff should be made to undergo firing practice at least once a year at a regular firing range. Such an exercise can be easily carried out with support of the local police or Army unit who will also be happy to spare the services of their armourer to examine the general state of being of the weaponry. All weapons should also be test fired at least once or twice a year.

All official firearms must be issued to well recognize entities, i.e. at any point of time it should be possible to ascertain the person who is in custody of a particular weapon. Cartridges issued should be accounted for and empties returned to store.

A single firearm must never be carried in the field as it is liable to be targeted by miscreants. Guns are best sent out at least in pairs. While walking, guns should be carried with the barrel pointing skywards or down and NEVER at chest level pointing ahead or backwards. A gun is not a walking stick and should not be used as one, as this could lead to the butt being damaged or dirt, water etc. entering the barrel and damaging it. In humid areas, it is advisable to plug the mouth of the barrel with a piece of cotton or cloth.

13.8. Emergency Response:-

Despite best efforts, sometimes mortalities of important wildlife species are going to happen in the field. In many cases, this may be due to natural causes while in some, poaching for profit or human wildlife conflict may be the driving force. The first step in such a situation is to ensure that there is no attempt to hide facts and the full details of the incident is brought out. If a cover up is attempted, it will only embolden poachers and also subordinate field staff that may fear to report such cases for fear of disciplinary action.

13.9. Investigating a Scene of Crime:-

Significance of the Scene of Wildlife Crime:- The scene of crime holds the key to successful investigation of the case. The offender is likely to leave behind vital clues at the scene of crime. Many critical evidences are likely to be lost if the place is overrun by a large number of people.

The quality and quantity of evidences available at the scene of crime are likely to change rapidly with the passage of time. Gathering of people at the scene, weather conditions, light conditions etc. are some of the important factors that contribute to the destruction of many important evidences from the scene of crime. Delay in visiting the scene of crime might affect the quality of investigation drastically.

Prompt action at the scene of crime may also lead to the arrest of culprits. Promptness in reaching the scene of crime might lead to obtaining valuable information from the persons who may have information related to the offence. The first set of information received from such persons may be very valuable in establishing the direction of the investigation while the same version obtained at a later stage is likely to be modified or edited due to various other considerations. It is important for the investigating officers to understand that in many wildlife offences, the carcass may have been moved, often by other carnivores etc. to a place other than where the offence was actually committed, thus further complicating the scenario. As such, there can be a primary scene of crime and it is possible to have several extensions. In order to investigate a crime successfully, it is absolutely essential for the investigating officer to pay undivided attention to protect, observe, process and record the scene of crime properly. Any damage, or tampering of the scene of crime, whether intentional or otherwise, would adversely affect the quality of investigation.

It is important to establish linkages between the scene of crime and the suspect(s) through the circumstantial, corroborative and physical evidences. From the forensic point of view, it is only the physical evidences that provide the I.O. and the court the following information about the crime:

- Nature of crime• Time and place of commission
- Targeted species
- Manner in which the crime was committed i.e. modus operandi
- Particular weapon/tool used
- Number and nature of persons involved (any specific group, tribe etc.)

The scene of crime should be thoroughly searched in a systematic matter so as to locate and collect all evidence linked to the crime. Access to the scene of crime should be carefully restricted so that evidence is not destroyed. Some of the things they may look for are:-

- Weapons, bullets, empty cartridges.
- Blood stains, hair, bone pieces, vomits, saliva, glass, paint, finger prints.
- Shoes, tyre marks and tracks.
- Cloth or other fibres, caught on bushesFaecal material.
- Footprints.
- Matchstick, matchbox, cigarette butts, gutkha pouches.
- Implements possibly used for carrying out the crime
- Places where the offender(s) may have stayed or sheltered or laid an ambush in the forest.

Forensic Tools such as fingerprinting, collecting of specimens of blood, footprints, examination of cartridges, weapons etc& should be made use of to strengthen the linking of the offenders with the crime.

When evaluating and examining such crimes, it is important to try and link such crimes to previously identified offenders. This linking of “New Crimes” to “Old Offenders” based on key evidences including modus operandi and forensic tools will go a long way in building the criminal Profile Directory of criminals in and around a given TR.

13.10. Flow Chart for Action When a Wildlife Crime/Mortality is Detected:-

- Inform the senior officer concerned immediately.
- Reach the spot at the earliest possible time with basic tools and forensic kit.
- Cordon off the area with the help of rope or tape.
- To facilitate collection of evidence, divide the crime area in to grids or radial circles.
- Note down every bit of information on the spot in a notebook or in a recording device. Please note that the weakest ink is still stronger than the best of memories, which can fade with time.

- Do not disturb/touch/manipulate the evidences unless photographs have been taken and sketches prepared. Take photographs from different angles. Try to make a video recording of the crime scene.
- 24• Record foot prints of animal(s), human beings, and tyre marks of vehicle if any. Plaster casts may also be prepared of these.
- Search and collect all possible evidences carefully in original condition with preservatives if needed. Search must be carried out at the eye level, ground and above eye level also. Properly pack and label the physical evidences.
- Make a note of names, addresses of witnesses and record their statements.
- Details of the crime scene like location, time, date, weather condition etc. may be recorded.
- Collect evidences from scene of crime, carcass of animal, body parts, and suspects on the spot.
- Surrounding area of the spot must be thoroughly searched.
- Route/escape followed by the suspect(s) must be checked for evidences.
- After recording evidences from carcass for wounds, bullet injuries, symptoms of poisoning, seizure and labeling, the body should be sent for post mortem.
- Please note that information about such mortality/crime/seizures should be brought to the notice of the Chief Wildlife Warden and NTCA at the earliest possible.

13.11. Collaboration with other Enforcement Agencies:-

Memorandums of Understanding with other enforcement agencies like Shashatra Seema Bal (SSB), Border Security Force (BSF), Central Reserve Protection Force (CRPF), Railway Protection Force (RPF), Indo-Tibetan Border Police (ITBP), Assam Rifles etc. will prove to be a very useful strategy in combating poaching and illegal trafficking.

13.12. Media Management:-

Wildlife crimes attract a lot of media attention. If not handled properly, Park Management authorities often face undue criticism. Efforts should be made to provide fair and accurate information to the media, without any attempt to hide or distort facts. A statement/press release should be made available, giving details of the incident for providing information to the media and public. If considered necessary, a Press Conference may also be organized. Only the authorized officer should talk to the media and sweeping statements should be avoided. In situations where the media persons want to visit the field, this can be facilitated after keeping into account other operational exigencies. Please note that the media is also performing its role in reporting such instances and if they are not provided the information, they may resort to reporting unverified and inaccurate versions of the incident, which can do greater damage.

CHAPTER FOURTEEN

ECOTOURISM, INTERPRETATION AND NATURE EDUCATION

14.1. Tiger Conservation Foundation and Management of Community Based Ecotourism Programmes:-

The Wild Life (Protection) Amendment Act, 2006 (Section- 38X provides for establishment of a Tiger Conservation Foundation in each tiger reserve, to facilitate and support management, apart from taking initiatives for involving people in conservation.

The Foundation is a new institutional framework which can complement the tiger reserve management and liaison with various eco-development committees and their confederations apart from production sectors in the landscape. The Foundation should be registered under the relevant rules of the State as a Trust, and as prescribed in the guidelines, will have a State level Governing Body, apart from a field level executive committee under the Chairmanship of the Field Director with representatives of the eco-development committees as nominated by the Governing Body. The Foundation would act as a “non profit center” and as a “development agency” by increasing local participation. It can secure the tiger reserve from financial constraints by providing funding support through various sources: recycling of gate receipts, service charges, donations and the like. The Foundation, may undertake various activities related to mainstreaming of conservation: eco-development, staff welfare, visitor regulation, field research, facilitating eco-development committees for market access, conducting capacity building programs, ecotourism and Joint Forest Management.

14.1.1. Aim and Objectives of the Foundation:-

The main aim of the Foundation shall be to facilitate and support the tiger reserve management for conservation of tiger and biodiversity, through multi-stakeholder participation as per approved management plans, and to support similar initiatives in adjoining landscapes, consistent with the national and state legislations. In pursuance of the said objectives, the functions of the Foundation have to be undertaken through the implementing agency and its staff and or sponsored/supported by it or through other institutions, agencies or individuals collaborated by the implementing agency.

To achieve this main aim, the Foundation shall have the following objectives:-

- a) To facilitate ecological, economic, social and cultural development in the tiger reserve and adjoining landscape.
- b) To provide support to safeguard the natural environment in the tiger reserve and relevant places.
- c) To facilitate the creation of, and or maintenance of such assets as felt necessary for fulfilling the above said objectives.
- d) To solicit technical, financial, social and other support required for the activities of the Foundation for achieving the above said objectives from different sources permitted by law.
- e) To support ecotourism, eco-development, research, environmental education, training, management and advisory aspects in the above and related fields to support the implementing agency.
- f) Anything incidental or ancillary to the above for furthering the above said objectives.

Funds of the Foundation:-

The following shall be the various sources of funds for running the affairs of the Foundation in conformity with the rules of the Foundation:-

- 1) The income generated from levying tourist entry fees and other charges for the services generated out of the MTR.
- 2) Contribution from other sources in terms of specific projects from national as well as international agencies as permitted by law.
- 3) Grant-in-aids, donation or assistance of any kind from any individuals or organizations including foreign Governments and other external agencies as permitted by law.
- 4) Any other activity as permitted by law and in conformity with the rules of the Foundation.

Ecotourism is being carried out within a limited area of the Reserve. The Deptt of tourism at both the State Govt and Council level have included MTR within the tourist circuit.

Ecotourism is being carried out locally in the buffer region and also in the core. However, an Integrated Tourism plan is currently lacking. Presently the main tourist attractions in the buffer are namely Jamduar, Ultapani, Runikhata (Gelephu in Bhutan), Kalamati, Manas National Park, Subankhata, Barnadi, and Bhairab Kunda. Most of the tourists are local as well as a few from neighboring West Bengal and also from Assam. Foreign tourist also visit the area but are presently very minimum in number.

Along with the regular tourists, MTR also attracts considerable number of picnickers from nearby areas. While these much localized short-term activities induce no major harm, proposed future measures will include strict regulation on number of such activities on a daily basis and ensuring proper disposal of the resultant waste materials. Day visitors are generally local people, with school children coming in groups.

14.2. Eco-tourism Guidelines and Constitution of Park Welfare Funds:-

For the proper regulation of tourism in nature Govt. of India has formulated Eco-tourism: Policy and Guidelines (2002). Further, NTCA has issued circular for proper regulation of eco-tourism – dated 14th December 2007.

Following regulation are prescribed for different categories of stakeholders. For the Park Management, the following operational guidelines are proposed:-

- The eco-tourism planning should be flexible, site-specific and participatory, and should form part of a larger eco-development/ eco-regional plan for the area
- Assessment of existing infrastructure, surface transportation, air service, road, electricity, water supply, law and order situation
- The eco-tourism package should invariably include:-
 - Simple, adequate boarding and lodging facilities, in tune with the environment and the general setting of the landscape
 - Road network within the identified tourism zone
 - Self - guided Nature trails

- Transportation options
- Interpretive Centres
- Way-side exhibits
- Signage
- Observation towers
- Public conveniences
- Garbage disposal facility
- Living quarters for staff/personnel
- Structures with an exotic look causing visual pollution and non-compatible and unaesthetic architecture should be avoided
- Site-specific micro - planning for community based eco-tourism should be resorted to
- Temporary housing structures blending with the surrounding should be encouraged.
- Establishing building codes in consultation with the Gram Sabhas apart from other regulations to ensure pollution free environment, with the concurrence of the respective “Zilla Sarkar”.
- Environmental, physical and social carrying capacities to limit the various developmental activities in the fringe area to be identified for eco-tourism.
- Mechanism to ensure continuous monitoring of adverse effects of tourism for quick redressal should be devised.
- Recognize eco-tourism operators, provide incentives to deserving cases and award quality labels.
- Provide visitor information and interpretation services (bilingual) covering:
 - “Do's” and “Don'ts”
 - What to see?
 - Where to see?
 - (Brochures, leaflets, guide service, visitor centres)
- Periodic training programs on eco-tourism should be conducted for tourism administration, planners, operators and general public.
- Ensuring training programme to the host community in:-
 - Lodge ownership/management
 - Basic education and awareness
 - Health and sanitation
 - Skill development for preparation of local souvenirs as appropriate
 - Codes of conduct
 - Forest and wildlife conservation
 - Litter control

- Forging partnerships with tourists and tourism industry
- Environmental management
- To evolve and implement eco-tourism package in a few selected sites initially as pilot projects

For Tour Operators/Developers:-

- To abide by the planning restrictions, codes and standards prescribed by the authorities
- Implementation of desired environmental principles through regulation
- Conducting EIA/environmental audits for new/ongoing eco-tourism projects
- Being sensitive to the conservation of endangered species and corridor value of the area
- To ensure construction of structures blending with the environment as per the prescribed building code
- To take into consideration the carrying capacity and sociological use-limits of the site while creating tourist facilities, and ensuring safety and convenience of tourists
- To use local material and design as far as possible, while avoiding over construction
- The planning, architectural design and construction of tourist facilities should use eco-friendly techniques viz., solar energy, recycling of garbage, harvesting of rain water, natural cross-ventilation instead of AC, self-sufficiency in food through kitchen garden and farming
- Energy and water saving devices should be used apart from controlled sewage disposal
- Control of noise pollution, chemical pollution and air emissions
- Use of signage/boards as per the standard prescriptions in the code
- Reduced use of environmentally unfriendly items like asbestos, CIS, pesticides, inflammable material
- Respecting the historic and religious sites in the area
- Providing appropriate interpretive service to visitors for communication with nature and local culture
- Ensuring proper marketing of eco-tourism products
- Ensuring training of staff on environmental issues
- Ensuring safety and security of visitors
- Respecting local inhabitants, culture and involving them in various activities and vocations as far as possible

For the Visitors:-

- Abiding by the code of conduct, “Do's” and “Don'ts”
- Helping conservation, apart from protecting any site natural or cultural, which may be adversely affected by tourism
- Avoiding wastage of resources

- Avoiding littering and carrying back all non - degradable litter
- Leaving the camp sites clean before departing
- Avoiding removal of plants, seeds, drift - wood from the site
- Respecting local culture/customs
- Respecting holy places
- Strictly adhering to the safety precautions

For the Host Community:-

- Respect the value of environment and cultural heritage
- Avoid overusing the area
- Co-operate with the authorities in ensuring healthy eco-tourism
- Realize and react to the threat of investors who see opportunities and exploit the locals
- Be friendly with the visitors as effective “nature guides” and “conservationists”

Development of PA-level Participatory Eco-tourism and Visitor Strategy:-

Action Points for Planning:-

- The development of an over-all eco-tourism strategy will incorporate the following:-
 - Local participation
 - Sound environmental design
 - Visitor management
 - Conservation education
 - Training
 - Financial sustainability
 - Monitoring and evaluation
 - To assess:
 - The existing tourism situation and potential
 - The desirable tourism situation and identify steps to attain the same
- To prepare a Participatory Community Based Eco-tourism strategy for the project area, involving the stakeholders through meetings and workshops
- The eco-tourism strategy should also address the following:-
 - Potential PA attributes vis-à-vis eco-tourism
 - Identification of sites
 - Development of monitoring mechanisms for ecological impact of eco-tourism
 - Visitor information and levels
 - Identify marketing opportunities

- Development of guidelines for visitors/staff viz., visitor centre, orientation centre, brochures, handbook, signage
- Development of mechanisms to collate visitation data for management
- Development of guidelines/building code for environmentally acceptable and culturally appropriate designs
- Identification of: staffing levels for tourism, future requirements and training needs
- Identifying: institutional arrangement for eco-tourism management, mechanisms to increase long-term local participation in benefit - sharing and decision-making, local training needs
- Developing, monitoring and evaluation of plans to assess local participation and benefit sharing
- Evolving legal framework for eco-tourism activities
- Establishing administration and legal requirements for: Zoning, entry fees, revenue-sharing with indigenous people

14.3. Interpretation programme:-

Interpretation facilities are vital for a protected area for both generation of some amount of revenue and generation of awareness of the tourists. Properly designed interpretation facilities educate the generally laymen tourists about the ecological, cultural and ethnic values of the area and for an area like MTR with diverse ecological zones, flora and fauna and myriad ethnic identities, interpretation facilities should be a vital component of the park interpretation programme. At present there are no Interpretation centres in MTR. the following four numbers of NICs cum training centres are proposed for attracting more tourists and also for nature awareness.

- NIC cum training centre at Bansbari
- Small NIC at Field Director's Office, Barpeta Road
- NIC in Kachugaon, Haltugaon, Chirang, Buxa and Dhansiri Forest Divisions
- NIC at Forest headquarters Kokrajhar

The Nature education and Awareness activities organized at the reserve is part of the strategy for better management. The following steps are recommended:-

- a) Attempt should be made to add more exhibits, murals, dioramas, specimen of plants, trophies, photographs, animal signs, etc.
- b) Models of implements and artifacts used by the local tribal (baskets, tools, furniture, ornaments, carvings made of natural materials etc.) should be exhibited in the NIC with proper leveling and description.
- c) An informative video film on forests and wildlife values of MTR should be prepared and shown to the visitors at the NIC auditorium.
- d) Brochures, pamphlets, handouts, posters and other informative materials should be prepared and made available to the visitors on payment.

- e) The library facility in the NIC should be improved by adding books, magazines and journals relating to environment, forestry and. A collection of reference materials like management plan, species list, research reports and articles on MTR should be available in the Library.
- f) Interpretative and Conservation education: Coverage of themes at the NIC at present is inadequate. The following themes and messages should be developed and displayed.
 - History of conservation in MTR
 - Prey-predator relationship of tiger and other carnivores in MTR,
 - Behaviour, social life, ecology and biology of Tiger, Leopard, Elephants and other important animals in MTR,
 - Ecological processes and forces at work in MTR,
 - Role of local people in conservation of nature,
 - Flora of MTR,
 - Effects of illegal felling of trees, grazing and fire on ecology and economy.
 - Man-Wildlife conflict,
 - Habitat Utilization by different animals
 - Do's and Don'ts for visitors in a PA.
- g) The NIC should remain open for visitors preferably on all the days of the week at fixed hours. Special programme should be held at the NIC on week end and other holidays to cater to the needs of the students, housewives and salaried people.
- h) Developing a website with all the relevant information related to tiger reserve such as management activities, information on flora and fauna, visitor facilities, tariff for ecotourism activities etc.

14.4. Nature Education:-

Natural Interpretation/education is an educational activity which aims at revealing meaning and relationships of complex ecosystems .It is better done through experiencing wilderness, and or through visual display of such relationships. Mere presentation of facts, figures, data, etc. becomes drab and uninteresting and fails to convince tourist. Following strategy for the development of interpretative media for tourist education in MTR is proposed.

14.4.1. Development of Nature Trail:-

At present only one nature trail exists in the Reserve near NIC at Rajabhatkhawa. It is desirable to develop a few more nature trails at suitable places, say near forest rest houses. Self-guided nature trails bring visitors in close contact with nature and give them a sensation of thrill and adventure. A sketch map should be drawn depicting significant natural features along the trail and should be placed at the starting point to help the visitors to orient themselves.

14.4.2. Guided Tourism:-

At present there is no guided tourism in MTR except a few eco-guides available at Kokilabari. Guided tourism is a specialised task to be manned by an experienced and well trained eco-guide. Initially it is required to identify the target groups like Students, School children, group of nature lover, FPC-EDC members, foreigners, research fellow etc. who can be taken to various places, properly interpreting various animal signs and calls, biotic influences on the wilderness and adverse effect of human activity on the Reserve, on the zone of influence, identifying various birds, local cultures, phenomenon of changing river courses, etc. The guided tourism has the noble role to play in transforming the peripheral nature lovers to the committed ones. They will be our messengers. They will take and spread the message in the society.

The Eco-guides will be selected from among local FPC/ EDC educated youth. They can be trained properly to act as Eco-guide. The charges for Eco-guide can be fixed by the park authority.

14.4.3. Signage:-

Signage is presently not adequate in MTR Good signage help people to find their way, prevent tedious enquires and very often provide interesting information to the tourists. There are 4 different types of signage that should be installed in MTR

- a) Directional Signage:- These signage show the way to various places like Range Office, Rest House, Orientation Centre, NIC, Rescue Centre, Parking Site, etc.
- b) Cautioning Signage:- These signage inform the tourist about the acts statutorily prohibited in the PA. These signage also inform the tourists about their responsibilities in preserving the serenity of PA.
- c) Orientation Signage:- These signage mainly include Maps, location sketches, etc. which helps in orienting the tourists. A map of MTR showing various zones and places of tourist interest should be placed at prominent locations.
- d) Interpretive Signage:- These are to be kept at certain strategic places like along a nature trail, at scenic view points, at places of historical and religious importance, etc. Brief and impressive interpretive signage must be installed at conspicuous places.

14.4.4. Audio-Visual programme:-

Video films and slide shows on Forests and Wildlife and other interesting features in MTR should be shown to tourists at NIC. Films/ Slides shows should also be held at regular interval in schools, tea gardens and villages in the vicinity of MTR

14.4.5. Nature Camp:-

The objective of organising nature camp is to introduce the participants with basic ecological principles through learning by personal experience. It encourages participants to discuss and analyse conservation issues in a constructive and problem solving manner. Students from schools and Colleges, Science and Nature Club and N.G.O's form the main target groups for nature camps.

Camp sites should be places of interest - away from sensitive and vulnerable habitat and safe for walking and halting overnight. Camp accommodation will normally be in tents. Permanent camps should not be constructed. For organizing nature camps, help of experienced N.G.O's may be taken. Camps should be organised from October to March. A nature camp should be of 5 - 10 days duration.

14.4.6. Bird Watching Points:-

Bird watching points should be developed at the numerous wetlands that occur within the Reserve. Guide and field staff should be given training in bird watching. Binoculars and books on bird watching should be provided at large and rest houses.

14.4.7. Use of media for publicity of PA:-

Help of the print and electronic media should be taken to promote the tourist potential of MTR. Publicity wing of Govt. of Assam/BTAD and Tourist Department should be involved for ensuring proper publicity of tourist spots in MTR.

14.5. Involvement of local people:-

Local villagers should be involved in the management of tourism in MTR so that they too have a stake in it. Local educated unemployed youth from FPC/EDC can be engaged as eco-guide after proper training. They can be engaged to run the catering facilities in the tourist lodges. Local vehicles, if available, should be hired for use by tourists. It is also desirable to seek their suggestions from FPCs/EDCs as to, how they can participate and get benefit directly/indirectly from tourism. This is extremely necessary to ensure their support in favour of conservation based tourism.

CHAPTER FIFTEEN

ORGANIZATION, ADMINISTRATION AND BUDGET

15.1. Buffer Areas Coordination Committee and its Linkages with Tiger Steering Committee and Tiger Conservation Foundation: -

The Buffer Area Coordination Committee will carry out the management of the Buffer Area in association with Tiger Steering Committee and Tiger Conservation Foundation (described in Chapter 13 of MTR-TCP- core area) on following broad principles:-

- Implementation of forestry activities after mainstreaming wildlife concerns.
- Implementation of eco-developmental activities for reducing resource dependency of local people on surrounding forests.
- Coordination with governmental/non governmental production sectors in the landscape for mainstreaming conservation.
- Habitat management and improvement activities will be carried out in the existing habitat of tiger and its prey species through active involvement of local communities. Community will be involved in the overall management of the buffer area.
- Site specific eco-development initiatives based on participatory village level micro plans will be carried out for the local communities for strengthening their livelihoods through a balanced approach of rationalization of resource use, biomass regeneration and alternatives, so that the ecological status of the area could be improved and maintained.
- Reciprocal commitments by the local people through specific measurable actions as per MoUs for improving protection and conservation of the area will be implemented. This may include rationalization of resource use from the forest, participation in fire protection and anti-poaching efforts.
- Ecotourism activities in the Buffer Area will be used as an important component of ecodevelopment for strengthening the livelihood of the local people and the protection of the area.
- Capacity building of the field staff as well as eco-development committee member will be undertaken on a regular basis through the Tiger Conservation Foundation. Similarly, intensive nature conservation awareness programme shall be part of the buffer area management plan with a focus on different stakeholders particularly local communities.

15.2. Coordination with EDCs, Confederation and other Line Agencies /Departments/ Production Sectors:-

Co-ordination with line agencies/departments is needed for Better protection. Regular meetings shall be organized with following line departments.

- Police, revenue, railway authorities, Judiciary: Monthly and 6-monthly
- Eco-development: Monthly

- Revenue, Rural development, Agriculture, health, Veterinary, Horticulture, Jila Panchayat, Women and child development, PHED, Education, Tribal welfare, Tea garden authorities etc.: As per requirements.

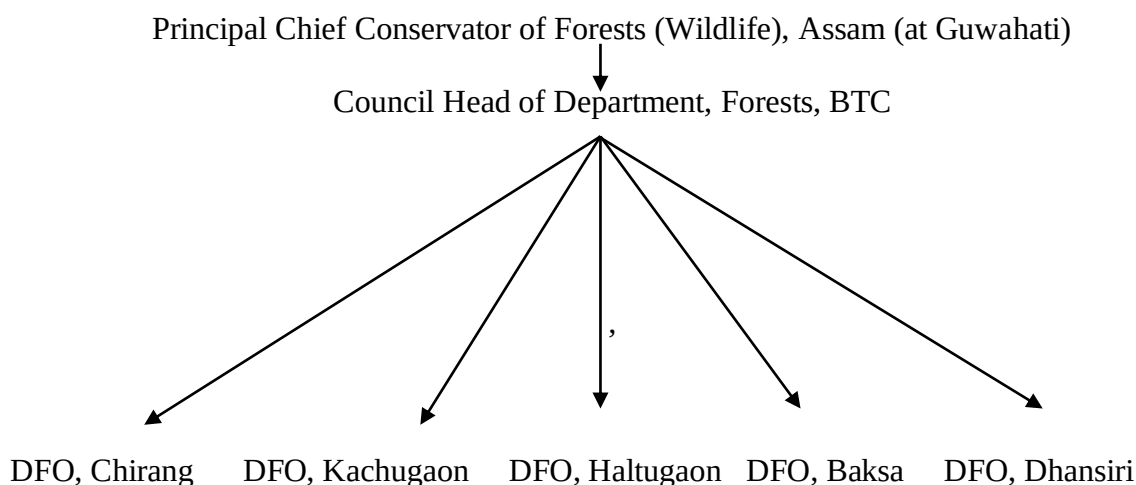
For co-ordination following measures shall be adopted:-

- Regular meetings with line departments: This will be done bi-annually.
- Coordinating with District Collector and CEO, Zilla Parishad (ZP) and Gram sabhas for organizing special meetings with line departments: This shall be carried out as per requirement and need of various project activities in the buffer areas.
- Knowing various schemes of line departments and identifying schemes suitable for the reserve area.
- Reserve tour of officials of line departments.
- Accreditation and highlighting achievements of other departments in reserve area.

15.3. Staff deployment:- The staff strength is still under utilized in buffer areas. As per the need, staff positions shall be required to fill up at earliest through BTC. Divisional Forest Officers of all the five buffer division shall be responsible for the requisition and hiring of staffs. Present distribution of staffs in buffer area is heavily lopsided. A re-distribution of staff as per specific protection needs in buffer division is necessary. Re-distribution of staff as well as re-organisation of range and beat jurisdiction shall be done as proposed. The minimum basic facilities and amenities shall be provided to the staff, particularly those posted in difficult locations. Incentives and rewards shall be given to staff for good works to boost up the morale of the staff. Provision of sufficient sophisticated fire arms and ammunition for staff to tackle poachers and smugglers shall be provided.

15.4. Administrative set up:-

Currently, there are five designated buffer divisions within MTR, namely, Chirang, Kachugaon, Haltugaon, Baksa and Dhansiri. Each divisions is under command of Divional Forest Officer, who are directly under the Council Head of Department (CHD), Forests, BTC. The administrative structure currently is as follows:



It is proposed that the administrative control of all buffer areas and divisions should be brought under the Field Directorate. Similarly, two DFO posts should be re-designated as deputy Director (East Buffer) and Deputy Director (West buffer) for better coordination and management.

15.4.1. Fund raising strategies: -

The NTCA will be the main fund provider for development, eco-development, research, protection, environmental education and other activities. The State Govt. will help in establishment, other developmental activities and tourism.

The gate money deposited in vikas nidhi will be use for protection and management of Protected Area, Eco-tourism and development of host community. Fund may be raised from different donors through Tiger Foundation.

15.5. Schedule of operations:-

All the operations in the PA will be completed as per the direction and scheduled prevailing in the department. All the operations in the PA will be completed as per the direction, APO and schedule prevailing in the department.

15.5.1 Schedule: -

The annual schedule shall be prepared by the Field Directors on the basis of various prescriptions of divisional plan proposals and shall be sent to the Council Head of Department, BTC and then forwarded to the Chief Wildlife Warden well in time for approval. Once approved and forwarded by the Council Head of Department, BTC various works should be implemented as per the schedule.

15.6. Activity budget:-

All the activities to be carried out as per sanctioned budget for buffer areas.

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PART III - CORRIDOR

PART A: THE EXISTING SITUATION

CHAPTER ONE

INTRODUCTION OF THE AREA

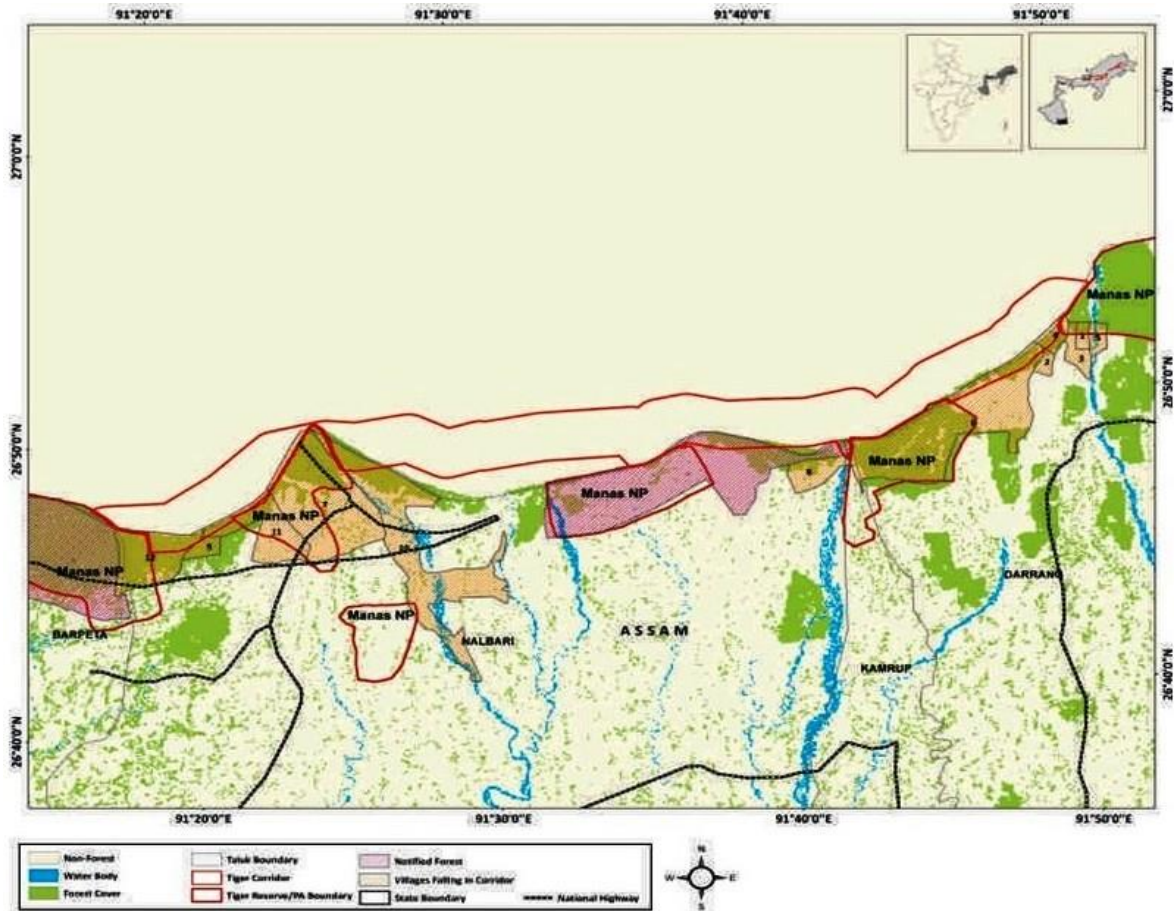
The conservation status of tiger is precarious and has aroused global concern in the recent years. Tigers are under threat due to many factors like habitat loss, depletion of prey population and direct killing (Sanderson *et al.* 2006). The conservation of the Royal Bengal Tiger *Panthera tigris tigris* in India has faced uphill challenges in recent years and its population has dwindled from about 40,000 to about 3500 during the past hundred years (WWF India, 2003; Moulton and Hulse, 1999). At present the population of tiger in the country has reached around 2226 as per recent government census (Jhala *et al.*, 2014).

The Brahmaputra Valley in Assam and the foothills of the eastern Himalayas are important strongholds of the Royal Bengal Tiger in India (Jhala *et al.* 2008, Karanth and Nichols, 2000; Sanderson *et al.* 2006). Manas, Nameri-Pakke, Kaziranga, and Orang are the few important tiger conservation sites the region that offers promising prospects for tiger conservation. The same tract of forest, more or less contiguous runs through the region and eventually meets the forests in Myanmar and the rest of SE Asia through Namdapha Tiger Reserve and other forest areas in the eastern Arunachal. Information on some of these populations are starting to accumulate as part of the national tiger monitoring effort however, not adequate and needs rigorous monitoring to strengthen conservation and protection of tiger, prey population and habitats.

1.1. Brief Description of the Area and significance for tiger conservation:-

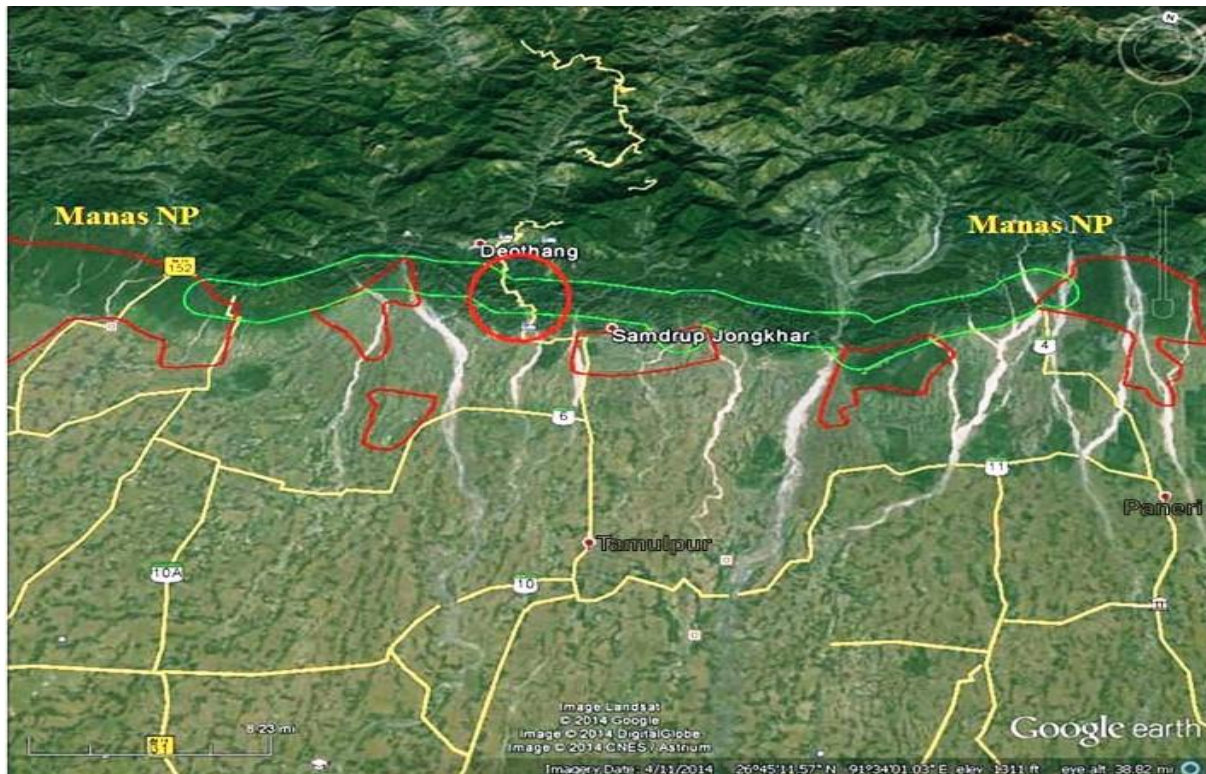
Manas Tiger Reserve spans across the districts of Kokrajhar, Bongaigaon, Barpeta, Nalbari, Kamrup and Darrang in north-west Assam, covering an area of 2,837 sq. km. of which 850 sq. km² is designated as the core area. To the north, it is separated from the Royal Manas National Park of Bhutan by River Manas and its tributaries- Beki and Hakua; while to the west, it is separated from the Buxa Tiger Reserve of West Bengal by River Sankosh. The region is affected by high levels of extremist activities, thus making conservation and scientific monitoring in the area a challenge. The Reserve Ripu Chirang Elephant Reserve within the Bhutan Biological Conservation Complex, in Bhutan is connected with the forests of Buxa in West Bengal, thus making a large transboundary conservation area. The entire area inclusive of the Bornadi Wildlife Sanctuary in Assam covers an area of 7,200 sq. km. Manas Tiger Reserve was camera trapped and tiger density is estimated to be 1.8 tiger per 100 sq. km. However, the region has higher potential and is on its path to recovery. With control of poaching of prey, tiger densities are likely to increase substantially, especially in the southern parts of Manas.

Figure 1.1 Least Cost Pathway corridor for Tiger movement between Manas Corridor overlaid with village map



Manas-Ripu Chirang-Buxa/Jaldapara-Gorumara-Singhalila landscape unit is about 7,200 km² with a single block of 5,000 km² from northern West Bengal (Gorumara) to the coniferous forests of Sikkim (Singhalila).

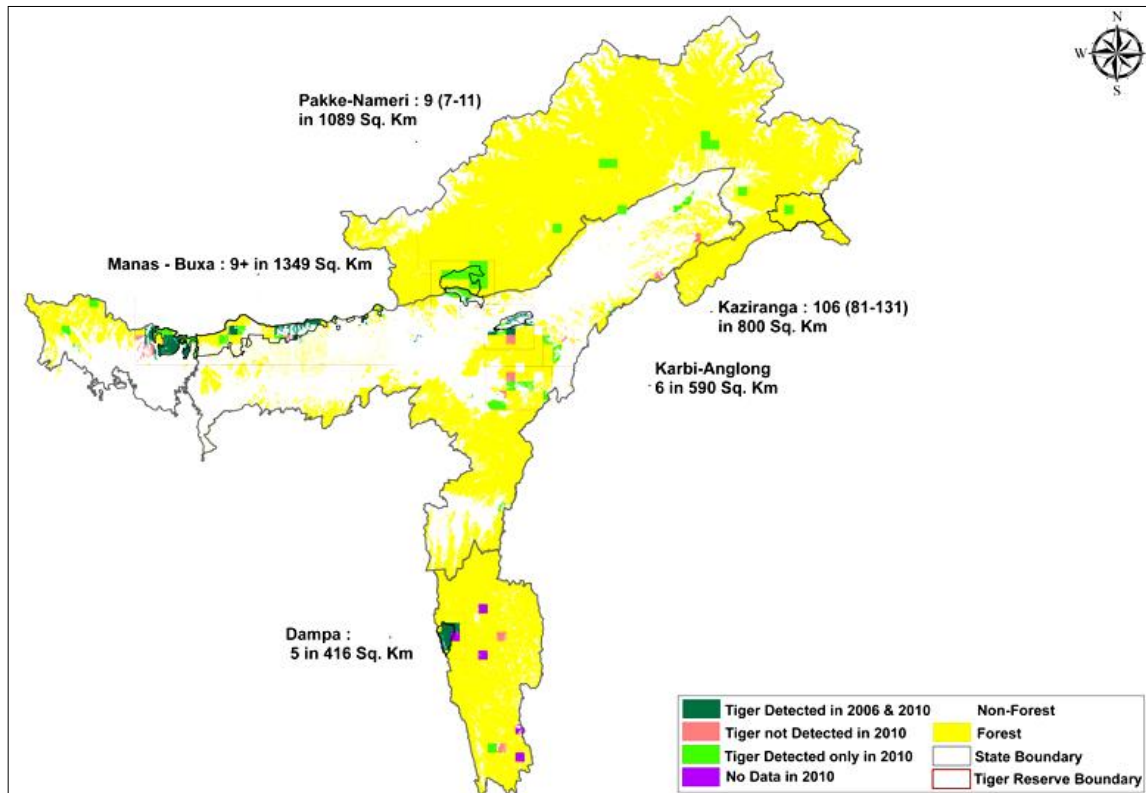
The forest connectivity in the Brahmaputra plains is patchy and fragmented, but the landscape is connected through the forests of Bhutan. On the Indian side, “stepping stone” connectivity exists between Gorumara, Jaldapara, Buxa, and Ripu Chirang through the district of Jalpaiguri. Connectivity between Ripu Chirang and Manas is degraded on the Indian side. This landscape needs to be managed through transboundary international cooperation with the Government of Bhutan (Jhala et.al., 2011).

Figure 1.2 Potential obstacles, bottlenecks and weak links within the corridors of Manas

The tiger populations in this landscape have historical evolutionary significance as they share the connecting gene pool with the south eastern tiger populations and represent the entry point of tigers into the Indian sub-continent (Jhala et.al., 2008; 2011).

Manas Tiger Reserve spans across the districts of Kokrajhar, Bongaigaon, Barpeta, Nalbari, Kamrup and Darrang in north-west Assam, covering an area of 2,837 km² of which 470 km² is designated as the core area. To the north, it is separated from the Royal Manas National Park of Bhutan by the River Manas and its tributaries- Beki and Hakua; while to the west, it is separated from the Buxa Tiger Reserve of West Bengal by the River Sankosh. Around 62 villages are located within two kilometres of the Reserve boundary between Rivers Sankosh and Dhansiri. The region is affected by high levels of extremist activities, thus making conservation and scientific monitoring in the area a challenge till date. The Reserve shares the area with the Ripu Chirang Elephant Reserve and further westwards continues with the forests of Buxa in West Bengal. The entire area inclusive of the Bornadi Wildlife Sanctuary in Assam covers an area of 7,200 km². The Manas Tiger Reserve was camera trapped with almost a total coverage and its current tiger density is estimated to be 1.8 tiger per 100 km². However, the region has high potential and is on its path to recovery. With control of poaching of prey, tiger densities are likely to increase substantially, especially in the southern parts of Manas.

Fig 1.3: Tiger occupancy, population extent, size and habitat connectivity in the North Eastern Hills and Bramhaputra Flood Plains Landscape (source: Jhala et.al., 2010)



1.2. Natural Habitat Corridors:-

Conservation of Tiger will not only require the management of core and the buffer areas but it will also be the necessary to maintain connectivity to other core areas for ensuring gene flow as an ecological requirement for long term survival of the species. Therefore, it will be necessary to identify these areas of connectivity/corridors between two source populations.

In fact, management of these critical areas will be as important as the core areas. In most of the cases such areas will be under traditional forestry practices and other land uses. These areas will also be under tremendous pressures due to habitations and human activities. Therefore, in such areas the existing management practices will have to be modified so as to upgrade and maintain the ecological status of the connectivity/corridors. Obviously the agenda of co-existence will have to be implemented for such areas with a focus on the wildlife habitat parameters and the livelihoods/developmental needs of the local communities. Role of the local communities, line agencies and other stakeholders will be extremely important for the management of such areas.

The plan for these areas has to be very simple and focused. Many of the activities of extension, research/monitoring and HRD will have to be linked with the Buffer Area Plan.

Value of Corridors:-

- Isolated populations of wild animals face the risk of extinction owing to insularization. Habitat fragmentation adversely affects wildlife due to decreased opportunity available for wild animal movement from different habitats. This in turn prevents gene flow in the landscape. The equilibrium theory of island biogeography predicts greater species richness in large wildlife areas or in smaller areas connected by habitat corridors owing to increased movements of wild animals. Such connecting habitats, apart from facilitating animal movements also act as refuge for spill over populations from the core areas. They may also act as smaller “source” by facilitating breeding and movement of native wildlife populations to colonize adjoining habitats. Natural linear features like rivers or mountain ranges may act as boundaries for wildlife populations. However, disturbance of corridors on account of human interventions (highways, canals, industries, roads, railway tracks, transmission lines) is deleterious to wildlife.
- “Source” populations are those which produce a surplus of animals which are potential colonizers. On the other hand, “Sinks” are those populations in which deaths exceed births, and their persistence depends on regular influx of immigrants.
- Patches of suitable habitats in the landscape may support wildlife populations (local populations), which may be separated from one another on account of various disturbance factors. Collectively, such patches of local populations are known as “regional populations”. This general situation of sub divided populations interacting with one another in a landscape to supplement new genes through movement is known as a “meta population”. In the context of tiger land tenure dynamics, the core-buffer areas conform to the “island-mainland” or “core satellite” form of meta population model. The core area of a tiger reserve provides a source of colonizers for the surrounding local populations of different sizes and varying degrees of isolation. The core area may not readily experience extinction owing to the protection inputs for maintaining its inviolate nature. However, the surrounding isolated patches in the buffer area may suffer from local extinction if wildlife concerns are not mainstreamed in the area. Therefore, a meta population management approach is required for the buffer zone as well as corridors to facilitate:-
 - Supplementing declining local tiger populations
 - Facilitating re-colonization in habitat patches through restorative management
 - Providing opportunity to tiger for colonizing new areas through patches of habitats (stepping stones) between isolated populations (Plate 4).

Corridors become crucial for maintaining viability of Population 2 as by itself it does not have the habitat to sustain greater than 20 breeding tigers (Fig 3).

1.3. Transboundary Habitat Corridors - At the Macro-Scale:-

Manas Tiger Reserve is a unique landscape as it has inter-state and transboundary habitat connectivity with other Protected Areas including two tiger Reserves. The landscape must be studied in its entirety as it is essential for survival of tigers in the area. In case of MTR, 5 remnant habitat corridors have been identified largely from known movement of

elephants across the elephants (Fig 1.3). It is likely that large carnivores such as Tigers are also perhaps using such these areas as instances of tiger pug marks have been found recently (as in Kachugaon and Subankhata RF areas respectively). The details on each of the corridors are mentioned below:-

Corridor-1. Baksa TR-Ripu RF-Phibsu WLS corridor:- this narrow strip of inter-state, transboundary corridor occurs in the western most of MTR. This is also the westernmost limit of Golden langur (*Trachypithecus geei*) and also the location where it was discovered for science by the legendary E.P.Gee in the 1950s.

Corridor-2. Chirang RF-Royal Manas National Park corridor:- This corridor can aptly be termed as the ‘bottleneck’ corridor as it has witnessed the maximum habitat alterations in the recent past. The transboundary corridor will be essential for linking the western landscape to the eastern landscape within MTR.

Corridor-3. Subankhata RF corridor:- this comprises of a narrow strip of forests currently under attempts of regeneration, recent evidence of tigers in the area have been highly encouraging.

Corridor-4. Barnadi WLS-Khaling WLS corridor:- This transboundary corridor is again a cause of concern as new reports of tiger presence has been ascertained, although seasonal elephant movement has been regularly reported.

Corridor-5. Bhairabkunda RF –Rowta RF- Sonai Rupai WLS corridor:- A potential corridor area, although further field based observations will be required to ascertain if elephants and tigers are able to move through this area and cross over to Sonai-Rupai Wildlife sanctuary which has recently been declared as a satellite core of Nameri Tiger Reserve.

1.4. Habitat Corridors - At the Meso-scale:-

From Management point of view, the 23 blocks of RF, PRF and USF areas within Manas Tiger Reserve also require habitat connectivity as it has also become disjunct in several areas (Fig 1.4). The corridors (with a minimum width of 3 km) are as follows:-

1. Chirang-Manas RF corridor:- This corridor passes through encroached RF areas with regenerating forests on the Indian side. The River Aie is a major tributary and the state highway runs through this. The road connects a main township in Bhutan (Gelephu) and is a major impediment towards re-linking this corridor.

2. Subankhata RF-Morapagladia RF-Darranga RF-Sukanjuli RF corridor:- These small blocks of forest land are currently under degraded forests but there is a tremendous potential to provide greater protection measures and reclaim the area as an important elephant corridor.

3. Kharkhari PRF-Kundaribeel PRF- Bhoirabkunda PRF-Bhoirabkunda RF corridor:- these forest blocks are crucial towards linking Manas TR to Sonai-Rupai WLS that has recently been proposed as a satellite core for Nameri Tiger Reserve.

Fig 1.4: Extent of Tree Cover in and around Manas Tiger Reserve and corridors-
 (image data source: <http://www.globalforestwatch.org>; Hansen et.al, 2013)

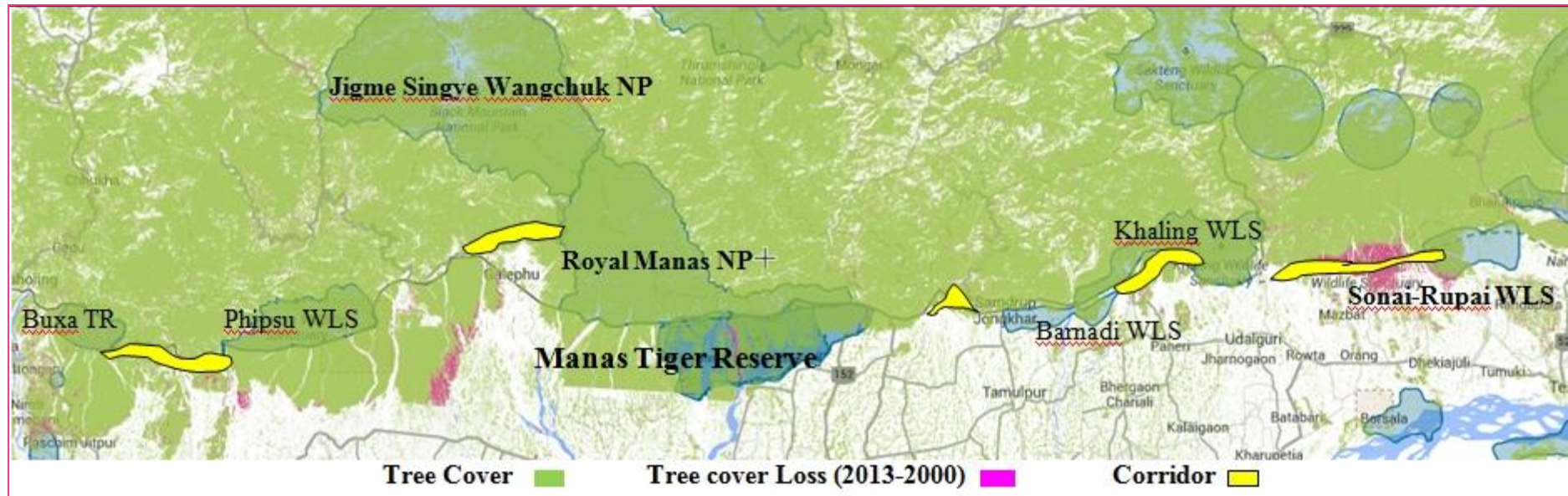
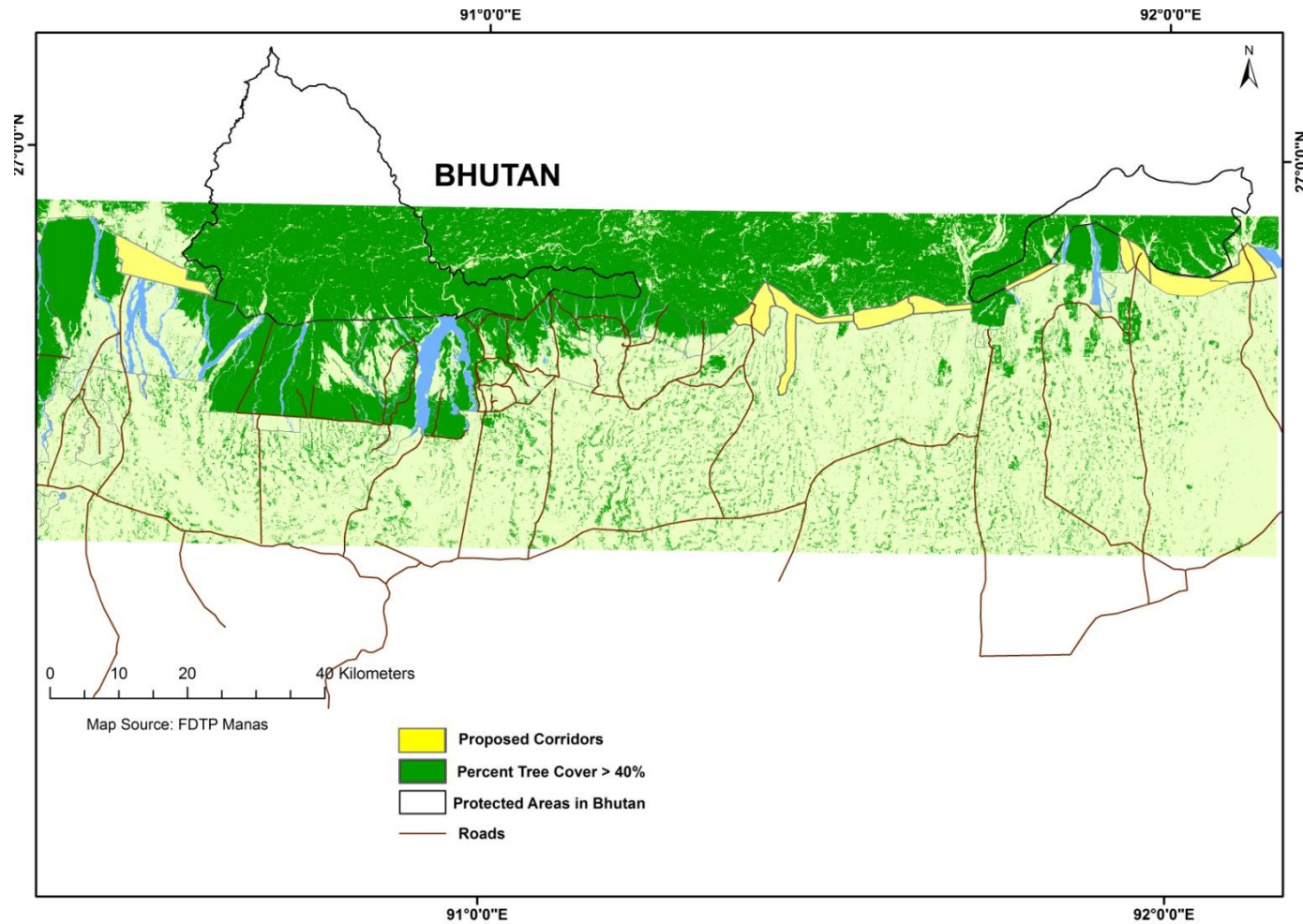


Fig 1.5: Proposed corridors linking buffers areas of Manas Tiger Reserve-
 (image data source: <http://www.globalforestwatch.org>; Hansen et.al, 2013)



CHAPTER TWO

STATUS OF TIGERS AND THEIR PREY

2.1. Introduction:

Tiger *Panthera tigris*, is used as a flagship or umbrella species in conserving wildlife and wild areas in many parts of Asia. A collaborative study (Borah et.al, 2013) was undertaken by using used remotely triggered camera traps and capture-recapture framework within Manas National Park in India and Royal Manas National Park in Bhutan to estimate the abundance and density of tigers in the Transboundary Manas Conservation Complex (TMCC) or TraMCA, which also act as corridor area.

A total of 14 individually identified tigers comprising of eight males and six females, were photo-captured during the 5,955 camera-trap night survey period. Four out of the 14 tiger identified were found to be using both the areas in MNP and RMNP, indicating healthy corridor area.

2.2. Over all abundance of Tigers:

Tiger abundance details not available from corridor areas. Although there are reports of tiger movement across the area, efforts for determining the abundance has not been carried out yet.

2.2.1. Overall Density of Tigers:-

Tiger density data not available from corridor areas. Although there are reports of tiger movement across the area, efforts for determining the density has not been carried out yet.

2.3. Prey species recorded:

Diversity of mammals and relationship with tigers:-

Apart from tigers, other carnivore species that are present in the corridor area include Leopard (including melanistic leopard), Clouded Leopard, Golden Cat, Marbled Cat, Leopard Cat, Jungle Cat, Dhole, Himalayan Black Bear, Sloth Bear, Jackal and Civets. Herbivore prey species photo captured included Gaur, Wild pig, Sambar, Barking Deer, Goral, Serow, Asian Elephant and Porcupines. Such wide variety of mammal species in the landscape could be attributed to the varied geographical topography as well as the different vegetation type present in the landscape.

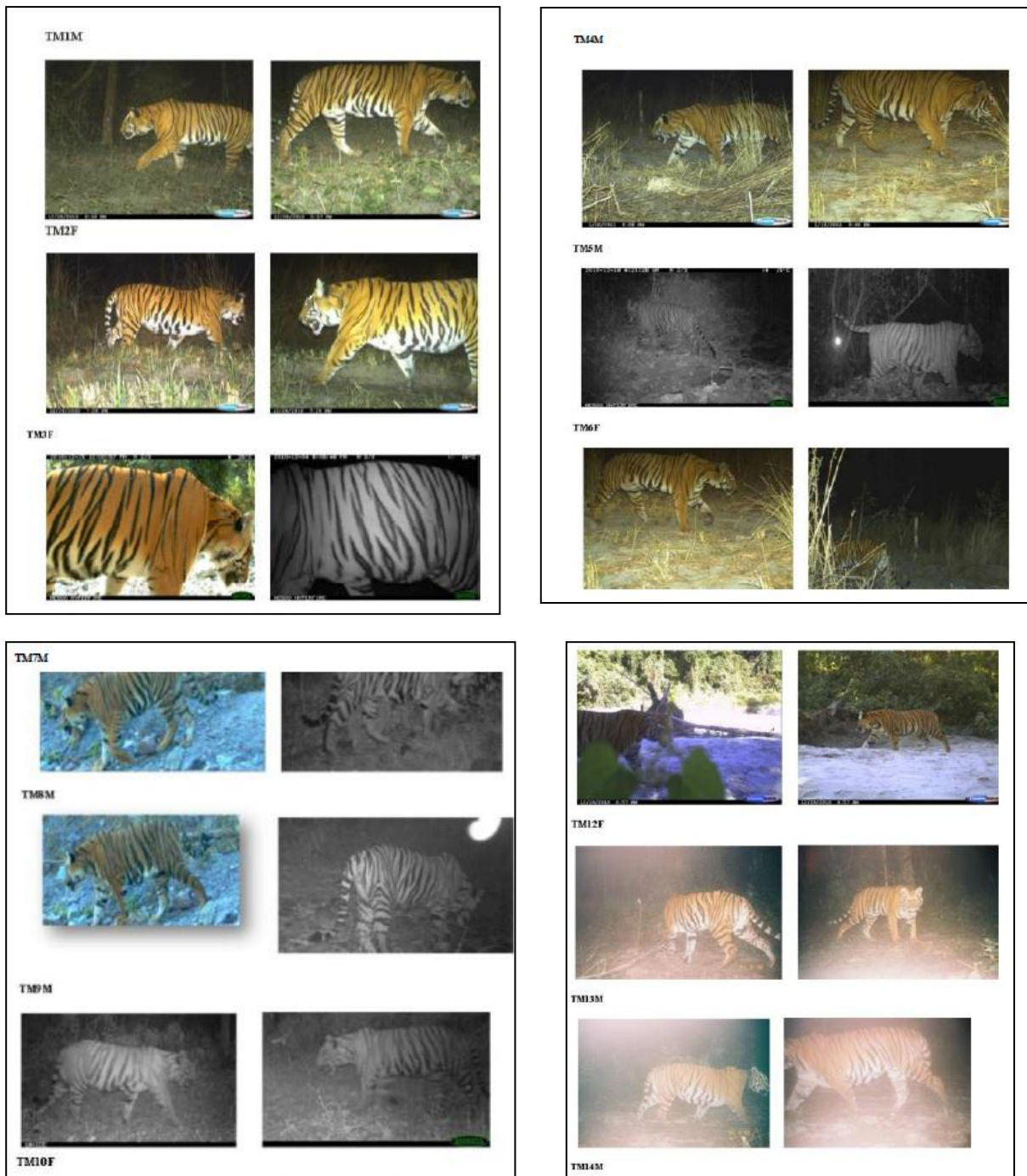
2.4. Future monitoring and management of Tigers:

Tigers in the corridor area of Manas is vital in terms of regional and global conservation of tigers in the wild. The region forms an indispensable corridor for the Terai-Arc Tiger Conservation Landscape between Terai regions (of Nepal and India) with landscapes in North eastern India, Myanmar and South East Asia. There are evidences that tigers are effectively using the landscape along India and Bhutan. Annual abundance and density estimation of tigers in corridor areas shall be carried out and will help monitor changes in populations and trends of these large carnivore population dynamics. The future plan shall evolve a lasting commitment by the two national governments of India and Bhutan for tiger conservation and monitoring. Efforts need to be made to develop a sustainable funding mechanism to ensure transboundary tiger monitoring and co-operation between both the governments.

2.5. Future monitoring and management of Corridors:

Beside tiger and prey monitoring, immediate activities shall include local-level exchanges and the formalisation of exchanges at a higher level. Future programmes shall also concentrate on developing specific field of skills and practical training, to report poaching and illegal trade of species. These steps will inspire confidence to build partnerships and commitment to a long-term process of collaboration. Monitoring interventions shall be planned and implemented. Future studies shall also address connectivity issues between landscapes in addition to continuation of long term monitoring of tiger populations and other associated species.

Plate 1: Some tiger individuals from across the transboundary corridor area (Borah et.al.,2013)



PART B: THE PROPOSED MANAGEMENT

CHAPTER THREE

LAND USE PATTERNS AND CONSERVATION MANAGEMENT ISSUES

3.1 The existing situation in the zone of influence:-

Most of the corridor areas, particularly in northern and western part of BTC areas have some forest villages. Many of these forest villages were known to be set up/established during the British period while many have been set up after independence also. Besides these, there are number of villages inside R.F. lands.

The population has a fairly high representation of schedule castes and Schedule Tribes and they account for most of the population. Most of the people living depend primarily on agriculture. Their income is also supplemented in most cases by primitive animal husbandry. Forest villagers cultivate their land and rear large number of cattle.

3.2 Land use patterns

The use of land in the corridor areas varies greatly depending on the nature of the parent material- soil, terrain, hydrological conditions, drainage, rainfall, temperature, irrigation facility etc. Lands are more fertile in south than in north as soil depth is more in south than in north. On the Northern side, there is scarcity of water and the land is less fertile. The village areas located at the outskirts of forest are mostly cultivated fields. Agriculture is mostly rain fed. Household orchards contain jack fruit, banana, mango, areca nut, etc. Paddy is the main crop. Traditional practice is followed for agriculture but the pattern is changing gradually.

3.3 Socio-economic Profile of Villages:-

As the timber logging operations gradually diminished and also completely stopped by mid 1990s, the people of villages took to other non-forestry occupations. The civil strife combined with remoteness of these villages has added to the backwardness of the people. Surrounding forests, come under the Assam Forest Department. Denial of access has caused conflict and antagonism towards the National Park and can affect the corridor areas if not managed.

3.4 Socio-economic and cultural environment:

District scenario: The socio-economic and cultural factors exert strong influence on the forest. About 90% of rural population is engaged in agriculture and allied activities and rest is in non-agricultural activities. A large number of female workers are engaged in the tea gardens and in agricultural activities. The pressure on agricultural land is increasing gradually.

3.5 People's economy and major employment sources:-

People residing in the corridor areas are very poor. Agriculture is the main occupation. Majority of families are small and marginal farmers and number of large farmers are very few. Huge labourers force is present. Villagers follow the traditional agricultural

practices. Irrigation facilities are poor and majority of the agricultural lands are rain fed and mono cropped. Most of the earlier employment that existed has either stopped or removed.

3.6 Resource Dependence:

Traditionally, local economy is dependent on forest resources. In fact, it used to be too heavily dependent on it. Poor families depend on sale of firewood for earning their livelihood. No in-depth study report on resource dependency of local people in the corridor area was available at the time of writing this Plan.

5.3.1. Implications of the land use and resource dependence for the conservation issues in the tiger reserve:

People have subsistence level of economy. This subsistence level of economy might changing to market economy. To augment their scarce income, they illegally fell trees, cut fodder grasses and thatch, graze cattle inside the forest. This exerts tremendous pressure on the Reserve.

Flood and soil erosion from time to time cause heavy damage to vegetation and agricultural land. Human and cattle population in corridor area is also increasing. This increases pressure on wildlife habitat.

Large quantity of firewood is removed through head loads. This is sold for earning livelihood. This is degrading habitat. Grazing is reducing palatable fodder resources of the reserve affecting population dynamics of wild animals. Graziers fire forest floor and extensive area is burnt. This degrades habitat quality. A large number of people collect NWFP. Collection is controlled very little which poses grave threat of over extraction.

Man-animal conflict is increasing gradually due to human settlement, development of agriculture and tea industry. Wild animals are getting disturbed and their habitat is shrinking gradually. Wild animals, particularly elephant and gaur, occasionally come out of the forests and cause damage.

Deforestation, because of biotic pressure, is not only damaging the natural flora and fauna in the region but also disturbing the local equations. Consequently, soil erosion enhanced by high rainfall and swift flowing of hilly streams is causing permanent damage to the land of these areas.

CHAPTER FOUR

VISIONS, GOALS, OBJECTIVES AND PROBLEMS

4.1. Vision:- To actively manage and restore corridors for facilitating the dispersal of tigers at landscape level.

4.2. Management Goals:-

- Mainstreaming of wildlife concerns through an integrated landscape and trans boundary approach, which in turn, requires us to identify the bottlenecks and areas where the corridor have been disrupted and suggest appropriate mitigation strategies

4.3. Management Objectives:-

- Keeping the corridor functional by taking up plantations with indigenous species on community land, assisting natural regeneration in degraded forest, gap planting with indigenous species in forest areas.
- Integrating the habitat isolates and correlating/upgrading the sink populations with source population of wildlife in mainland core.
- Ensuring better management that includes the concept of Ecological development and sustainable livelihood.
- To provide suitable habitat to the spillover population of tiger, co-predators and prey and to link the meta-population with the core, source population through usable corridors and involvement of a trans-boundary approach.
- To create proper sustainable habitat for the tiger, co-predators and prey population by way of increasing prey base, creating plantation of indigenous and local trees, grasses, fodder and fruit species and practice of agro-forestry in non-forest areas.

4.4. Problems in Achieving Objectives:-

- Insurgency and its aftermath. The Tiger Reserve forms a major chunk of BTAD, which is a newly constituted Autonomous Council since 2003. Ethnic clash and civil strife have marred the landscape in the past two decades.
- Lack of recent cadastral surveys to ascertain the actual boundaries of the Reserve.
- Segregation of Command and lack of coordination between Core (National Park) and buffer (Territorial) forest divisions.
- Fragmented forest areas, especially in the western and eastern part of the reserve that has resulted in loss of connectivity between habitats.
- Hunting and poaching of wildlife mainly for meat and also for wildlife trade to some extent.
- Illegal expansion and forest conversion for establishing tea and rubber gardens.

- Low productivity of small land holdings and dependency on rain for cropping success leads to unemployment, and opportunistic tree felling and hunting in the non-hunting season.
- Lack of conservation awareness and also proper orientation/capacity building of Forest Departmental staff.

3.5. Strengths - Weaknesses - Opportunities - Threats (Limitations) (SWOT) Analysis:- Strengths:-

- Resence of large tracts of 'good' forested landscape including the connectivity with forest areas in Bhutan.
- A strong core (Manas National Park), that has been steadily strengthened after the insurgency period of 1990s. Prime focus for elected leaders of BTAD and several national and international NGOs and aid agencies, including the World Heritage Site committee of UNESCO.
- Low human population density as compared to other sites in northeast India.
- Unique initiative with involvement of local youth for helping out in forest protection.

Weaknesses:-

- Presence of militant groups and their dominance in regulating forest transactions in RF areas.
- Wildlife hunting and trapping for meat and the resultant loss in prey base.
- Presence of forest villages and their continuous expansion into forest areas.
- Cattle grazing, illegal collection of timber, firewood, sand, boulders and other forest produce.
- Floods and changing river courses as a result, accessibility to the interior of Reserve is restricted during the Monsoon season.
- Lack of intra-departmental and inter-departmental coordination.
- Absence of a consolidated LANDUSE PLAN and ECO-SENSITIVE ZONE.

Opportunities:-

- Availability of 'good' habitat to achieve the goal of management with minimal protection.
- Willingness of people to accept to changes for betterment.
- Vast scope of ecotourism and other indigenous initiatives such as the involvement of local youth as conservation volunteers.

Threats:-

- Natural geomorphological conditions (changing courses of rivers, flood and droughts, seismic belt etc.)
- Severe unemployment among locals
- Backwardness of local area due to poor development of infrastructure etc.
- Traditional dependence on forests and other natural resources.

CHAPTER FIVE

MANAGEMENT STRATEGIES (AT MESO SCALE)

5.1. Habitat Corridors:

From Management point of view, the 23 blocks of RF, PRF and USF areas within Manas Tiger Reserve also require habitat connectivity as it has also become disjunct in several areas (Fig 4). The corridors (with a minimum width of 3 km) are as follows:-

1. Chirang-Manas RF corridor:- This corridor passes through encroached RF areas with regenerating forests on the Indian side. The River Aie is a major tributary and the state highway runs through this. The road connects a main township in Bhutan (Gelephu) and is a major impediment towards re-linking this corridor.

2. Subankhata RF-Morapagladiya RF-Darranga RF-Sukanjuli RF corridor:- These small blocks of forest land are currently under degraded forests but there is a tremendous potential to provide greater protection measures and reclaim the area as an important elephant corridor.

3. Kharkhari PRF-Kundaribeel PRF- Bhoirabkunda PRF-Bhoirabkunda RF corridor:- these forest blocks are crucial towards linking Manas TR to Sonai-Rupai WLS that has recently been proposed as a satellite core for Nameri Tiger Reserve.

4.2. Adaptive strategies:-

In the crucial forest corridors the following must be ensured:-

- Large-scale and systematic plantation of wild animal fodder tree species and reclaiming of the land.
- Monitoring wildlife/tiger presence in standardized formats on a daily basis.
- Foot patrolling by staff to ensure protection and exchange of tiger/wildlife presence data with nearby Protected Area or Tiger Reserve.
- Timely payment of compensation for livestock depredation by wild carnivores regulating livestock grazing in areas prone to wild ungulates.
- Payment of compensation for crop damage by wild animals and setting up of and make functional fire protection Village Forest Committees.
- Review of wildlife status in the meetings of Forest Development Agency and regulating collection of Non Timber Forest Produce including monitoring village cattle for disease, maintenance of village level wildlife crime dossier.
- Protection of riparian margins, retention of old/dead trees and staggering of forest stands belonging to different age groups.

In case of Agricultural (revenue land) areas it must be ensured that:-

- adoption of 'eco-agriculture' as a land use to produce food as well as to conserve wildlife and maintaining non-domestic habitat
- discouraging sudden change in cropping patterns(viz lure crops) to avoid accentuating man-wild animal conflicts
- maintaining a habitat mosaic, viz. fallow land, cultivation field, fruit orchard, plantation, under planting of spices, small timber etc. to mimic natural forest
- promoting soil conservation
- providing economic incentives for safeguarding wildlife concerns
- providing incentive for carbon, water and other environmental services to local people
- compensating losses due to wildlife
- recognizing the value of traditional farming in conservation
- Fostering use of green manure and discourage use of chemical manures and pesticide.

CHAPTER SIX

MANAGEMENT STRATEGIES (TRANSBOUNDARY)- AT MACRO SCALE

6.1. Habitat corridors:-

Manas Tiger Reserve is a unique landscape as it has inter-state and transboundary habitat connectivity with other Protected Areas including two tiger Reserves. The landscape must be studied in its entirety as it is essential for survival of tigers in the area. In case of MTR, 5 remnant habitat corridors have been identified largely from known movement of elephants across the elephants (Fig 3). It is likely that large carnivores such as Tigers are also perhaps using such these areas as instances of tiger pug marks have been found recently (as in Kachugaon and Subankhata RF areas respectively). The details on each of the corridors are mentioned below:-

Corridor-1. Baksa TR-Ripu RF-Phibsu WLS corridor:- this narrow strip of inter-state, transboundary corridor occurs in the western most of MTR. This is also the westernmost limit of Golden langur (*Trachypithecus geei*) and also the location where it was discovered for science by the legendary E.P.Gee in the 1950s.

Corridor-2. Chirang RF-Royal Manas National Park corridor:- This corridor can aptly be termed as the ‘bottleneck’ corridor as it has witnessed the maximum habitat alterations in the recent past. The transboundary corridor will be essential for linking the western landscape to the eastern landscape within MTR.

Corridor-3. Subankhata RF corridor:- this comprises of a narrow strip of forests currently under attempts of regeneration, recent evidence of tigers in the area have been highly encouraging.

Corridor-4. Barnadi WLS-Khaling WLS corridor:- This transboundary corridor is again a cause of concern as new reports of tiger presence has been ascertained, although seasonal elephant movement has been regularly reported.

Corridor-5. Bhairabkunda RF –Rowta RF- Sonai Rupai WLS corridor:- A potential corridor area, although further field based observations will be required to ascertain if elephants and tigers are able to move through this area and cross over to Sonai-Rupai Wildlife sanctuary which has recently been declared as a satellite core of Nameri Tiger Reserve.

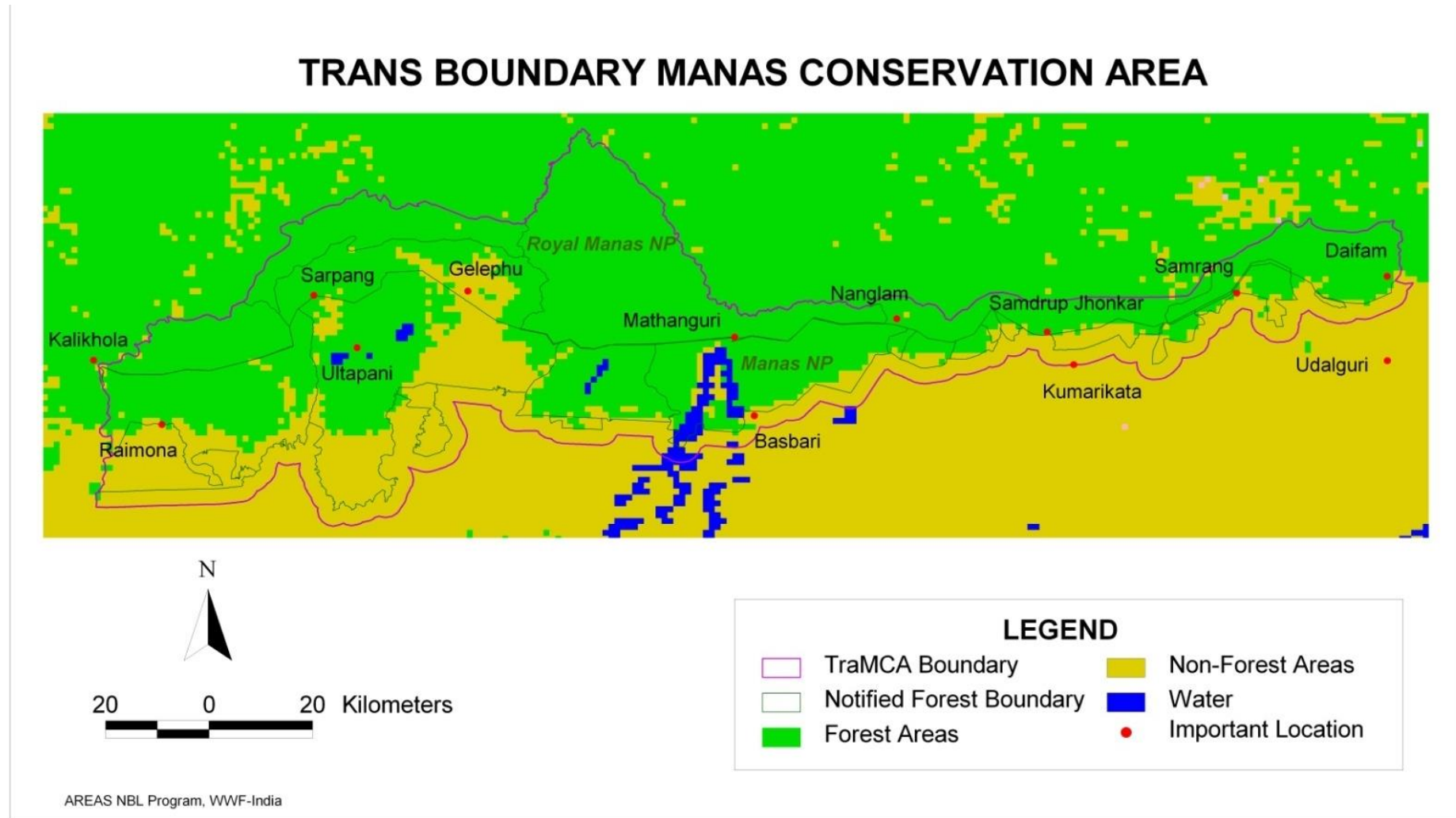
6.2. Adaptive strategies:-

Since the movement of animals (especially tigers and elephants) in the biological corridors exist in the inter-state and internationally too, it is proposed that the landscape unit be also managed as a trans-boundary conservation landscape.

In this regard the concept of Transboundary Manas Conservation Area (TraMCA) already exists and significant work has been done under this for the last few years.

TraMCA is a region of high biological diversity extending along south eastern Bhutan and north eastern India. The landscape forms a vital mosaic of conservation spaces across the Eastern Himalayas, and stretches from the Ripu-Chirang Reserve Forest in India in the west to Bhutan’s Khaling Wildlife Sanctuary in the east. TraMCA covers three protected areas in Bhutan, including Phibsoo Wildlife Sanctuary (PWS), Royal Manas National Park (RMNP) and Khaling Wildlife Sanctuary (KWS), as well as two biological corridors. In India, TraMCA comprises all of the Manas Tiger Reserve. The Manas Tiger Reserve in India and Royal Manas National Park in Bhutan form the core of this biologically outstanding trans-boundary region that is home to tigers, elephants, rhinos and more than 1,500 other species of mammals, birds and vascular plants.

Figure 5.1: Map of Trans-boundary Manas Conservation Area-



The landscape represents immense habitat diversity with tropical grasslands ranging in elevation from 40 to 150 m, subtropical forest located at 300 m, and warm broadleaved forest between 1000 m to 2000 m. The landscape is important for achieving global tiger conservation goals and the Indian Rhino Vision 2020, which seeks to increase the rhino population from 2000 to 3000 in the state of Assam. In addition, the landscape is important for the conservation of Asian elephants and endemic species of the Eastern Himalayas including pygmy hog, hispid hare, golden langur, swamp deer, Bengal florican and white-bellied heron.

The rivers that cascade down the Himalayas to join the Brahmaputra are valuable for the ecosystem services they provide to both upstream and downstream communities in Bhutan and India. The Manas River flows through Royal Manas National Park and Manas National Park, and makes both the parks an important watershed area in the region. Protecting the forests that maintain the flows is essential, especially in view of the large scale hydropower development now under way. In addition, numerous indigenous communities in TraMCA add cultural and ethnic diversity to the rich landscape.



TraMCA was conceptualized in 2011 with the vision to jointly develop and manage a trans-boundary conservation area between Bhutan and India for the benefit of people and wildlife (Annex 1). The MoU on this collaboration is currently under review by the governments of Bhutan and India. Despite the slow progress of the MoU, there has been productive field level collaboration between Bhutan and India to contribute to the vision of TraMCA. Joint tiger monitoring surveys have been initiated in both Royal Manas National Park, Bhutan and Manas National Park, India. The surveys culminated in a joint report titled “Tigers Across Borders”, which was launched in Bhutan in October 2012 at the second Asian Ministerial conference on Tiger Conservation.

WWF - Bhutan has also been able to negotiate with the Government of Bhutan concerning the relocation of the town of Nanglam in the Samdrup Jongkhar district in eastern Bhutan. This relocation is important in that the proposed location could have impacted the corridor between RMNP and KWS, according to the findings of the corridor survey initiated in 2012.

In light of the importance of this trans-boundary space for people and wildlife in both India and Bhutan, and as a step toward institutionalizing a joint vision, the TraMCA Action Plan was developed. The TraMCA Action Plan is an outcome of the stakeholder planning workshop organized in Phuntsholing, Bhutan in December 2012, which was attended by government (Forest Department) and local NGO representatives of both countries. The action plan was developed through brain storming exercises that identified and prioritized the key threats in TraMCA. These exercises helped with the development of key objectives, outcomes and activities to address the prioritized threats, along with budget estimates. For details concerning the TraMCA workshop report, see Annex-2.

The Action Plan will be used to leverage government support in India with both state and central government agencies, as well as in Bhutan to get the Memorandum of Understanding (MoU) endorsed between the two governments. The plan will also be presented to a diverse group of stakeholders at the local and national level to establish their endorsement and support.

6.3. Threats:-

TraMCA faces several threats due to its porous border, rising human population and pressure from development activities on both the Bhutan and India side of the border. Five priority threats or challenges in TraMCA, which require interventions on both sides of the trans-boundary landscape have been identified and are as follows:-

- 1) **Habitat loss and fragmentation:-** The loss of habitat and fragmentation are attributed to infrastructure development such as hydropower plants, road construction, transmission lines, industrial enterprises, encroachment in forest areas, illegal logging and weak enforcement.
- 2) **Habitat degradation:-** Habitat degradation is due to grazing by livestock, man-made fires, more frequent floods linked to climate change, unmanaged extraction of natural resources/illegal logging, and invasive species.
- 3) **Loss and decline of wildlife:-** There is loss and decline of wildlife especially in the Reserve Forest areas due to poaching, hunting, habitat loss and degradation and weak enforcement. The highly porous border between Bhutan and India makes it conducive for illegal activities.
- 4) **Human wildlife conflicts:-** Human wildlife conflicts are observed to be rising on both sides of the border. The causes are linked to habitat loss and fragmentation, agricultural patterns and land use system, limited understanding of living in proximity with wildlife, lower level of tolerance of conflicts, ineffective compensation and inadequate conflict management systems.
- 5) **Mechanisms to convert political willingness into action:-** Although there is political support and willingness for conservation from both sides at the government level, translating this interest into action on the ground has been an issue. The reasons for this are linked to political instability in the area, lack of benefit sharing systems and mechanisms, or not being able to actualize benefits from conservation to people due to

inability to put values on ecosystem services. This has resulted in policies that do not support benefit sharing being put in place.

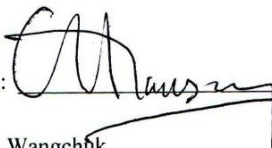
Fig 5.2: Resolution of the First India-Bhutan consultative meeting on 30.02.2013

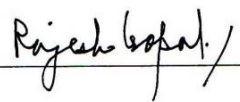
**Resolution of the First India-Bhutan Consultative Meeting on
Trans-boundary Biodiversity Conservation, 20th February, 2013
at the Manas Tiger Reserve, Assam, India**

The representatives of the Government of India and the Royal Government of Bhutan, while expressing concern on the increasing threats to biodiversity caused by various factors and realizing the urgent need for an effective strategy to address the problem confronting the biodiversity conservation and ecological security in the trans-boundary region specially with a focus on tiger and rhinoceros conservation hereby resolve to:

- (1) Formalise Memorandum of Understanding (MoU) between the Royal Government of Bhutan and Government of India on Trans-boundary Biodiversity Conservation with special focus on tiger and rhinoceros.
- (2) Form working group of officers at operational level involving NGOs on either side, organize regular trans-boundary meetings and exchange visits of officials of both countries.
- (3) Initiate collaborative research and monitoring on tiger and rhinoceros.
- (4) Prepare joint strategy for tiger recovery sites in trans-boundary areas.
- (5) Identify and strengthen restoration and management programs of wildlife corridors and connectivity in trans-boundary areas.
- (6) Conduct tiger population estimation simultaneously and share tiger photo IDs.
- (7) Share best practices on conservation and livelihood improvement activities of local communities around habitats including eco-tourism.
- (8) Support mutual exchange of scientific advancements relating to innovative wildlife research, scientific studies, assessment and monitoring including source-sink population.
- (9) Strengthen joint actions on curbing poaching, illegal wildlife trade and forest products smuggling besides sharing of information.
- (10) Develop joint human-wildlife conflict mitigation strategy.

Signed on the 23rd day of month August, 2014 at New Delhi.

Signed: 
Sonam Wangchuk
Chief of Wildlife Conservation Division
Thimpu-11002.

Signed: 
Dr. Rajesh Gopal
Additional Director General (Project Tiger)
& Member Secretary,
National Tiger Conservation Authority
New Delhi.

Appendix – 1

(Gazette Notification of Manas National Park)

The 7th September, 1990

No. FRW.55/86/64.- In exercise of power conferred by section 35 of “The wild Life (Protection) Act, 1972”. The Governor of Assam is pleased to declare the area include within the limits of the boundaries described in the ‘Schedule A’ below to be a National Park with effect from the date of publication of the this Notification.

SCHEDULE-‘A’

District	: Barpeta and Kokrajhar.
Subdivision	: Barpeta and Kokrajhar.
Forest Division	: Manas Tiger Reserve.
Area	: 500.00 sq. km. (approx)

DESCRIPTION OF BOUNDARIES

North- from the point where the Sukanjan River crosses Indo-Bhutan Boundary at B. P. No. 192/3 the Northern Boundary runs along the Indo-Bhutan Boundary eastwards upto the point where the Potanadi (Agarbari) river crosses the Indo-Bhutan Boundary at B. P. N. No. 220.

(PART-HA)**THE ASSAM GAZETTE, DECEMBER 5, 1990**

East—from the point of Indo-Bhutan Boundary Pillar No. 220 along the left bank of Potanadi (Agarbari) river towards South to a point where it meets the Southern Boundary of the Koklabari R. F. (Additionn). Thence along the Southern Boundary road of Koklabari R. F. (Addition) Westwards to a point where it meets Randhani Bandhani stream (about 0.8 km.) below Koklabari camp and thence along the old Boundary of N. K. R. F. (Addition) at bearing of 267° For a distance of 1320.00 m. to B. P. No. 1.

THENCE FROM:

B. P. No.	To B. P. No.	At a bearing	To a distance
1	2	267°	340.00 meters
2	3	15°	180.00 meters
3	4	277°	3160.00 meters

Thence the Boundary line runs the left bank of Anglichinga river in a southerly direction from B. P. No. 4 to B. No. 23.

From B. P. No.	To B. P. N.	At a bearing	To a point
4	5	189°	140.00 meters
5	6	237°	220.00 meters

6	7	92°	560.00 meters
7	8	245°	200.00 meters
8	9	236°	320.00 meters
9	10	180°	400.00 meters
10	11	180°	400.00 meters
11	12	182°	360.00 meters
12	13	221°	380.00 meters
13	14	164°	345.00 meters
14	15	150°	240.00 meters
15	16	96°	200.00 meters
16	17	217°	180.00 meters
17	18	180°	220.00 meters
18	19	88°	110.00 meters
19	20	174°	160.00 meters
20	21	125°	720.00 meters
21	22	225°	920.00 meters
22	23	161°	460.00 meters

From B. P. No. 23 the Boundary line runs in the Western direction to B. P. No. 24 at a bearing of 2742 for a distance of 1540.00 M. along the Northern Boundary of Agrong Forest Village in a close proximity of Betbari Camp. Thence to B. P. No.-25 at a bearing of 1668 for a distance of 2400.00 M. where meets the old Southern Boundary road of N. K. R. F. (Addition) near Khojabari Forest Camp.

Southern- From the terminating point of the Eastern Boundary it runs along the old Agrong Bhuyanpara road South Boundary road of N. K. R. F. (Addition) to bhuyanpara Range office. Thence along the old Southern Boundary road of N. K. R. F. touching at Katajhar Beat and Bhatgali Beat office and going further West upto the Eastern Boundary of Kahitama R.F. Thence along the left bank of Mora Manas where it meets the Southern Boundary of Kahitama R.F. and crosses Mora Manas. Thence along the old Southern Boundary road of Kahitama R.F. Thence it crosses the Jia Manas (Hakua) and runs along the Eastern Boundary of Panbari R.F. where it meets the Southern Boundary of Panbari R. F. Thence along the South Boundary of Panbari R. F. and thence along the Western Boundary of Panbari R. F. to a point on the left bank of Burisuti river.

West- Thence along the left bank of Burisuta river and thence along the right bank of Sukanjan river to the starting point on the Indo-Bhutan B. P. No. 192/3.

Sd/-
A. C. CHANGKAKATI,
Secretary to the Govt. of Assam,
Forest Department.

Appendix- 2
(Gazette Notification of Critical Tiger Habitat)

GOVERNMENT OF ASSAM
ORDERS BY GOVERNOR
The 20th December, 2007

No. FRW.2/2007/17- In exercise of the powers conferred under section 38(V) of Wildlife (Protection) Act. 1972 as amended in 2006, the Governor of Assam is pleased to declare the following areas as Critical Tiger Habitats in the Tiger Reserves of the state of Assam in the interest of Conservation of Tiger.

1. Manas Tiger Reserve:- 840.04 Sq. Km.:-

- A. Manas National Park (500 sq. km) Boundary Description :: As notified vide Govt. Notification No. FRW.55/86/64, dt.7/9/1990.
- B. Bomadi Wildlife Sanctuary (22.21 sq. km.) Boundary Description :: As notified vide Govt. Notification No. GFR.145/42, dt. 25/4/1942.
- C. Daodhara Reserved Forests: (17.49 Sq. km.) Boundary Description :: As notified vide Govt. Notification No. AFR.45/52/59, dt. 27/7/1959.
- D. Manas Reserved Forests (Part) (300.34 sq. km.) Boundary Description :: As notified vide Govt. Notification No. FRW. 1886R, dt. 11/07/1927.

2. Kaziranga Tiger Reserve – 625.58 Sq. Km.:-

- A. Kaziranga National Park :- (430 sq. km.) Boundary Description as notified vide Govt. Notification No. FOR/WL/722/68 dated 11/02/1974.
- B. Kaziranga 1st Addition :- (43.79 sq. km.) Boundary Description as notified vide Govt. Notification No. FRS. 253/90/198, dt. 28/5/1997.
- C. Kaziranga 6th Addition:- (37.60 sq. km.) Boundary Description as notified vide Govt. Notification No.FRS.104/85/289, dt. 7/8/1999.
- D. Laokhowa Wildlife Sanctuary: (70.13 sq. km.) Boundary Description as notified vide Govt. Notification No. 270F, dt. 7/1/1907.
- E. Burachapori Wildlife Sanctuary: (44.06 sq. km.) Boundary Description as notified vide Govt. Notification No. FRW. 31/92/PT/15, dt. 11/7/1995.

3. Nameri Tiger Reserve-200 sq. km.:-

- A. Nameri National Park:- 200 sq.km. Boundary Description as notified vide Govt. Notification no. FRW.11/96/81 dated. 13/8/1998.

By orders.

Sd/-

(B. B. Haqjer, IAS)

Commissioner and Secretary to the Govt. of Assam.
Department of Environment & Forests.

Copy forwarded for information to:-

1. P.S. to Hon'ble Minister, Environment and Forest. He is requested to bring it to the notice of Hon'ble Minister.
2. The principal Chief Conservator of Forest, Assam, Guwahati-8

3. The principal Chief Conservator of Forest, Wildlife and Chief Wildlife Warden, Assam, Guwahati-8
4. All Chief Conservators of Forests, Assam.
5. Concerned Deputy Commissioners of Assam.
6. The member Secretary, National Tiger Conservation Authority, Shahajahan Road, New Delhi-110011.
7. The Director General of Forests & Special Secretary, GOI, Ministry of Environment and Forests, Lodhi Road, New Delhi-110003.
8. The Director General of Police, Assam, Guwahati-7.
9. All Conservator of Forests in Assam.
10. All Divisional Forest officers in Assam.
11. The Superintendent, Government Press. He is requested to publish this notification in the next issue of the Assam Gazette. He is also kindly to send 100 copies of the said notification to the undersigned.

Sd/-
(B. B. Haqjer, IAS)
Commissioner and Secretary to the Govt. of Assam.
Department of Environment & Forests.

Appendix - 3
(Gazette Notification of Manas Tiger Reserve)

GOVERNMENT OF ASSAM
DEPARTMENT OF ENVIRONMENT AND FORESTS
DISPUR ::: GUWAHATI

ORDER BY THE GOVERNOR
NOTIFICATION

Dated Dispur, the 30th May' 08

No. FRW. 25/2008/36 : In exercise of the powers conferred under the sub- section (1) of section 38 (v) of the Wildlife (Protection) Act 1972 (Central Act 53 of 1972) the Governor of Assam on the recommendation of Tiger Conservation Authority hereby declares that the area, the boundaries which are specified in the schedule below, as a tiger reserve.

THE SCHEDULE

The Name of the Project Tiger	: Project Tiger Manas (Manas Wildlife Sactuary along with the reserved forests of Kachugaon, Haltugaon, Chirang and Dhansiri Territorial divisions of BODOLAND TERRITORIAL AREAS DISTRICT AREA along Indo- Bhutan International Boundary.
The Name Of the Districts	: Kokrajhar, Chirang, Bagsa and Udalguri.
Forest Division (S)	: Manas National Park, Orang Wildlife Division, Dhansiri Division, Kachugaon Division, Haltugaon Division and Chirang Division.
Area of the Forest Block	: Manas National Park : 500.00 Sq. km. Borandi Wildlife Sanctuary : 26.22 Sq. km. Reserved Forests : 2310.88 Sq. km.
Total areas = 2837.10 Sq. km.	
Core Area	: 526.22 Sq. km.
Buffer Area	: 2310.88 Sq. km.
Total = 2837.10 Sq. km.	

BOUNDARY DESCRIPTION : From the point where the Sankosh river cuts the Indo-Bhutan International Boundary, eastwards to the point where the tri radiate pillar indicates the Assam, Bhutan and the Arunachal Boundaries. From that point eastward and then westwards along the southern boundaries.

:: 2 ::

of Khalingduar, Barnadi Wildlife, Marapagladiya, Subankhata, Batabari, Dihira, Daodhara Reserve Forests, Manas National Park, Manas Reserve Forest, Bengtol Reserve Forest, Chirang Reserve Forest and Ripu Reserve Forest and Kachugaon Reserve Forest till it meets the Sankosh river downstream.

B. B. Hagjer,
Commissioner & Secretary to the Govt. of Assam,
Environment and Forest Department.

Memo No. FRW. 25/2008/36-A

Dated Dispur, the 30th May' 08.

Copy to :-

1. The P.P.S. to Chief Minister, Assam, Dispur.
2. The P.S. to Minister, Environment and Forests, Assam.
3. The Principal Chief conservator of Forests, Assam, Guwahati- 8.
4. The Principal Chief conservator of Forests (Wildlife), Assam, Guwahati-8.
5. The Director, Kaziranga National Park, Bokakhat.
6. The Director, Manas National Park, Barpeta Road.
7. The Director, Nameri National Park.
8. The Chief Conservator of Forest, Assam.
9. The Conservator of Forests.
10. The Divisional Forest Officer.
11. The Deputy Director, Assam Government Press, Bamunimaidan, Guwahati- 21.

By order etc.

Sd/-
Joint Secretary to the Govt. of Assam,
Environment and Forest Department.

Appendix – 4
(Establishment of Manas Biosphere Reserve)

Notification

Government of India
Paryavaran Bhawan, C.G.O Complex
Ministry of Environment & Forests
Lodhi Road, New Delhi- 110 003

No. 16/2/84-CSC

Dated: 14th March 1989

To,

The Chief Secretary,
Government of Assam, Dispur,
Guwahati

Sub: Establishment of Biosphere Reserve at Manas in Assam.

Sir,

1. The Government of India has identified potential sites for preserving biological diversity with the following broad objectives:-

- Conservation of representative samples of ecosystem;
- Provision of long-term conservation of genetic diversity in situ;
- Promotion of basic and applied research work and its monitoring; and
- Dissemination of experience for education and training.

2. Manas in the State of Assam represent the Burma Monsoon forests biogeographic region. In account with the guidelines on the subject, a project for setting up of a Biosphere Reserve in Manas area was prepared by the Ministry of Environment and Forests based on the report prepared by the Zoological Survey of India.
3. The matter has been considered in detail by the Government of India in consultation with the Government of Assam and it has been decided to set up the Biosphere Reserve in the Manas area. The Biosphere Reserve will be deemed to have come into being with effect from 14.3. 1999.
4. The total area of the Biosphere Reserve is about 2,837km² i.e., the existing Manas Tiger Reserve. The boundary and zonation into core and buffer zones of the Biosphere Reserve are given at annexure I. The details of the area to be earmarked for the manipulation activities such as forestry, agriculture, eco-representation, agro forestry, etc., will be worked out by the project authorities.

Annexure- I: Zonation - Manas Biosphere Reserve
General description and the boundary:-

The Manas Biosphere Reserve will cover an area of 2,837km² in the State of Assam along with international boundary between India and Bhutan. The area runs along the Indo-

Bhutan international boundary connecting rivers Sankosh and Dhansiri in the west and east respectively, in the Darrang district of Assam. The area lies, between the longitudes 90° 30' to 91° 15' E and latitudes 25° 45' to 26° 50' N.

Zonation:-

Core Zone:- The Manas Biosphere Reserve will have a core zone of 391 km² i.e., the core of the existing Manas Tiger Reserve.

Buffer Zone:- The remaining area, i.e., 2,446 km² will serve as buffer Zone of the Biosphere Reserve.

5. The following will be important aspect of the Manas Biosphere Reserve:

a) The core and the buffer areas and manipulation activities which may be permitted in the buffer Zone will be in conformity with the general guidelines for biosphere reserve and will be determined accordingly by the Management Council. A detailed map will subsequently be submitted by the Government of Assam.

b) The core zone of the Biosphere Reserve will be kept absolutely undisturbed. The Biosphere Reserve by itself will not affect the rights of the tribal or other people of the area.

c) The constitution of the Biosphere Reserve by itself will not, in any way, change the status of legal ownership of the land and forests.

d) There will be a Biosphere Reserve Management Council with the composition given in Annexure-II.

Annexure II: Management Council of Manas Biosphere Reserve

1. Chief Secretary, Government of Assam	: Chairman
2. Joint Secretary (Wildlife), Ministry of Environment & Forests	: Member
3. Joint Secretary & Financial Adviser, Ministry of Environment & Forests	: Member
4. Director- In charge of Biosphere Reserves Programme, Ministry of Environment & Forests	: Member
5. Secretary to the Government of Assam, Forest Department	: Member
6. Chief Conservator of Forests, Government of Assam	: Member
7. Director of Manas Biosphere Reserve	: Member convener
8. Representative of Botanical Survey of India	: Member
9. Representative of Zoological Survey of India	: Member

e) The Government of India will provide financial assistance for approved items of expenditure included in the Action and Management Plan be prepared by the Government of Assam. This may be come under following heads:-

- Survey
- Conservation
- Protection
- Ecorestoration
- Education & awareness

f) There will be a Research Committee as per composition shown in Annexure-III.

Annexure III: Composition of Research Committee on Manas Biosphere Reserve

1.	Chief Wildlife Warden, Government of Aassam	:	Member convener
2.	Director, Zoological Survey of India	:	Member
3.	Representative of Guwahati University	:	Member
4.	Field Director, Manas Biosphere Reserve	:	Member
5.	Director, Botanical Survey of India	:	Member
6.	Representative of Ministry of Environment & Forests	:	Member
7.	Director, Wildlife Institute of India, Dehradun	:	Member

g) The subjects of research and the institutions identified for the purpose are shown in Annexure-IV. There may be additions and alterations in the list, when necessary.

Annexure- IV: List of Research Institutions and priority areas identified for undertaking research in Manas Biosphere Reserve area

INSTITUTIONS		Priority Areas	
1	Regional Center of Botanical Survey of India	:	Floral inventories
2.	Regional Center, Zoological Survey of India	:	Faunal inventories
3.	Guwahati University	:	Ecological studies
4.	Wildlife Institute of India	:	Study on Wildlife
5.	Central Water Commission	:	Hydrological Studies
6.	Regional Center of Indian council of Agricultural Research	:	Problem connected with land use specialty agriculture

h. The Government of Assam will set up a local Committee for coordination of the activities of the various Departments in the Biosphere Reserve area.

i) The Government of Assam will nominate an Officer as Director of the Biosphere Reserve. He may be an existing functionary who may not necessarily be an exclusive functionary for this purpose.

Yours faithfully,

(K. P. Geethakrishnan)
Secretary to The Government of India

Encl: As stated

Copy to:-

1. The Secretary, Planning Commission, Yojana Bhavan, New Delhi.
2. Chief (Science), Planning Commission, Yojana Bhavan, New Delhi.
3. Secretary, Department of Forests, Government of Assam, Dispur, Guwahati.
4. Secretary, Department of Environment, Govt. of Assam, Dispur, Guwahati.
5. Chief Conservator of Forests, Govt. of Assam, Dispur, Guwahati, Assam.
6. Chief Wildlife Warden, Govt. of Assam, Dispur, Guwahati.

(K. P. Geethakrishnan)
Secretary to The Government of India

Appendix – 5

Notification regarding constitution of “State Level Steering Committee” for the Biosphere Reserves of Assam

**GOVERNMENT OF ASSAM
FOREST DEPARTMENT:: DISPUR**

**ORDERS BY THE GOVERNOR
NOTIFICATION**

Dated Dispur, the 3rd November, 1999

No. FRW.53/97/Pt.I/44: For smooth functioning and in pursuance of Govt. of India’s guidelines, the Governor of Assam is pleased to constitute the “State Level Steering Committee” for the Biosphere Reserves of Assam with the following members:

1. Chief Secretary	: Chairman.
2. Commissioner & Secretary, Forest Department	: Member.
3. Principal Chief Conservator of Forest	: Member.
4. Representative of Ministry of Environment & Forests, Government of India	: Member.
5. Representative of Z.S.I. (Zoological Survey of India)	: Member.
6. Representative of B.S.I. (Botanical Survey of India)	: Member.
7. Commissioner, Upper Assam Division, Jorhat	: Member.
8. Commissioner, Lower Assam Division, Guwahati	: Member.
9. Deputy Commissioner, Tinsukia	: Member.
10. Deputy Commissioner, Dibrugarh	: Member.
11. Deputy Commissioner, Barpeta	: Member.
12. Deputy Commissioner, Bongaigaon	: Member.
13. Director, Panchayat & Rural Development, Assam	: Member.
14. Chief Conservator of Forests (Wildlife)	: Member Secretary.

The following will be permanent special invitee:-

1. Field Director, Manas Tiger Project, Barpeta Road.
2. Divisional Forest Officer (Wildlife), Tinsukia.

In addition, officials from Department & Works P.H.E., P.W.D., etc. may also be invited as necessary.

The committee will advise on policy and programme formulation for Biosphere Reserve Programme in the State.

- Advise on policy/programs for the Biosphere Reserves.
- Lay down guidelines for the preparation of the Management Action Plan for the Biosphere Reserve.
- Approve the Management Action Plans.
- Oversee the implementation of the Management Action Plan including monitoring and evaluation.
- Suggest priority areas for management and Scientific Research evaluation of Research proposals for funding, monitoring of the progress of Scientific Research and integration of Scientific findings with the management activities.
- Develop criteria for selecting new sites for Biosphere Reserves.
- Approve and recommend the Govt. of India proposals for setting up of new Biosphere Reserves.
- Carry out any other function/activity which may be necessary from time to time under the Biosphere Reserves proposal.

The Committee should sit at least once a year.

Sd/- A. Jain
Commissioner & secretary
to the Govt. of Assam
Forest Department, Dispur.

Appendix - 6

(Notification regarding constitution of “Local Committee” for the two Biosphere Reserves of Assam namely Manas and Dibru-Saikhowa)

GOVERNMENT OF ASSAM FOREST DEPARTMENT:: DISPUR

ORDERS BY THE GOVERNOR NOTIFICATION

Dated Dispur, the 23rd August, 1999

No. FRW. 53/97/Pt.I/33: For smooth functioning and in pursuance of Govt. of India’s guidelines, the Governor of Assam is pleased to constitute the “Local Committee” for the two Biosphere Reserves of Assam namely Manas and Dibru-Saikhowa, with the following members:

MANAS BIOSPHERE RESERVE:

1. Field Director, Project Tiger &
Director of Biosphere Reserves : Chairman.
2. Representative of Deputy Commissioner,
Barpeta/Bongaigaon : Member.
3. Senior BDOs of Dev. Blocks having contiguous
border with the reserves in Barpeta / Bongaigaon
districts : Member.
4. The presidents of Gaon Panchayats
having contiguous border with the reserve in
Barpeta/Bongaigaon districts. Their number
should not exceed 5 and this should be rotated annually : Member.
5. The Gaon Burahas of Forest Villages, if any
their number should not exceed 3 and should
be rotated annually : Member.
6. Representatives of two local
Non-Government Organization : Member.
7. Deputy Director, Manas Tiger Reserve : Member Secretary.

The following may be invited as Special Invitees depending upon requirements:

1. District Agriculture Officer, Barpeta/ Bongaigaon.
2. District Veterinary Officer, Barpeta/ Bongaigaon.
3. District Fishery Officer, Barpeta/ Bongaigaon.
4. District Elementary Education Officer Barpeta/ Bongaigaon.
5. Executive Engineer, PWD, Barpeta/ Bongaigaon.

6. Executive Engineer, PHE, Barpeta/ Bongaigaon.

7. D.F.O. Social Forestry, Barpeta/ Bongaigaon.

The Local Committee will,

- (1) Select the villages for eco-development works which could be ultimately defined as “Eco-development Zone.
- (2) Select and prioritize schemes and beneficiaries.
- (3) Oversee the implementation of the scheme, and
- (4) Create awareness in the fringe areas.

The committee should sit at least 3 times a year.

Sd/- A. Jain
Commissioner & Secretary
to the Govt. of Assam
Forest Department, Dispur.

Appendix – 7

(Notification of Chirang-Ripu Elephant Reserve)

THE ASSAM GAZETTE
EXTRA ORDINARY

PUBLISHED BY AUTHORITY

No. 42 Dispur, Monday, 10th March, 2003, 19th Phalguna, 1924 (S.E.)

GOVERNMENT OF ASSAM
ORDER BY THE GOVERNOR
ENVIRONMENT OF DEPARTMENT FORESTS :::: DISPUR

NOTIFICATION

The 6th March, 2003

No. FRW-44/2002/47. In pursuance of the guidelines of the 'Project Elephant', Government of India, and in view of the consent of the Government of India conveyed vide F. No. 7-2/00 (PE) – (iii) dated July 13, 2002, the Governor of Assam is pleased to declared the land described in the schedules below as an 'Elephant Reserve'

SCHEDULES

A. LOCATION, Area, etc.

District (civil)..... Barpeta, Bongaigaon, Darrang, Kamrup, Kokrajhar and Nalbari.

Sub-division(civil)..... Bajali, Barpeta, Bongaigaon, Gossaigaon, Kokrajhar, Mangaldoi, Nalbari, Rangiya and Udalguri.

Forest Division..... Aie Valley, Darrang, Haltugaon, Kachugaon, Manas Project Tiger, Mangaldoi Wildlife and North Kamrup.

Name..... CHIRANG-RIPU ELEPHANT RESERVE

Area..... 2600 sq. km.

306 THE ASSAM GAZETTE, EXTRAORDINARY, MARCH 10, 2003

B. Boundary/Area description

North: From the left bank of the Sankosh river, on the Indo-Bhutan international Boundary Pillar No. 117, the boundary runs eastwards along the international boundary till it reaches the left bank of the river Pagladiya, i.e., the northernmost point of Subankhata RF (RF=reserve forest)

- East: From the junction of the left bank of the Pagladiya river and the international Boundary, it runs along the left bank of the river down stream till it touches the south eastern corner of the notified Subankhata RF.
- South: Thence the boundary runs along the southern notified boundary of Subankhata RF, Dihira RF, Batabari RF, Deodhara RF, kokilabari RF, Manas National Park, Manas RF, Sissobari RF, Teklai RF, Bengtol RF (also the eastern and western boundaries of the last three RFs), Chirang RF, Ripu RF and Kachugaon RF till it touches the left bank of the Sankosh river.
- West: Thence from this point the boundary runs along the left bank of the Sankosh river upstream till it meets the boundary Pillar No. 117 at indo-Bhutan international boundary.

In addition to the area described above, the 'CHIRANG-RIPU ELEPHANT RESERVE' also includes four other disjunct areas, the largest of which comprises of contiguous forests in Barnodi Wildlife Sanctuary, Khalingduar RF and Neoli proposed RF. This area along with two other disjunct pockets, i.e. Darranga RF and Bhairabkunda RF (part, i.e., the area falling towards west of the Dhansiri river) have contiguity with the remaining reserve through forests inside Bhutan. The fourth disjunct pocket forming part of 'Elephant Reserve' is Mora Pagladiya RF.

DR. ANWARUDDIN CHOUDHURY
Joint Secretary to the Government of Assam
Environment & Forest Department, Dispur.

Appendix - 8

A checklist of Flora of Manas

Sl. No.	Scientific name	Status	Family
Dicotyledons			
1	<i>Clematis gouriana</i> Roxb.	Sc	Ranunculaceae
2	<i>Dillenia indica</i> L.	C	Dilleniaceae
3	<i>Dillenia pentagyna</i> Roxb.	C	Dilleniaceae
4	<i>Magnolia pterocarpa</i> Roxb.	R	Magnoliaceae
5	<i>Michelia champaca</i> L.	Sc	Magnoliaceae
6	<i>Polyalthia simiarum</i> (Hook. F. et Thunb.) Hook. F. Thunb.	R	Annonaceae
7	<i>Parabaena sagittata</i> (Ham.) Miers.	Un	Menispermaceae
8	<i>Stephania japonica</i> (Thunb) Miers.	R	Menispermaceae
9	<i>Nymphaea nouchali</i> Burm. f.	C	Nymphaeaceae
10	<i>Argemone maxicana</i> L.	C	Papaveraceae
11	<i>Rorippa indica</i> (L.) Hiern.	Un	Brassicaceae
12	<i>Xylosma longifolia</i> Clos.	Un	Brassicaceae
13	<i>Cleome scaposa</i> D.C.	Sc	Capparidaceae
14	<i>Cleome spinosa</i> L.	Sc	Capparidaceae
15	<i>Cleome viscosa</i> Linn	C	Capparidaceae
16	<i>Crateva religiosa</i> Forst.	R	Capparaceae
17	<i>Drymeria cordata</i> Willd.	Un	Caryophyllaceae
18	<i>Polycarpon prostratum</i> (Frossk.) Asch. & Schweinf.	Un	Caryophyllaceae
19	<i>Stelaria media</i> L.	C	Caryophyllaceae
20	<i>Casearia vareca</i> Roxb.	C	Flacourtiaceae
21	<i>Polygonum arvensis</i> Willd.	C	Polygalaceae
22	<i>Portulaca oleraceae</i> L.	Un	Portulacaceae
23	<i>Tamarix dioica</i> Roxb.	Sc	Tamaricaceae
24	<i>Mesua ferrea</i> Roxb.	R	Guttiferae
25	<i>Bombax ceiba</i> L.	C	Bombacaceae
26	<i>Abelmoschus manihot</i> (L.) Madicus	Un	Malvaceae
27	<i>Kydia calycina</i> Roxb.	R	Malvaceae
28	<i>Pterospermum acerifolium</i> Willd.	C	Malvaceae
29	<i>Sida acuta</i>	C	Malvaceae
30	<i>Sida cordata</i> (N. Burmen) Borssum.	C	Malvaceae
31	<i>Sida cordifolia</i> L.	C	Malvaceae
32	<i>Sida rhombifolia</i> L.	C	Malvaceae
33	<i>Urena lobata</i> L.	C	Malvaceae
34	<i>Abroma augusta</i> (L.) L. f.	Un	Sterculiaceae
35	<i>Sterculia villosa</i> Roxb.	C	Sterculiaceae
36	<i>Cannabis sativa</i> L.	C	Tiliaceae
37	<i>Corchorus aestuans</i> L.	R	Tiliaceae
38	<i>Grewia sapida</i> Roxb.	C	Tiliaceae
39	<i>Grewia serrulata</i> DC.	Sc	Tiliaceae
40	<i>Triumfetta rhomboidea</i> Jacq.	Sc	Tiliaceae
41	<i>Sloanea sterculiacea</i> Var. <i>assamica</i> (Benth.) Coode.	Un	Elaeocarpaceae
42	<i>Linum usitatissimum</i> L.	Sc	Linaceae
43	<i>Reinwardtia indica</i> Dumort.	En	Linaceae

44	<i>Oxalis corniculatus</i> L.	C	Oxalidaceae
45	<i>Oxalis cordata</i> DC.	C	Oxalidaceae
46	<i>Biophytum reinwardtii</i> (Zucc.) Klotz.	C	Geraniaceae
47	<i>Biophytum sensitivum</i> (L.) DC.	C	Geraniaceae
48	<i>Impatiens tripetala</i> Roxb.	C	Balsaminaceae
49	<i>Impatiens trilobata</i> DC.	C	Balsaminaceae
50	<i>Glycosmis arborea</i> (Roxb.) DC.	C	Rutaceae
51	<i>Micromelum mintum</i> (Forst.f.) W.A.	Un	Rutaceae
52	<i>Murraya koenigii</i> Spreng.	C	Rutaceae
53	<i>Murraya paniculata</i> (L.) Hack.	Sc	Rutaceae
54	<i>Garuga floribunda</i> Decn. Var. <i>gamblei</i> (King ex Smith) Kalk.	R	<i>Burseraceae</i>
55	<i>Aphanamixis polystachya</i> (Wall.) Parker.	Sc	Meliaceae
56	<i>Chukrasia tabularis</i> A. Juss.	R	Meliaceae
57	<i>Dysoxylum binectiferum</i> Hk.f. et Bedd.	Sc	Meliaceae
58	<i>Azadirachta indica</i> A. Juss.	Sc	Meliaceae
59	<i>Toona ciliata</i> Roem.	C	Meliaceae
60	<i>Olex nana</i> Wall. Ex Benth.	Sc	Olcaceae
61	<i>Ziziphus mauritiana</i> Lamk.	Sc	Rhamnaceae
62	<i>Ziziphus rugosus</i> L.	Sc	Rhamnaceae
63	<i>Cayratia pedata</i> (Lour.) A. L. Juss. Ex Gagnep.	Sc	Vitaceae
64	<i>Cayratia trifolia</i> (L.) Domin.	Sc	Vitaceae
65	<i>Vitis barbata</i> Wall.	Sc	Vitaceae
66	<i>Ampelocissus barbata</i> (Wall.) Planch.	Un	Vitaceae
67	<i>Cissus assamica</i> (Lows.) Craib.	R	Vitaceae
68	<i>Cissus rependa</i> Vahl.	R	Vitaceae
69	<i>Cissus adnata</i> Roxb.	Sc	Vitaceae
70	<i>Tetrastigma leucostaphylum</i> (Dennst.) Balak.	Un	Vitaceae
71	<i>Leea aequata</i> L.	C	Leeaceae
72	<i>Leea alata</i> Edgew.	C	Leeaceae
73	<i>Leea asiatica</i> (L.) Ridsdale.	C	Leeaceae
74	<i>Lepisanthes senegalensis</i> (Poir.) Lunhouts.	Un	Sapindaceae
75	<i>Cardiospermum helicacabum</i> Linn.	Sc	Sapindaceae
76	<i>Asculus assamica</i> Griff.	Sc	Hippocastanaceae
77	<i>Mangifera indica</i> L.	Sc	Anacardiaceae
78	<i>Mangifera sylvatica</i> Roxb.	R	Anacardiaceae
79	<i>Pegia nitida</i> Colebr.	C	Anacardiaceae
80	<i>Moringa oleifera</i> Lamk.	C	Moringaceae
81	<i>Atylosia scarabaeoidea</i> (L.) Benth.	Un	Papilionaceae
82	<i>Atylosia goensis</i> (Dalz.) Dalz.	Un	Papilionaceae
83	<i>Butea monosperma</i> (Lam.) Taub.	C	Papilionaceae
84	<i>Butea parviflora</i> Roxb.	C	Papilionaceae
85	<i>Crotolaria albida</i> Heyne ex Roth.	C	Papilionaceae
86	<i>Crotolaria juncea</i> Linn.	C	Papilionaceae
87	<i>Crotolaria pallida</i> Ait.	Sc	Papilionaceae
88	<i>Crotolaria sessiliflora</i> L.	C	Papilionaceae
89	<i>Dalbergia sissoo</i> Roxb.	C	Papilionaceae
90	<i>Derris indica</i> (Lamk.) Bennet.	C	Papilionaceae
91	<i>Desmodium gangeticum</i> (L.) Dec. prod.	C	Papilionaceae

92	<i>Desmodium griffithianum</i> Benth.	R	Papilionaceae
93	<i>Desmodium velutinum</i> (Willd.) D C.	R	Papilionaceae
94	<i>Desmodium laxiflorum</i> L.	C	Papilionaceae
95	<i>Desmodium polycarpon</i> D.C.	C	Papilionaceae
96	<i>Desmodium triangularae</i> (Retz.) Mor.	C	Papilionaceae
97	<i>Desmodium triquetrum</i> D C. Subsp. <i>Pseudotriquetrum</i> (Schin.) Prain.	Un	Papilionaceae
98	<i>Desmodium triflorum</i> D C.	C	Papilionaceae
99	<i>Flemingia macrophylla</i> (Willd.) Prain ex Merrill	C	Papilionaceae
100	<i>Flemingia strobilifera</i> (L.) R. Br.	C	Papilionaceae
101	<i>Mucuna pruriens</i> (L.) DC. Prodr.	R	Papilionaceae
102	<i>Pueraria subspicata</i> Benth.	C	Papilionaceae
103	<i>Tephrosia candida</i> (Roxb.) DC. Prodr.	C	Papilionaceae
104	<i>Uraria picta</i> (Jacq.) Desv.	C	Papilionaceae
105	<i>Uraria rufescens</i> (DC) Schindl.	C	Papilionaceae
106	<i>Vigna trilobata</i> (L.) Verd.	C	Papilionaceae
107	<i>Bauhinia acuminata</i> L.	C	Caesalpiniaceae
108	<i>Bauhinia purpurea</i> L.	C	Caesalpiniaceae
109	<i>Bauhinia scandens</i> L. var. <i>horsfieldii</i> Miq. Ohashi	R	Caesalpiniaceae
110	<i>Bauhinia variagata</i> L.	Sc	Caesalpiniaceae
111	<i>Cassia alata</i> .	Sc	Caesalpiniaceae
112	<i>Cassia fistula</i> L.	Sc	Caesalpiniaceae
113	<i>Cassia occidentalis</i> Linn.	C	Caesalpiniaceae
114	<i>Cassia mimosoides</i> L.	C	Caesalpiniaceae
115	<i>Cassia siama</i> L.	C	Caesalpiniaceae
116	<i>Cassia sophera</i> L.	C	Caesalpiniaceae
117	<i>Cassia tora</i> L.	C	Caesalpiniaceae
118	<i>Acacia catechu</i> (L. f.) Willd.	Sc	Mimosaceae
119	<i>Albizia odoratissima</i> (L. f.) Benth.	C	Mimosaceae
120	<i>Albizia procera</i> (Roxb.) Benth.	C	Mimosaceae
121	<i>Entada pursaetha</i> DC.	Sc	Mimosaceae
122	<i>Mimosa himalayana</i> Gamble.	C	Mimosaceae
123	<i>Mimosa pudica</i> L.	C	Mimosaceae
124	<i>Duchesnea indica</i> (Andr.) Focke	Un	Rosaceae
125	<i>Terminalia belerica</i> (Gaertn.) Roxb.	C	Combretaceae
126	<i>Terminalia arjuna</i> (DC.) Wight et Arn.	R	Combretaceae
127	<i>Terminalia chebula</i> (Gaertn.) Retz.	C	Combretaceae
128	<i>Syzigium cumini</i> (L.) Skeets.	C	Myrtaceae
129	<i>Syzigium formosum</i> (Wall.) Masamune	Sc	Myrtaceae
130	<i>Syzigium oblatum</i> (Roxb.) Wall. Ex A.M.N. & J. M. Cowan.	Sc	Myrtaceae
131	<i>Careya arborea</i> Roxb.	C	Baringtoniaceae
132	<i>Melastoma malabathricum</i> L.	C	Melastomaceae
133	<i>Osbeckia nepalensis</i> H. K. F.	C	Melastomaceae
134	<i>Osbeckia nutans</i> Train in Trans.	Sc	Melastomaceae
135	<i>Cuphea balsaminea</i> .	Sc	Lythraceae
136	<i>Duabanga grandiflora</i> (Roxb. Ex DC.) Walp.	C	Lythraceae
137	<i>Lagerstroemia parviflora</i> Roxb.	C	Lythraceae
138	<i>Lagerstroemia flos-reginae</i> Roxb.	Sc	Lythraceae
139	<i>Woodfordia fruticosa</i> (L.) Kurz.	R	Lythraceae

140	<i>Ludwigia adscendens</i> Hara.	Un	Onagraceae
141	<i>Ludwigia octovalvis</i> (N. Jacq.) Raven ssp. <i>Sessiliflora</i> (Michali) Raven.	Un	Onagraceae
142	<i>Fissendocarpa linifolia</i> (Vahl.) Bennet	Un	Onagraceae
143	<i>Trapa natans</i> L. var. <i>bispinosa</i> (Roxb.) Makind.	C	Trapaceae
144	<i>Gymnopetalum cochiniensis</i> (Lour.) Kurz.	Un	Cucurbitaceae
145	<i>Luffa aegyptiaca</i> Mill.	Un	Cucurbitaceae
146	<i>Momordica charantia</i> L. Roxb.	Sc	Cucurbitaceae
147	<i>Momordica dioica</i> Roxb.	Sc	Cucurbitaceae
148	<i>Mukia maderaspatana</i> (L.) Roemer.	C	Cucurbitaceae
149	<i>Trichosanthes tricaspidata</i> Lour.	Un	Cucurbitaceae
150	<i>Oenanthe benghalensis</i> DC.	Un	Apiaceae
151	<i>Oenanthe javanica</i> (Bl.) DC.	Un	Apiaceae
152	<i>Anthocephalus chinensis</i> (Lamk.) Rich. Ex Walp.	Sc	Rubiaceae
153	<i>Borreria hispida</i> K. schum.	C	Rubiaceae
154	<i>Coffea bengalensis</i> Wall ex Roxb.	C	Rubiaceae
155	<i>Hedyotis coronaria</i> Craib.	Sc	Rubiaceae
156	<i>Hedyotis costata</i> L.	Sc	Rubiaceae
157	<i>Hedyotis scandens</i> D. Don.	C	Rubiaceae
158	<i>Ixora acuminata</i> Roxb.	R	Rubiaceae
159	<i>Mussaenda roxburghii</i> Hook.f.	Sc	Rubiaceae
160	<i>Hedyotis corymbosa</i> (L.) Lamk.	Sc	Rubiaceae
161	<i>Paederia scandens</i> (Lour.) Merril.	Sc	Rubiaceae
162	<i>Ageratum conyzoides</i> L.	C	Asteraceae
163	<i>Biden biternata</i> (Lour.) Mers. And Sherff.	C	Asteraceae
164	<i>Chromolaena odorata</i> (L.) King.	C	Asteraceae
165	<i>Crassosaphlum crepidiodes</i> (Benth.) S.Moore	Un	Asteraceae
166	<i>Eclipta alba</i> Hassk.	C	Asteraceae
167	<i>Elephantopus scabar</i> Linn.	Sc	Asteraceae
168	<i>Emilia sonchifolia</i> (L.) DC.	Un	Asteraceae
169	<i>Eupatorium cannabinum</i> L.	R	Asteraceae
170	<i>Gnaphalium leuto-album</i> L.	Un	Asteraceae
171	<i>Mikania micrantha</i> HBK.	Un	Asteraceae
172	<i>Parthenium hysterophorus</i> L.	R	Asteraceae
173	<i>Senecio sisymbriiformis</i> DC	C	Asteraceae
174	<i>Senecio latiligulatus</i> Balak.	C	Asteraceae
175	<i>Sonchus asper</i> Vill.	C	Asteraceae
176	<i>Spilanthus clava</i> D.C.	C	Asteraceae
177	<i>Synedrella nodiflora</i> Linn.	C	Asteraceae
178	<i>Tithonia diversifolia</i> L.	R	Asteraceae
179	<i>Tridax procumbens</i> L.	C	Asteraceae
180	<i>Vernonia cineria</i> var. <i>cineria</i>	C	Asteraceae
181	<i>vernonia cineria</i> var. <i>linifolia</i> (Bl.) Koster.	C	Asteraceae
182	<i>Mesua indica</i> Wall.	Sc	Myrsinaceae
183	<i>Alstonia scholaris</i> Brown.	Sc	Apocynaceae
184	<i>Holarrhena antidysenterica</i> (L.) Wall. Ex A.DC.	R	Apocynaceae
185	<i>Rauvolfia densiflora</i> L.	R	Apocynaceae
186	<i>Rauvolfia serpentina</i> (L.) Benth. ex Kurz.	Sc	Apocynaceae
187	<i>Tabernaemontana divericata</i> .	C	Apocynaceae

188	<i>Wrightia arborea</i> (Dennst.) Mabb.	Sc	Apocynaceae
189	<i>Calotropis acia</i> Buch-Ham.	C	Asclepiadaceae
190	<i>Budleja asiatica</i> Lour.	Sc	Loganiaceae
191	<i>Hydrolea zeylanica</i> (L.) Vahl.	C	Hydrophyllaceae
192	<i>Nymphoides cristata</i> (Roxb.) O.Ktze.	C	Menyanthaceae
193	<i>Cynoglossum zeylanicum</i> Thunb. Ex Lehm.	Sc	Boraginaceae
194	<i>Heliotropium indicum</i> L.	Sc	Boraginaceae
195	<i>Argyreia argentia</i> Arm. Ex choisy	C	Convolvulaceae
196	<i>Argyreia nervosa</i> (Burm. f.) Boj.	C	Convolvulaceae
197	<i>Argyreia roxburghii</i> Choisy.	C	Convolvulaceae
198	<i>Cuscuta reflexa</i> Roxb.	Sc	Convolvulaceae
199	<i>Evolvulus nummularius</i> Linn.	C	Convolvulaceae
200	<i>Ipomoea aquatica</i> Forsk.	C	Convolvulaceae
201	<i>Ipomea quamoclit</i> Linn.	Sc	Convolvulaceae
202	<i>Merremia umbellata</i> (L.) Hall.f.	Sc	Convolvulaceae
203	<i>Merremia vitifolia</i> (Burm. f.) Hall.f.	Sc	Convolvulaceae
204	<i>Capsicum annuum</i> L.	En	Solanaceae
205	<i>Datura fastuosa</i> *	Sc	Solanaceae
206	<i>Physalis minima</i> L.	C	Solanaceae
207	<i>Solanum myriacanthus</i> Duss.	Sc	Solanaceae
208	<i>Solanum nigrum</i> L.	C	Solanaceae
209	<i>Solanum torvum</i> SW.	C	Solanaceae
210	<i>Solanum xanthocarpum</i> Sch & Wendl.	C	Solanaceae
211	<i>Lindernia crustacea</i> (L.) Muell.	C	Scrophulariaceae
212	<i>Lindernia ruelloides</i> (Colsm.) Mukherjee.	C	Scrophulariaceae
213	<i>Limnophila sessiliflora</i> (Vahl.) Bl. Bijdr.	C	Scrophulariaceae
214	<i>Mazus pumilus</i> (Burm.f.) Steenis.	C	Scrophulariaceae
215	<i>Mecardonia procumbens</i> (Miller) Small.	C	Scrophulariaceae
216	<i>Scoparia dulcis</i> L.	C	Scrophulariaceae
217	<i>Torenia diffusa</i> .	C	Scrophulariaceae
218	<i>Torenia vagans</i> Roxb.	C	Scrophulariaceae
219	<i>Utricularia aurea</i> Lour.	Sc	Utriculariaceae
220	<i>Oroxylum indicum</i> (L.) Vent.	Sc	Bignoniaceae
221	<i>Stereospermum chelonoides</i> DC.	Sc	Bignoniaceae
222	<i>Thunbergia fragrans</i> Roxb.	Sc	Thunbergiaceae
223	<i>Thunbergia grandiflora</i> Roxb.	C	Thunbergiaceae
224	<i>Justicia adhatoda</i> L.	C	Acanthaceae
225	<i>Andrographis paniculata</i> Nees.	C	Acanthaceae
226	<i>Barleria cristata</i> L.	C	Acanthaceae
227	<i>Dicliptera roxburghiana</i> Nees.	C	Acanthaceae
228	<i>Eranthemum nervosum</i> (Vahl.) R. Br.	Un	Acanthaceae
229	<i>Eranthemum scabrum</i> Wall. ex T. And.	Un	Acanthaceae
230	<i>Justicia simplex</i> D. Don.	C	Acanthaceae
231	<i>Lepidogathis incurva</i> Buch-Ham ex. D. Don.	C	Acanthaceae
232	<i>Phlogocanthus carviflorus</i> Nees	C	Acanthaceae
233	<i>Phlogocanthus thyrsoformis</i> (Hardw.) Mabb.	C	Acanthaceae
234	<i>Rungia parviflora</i> (Retz.) Nees.	C	Acanthaceae
235	<i>Callicarpa arborea</i> Roxb.	C	Verbenaceae
236	<i>Callicarpa macrophylla</i> Vahl	C	Verbenaceae

237	<i>Clerodendrum indicum</i> (L.) O.Ktze.	C	Verbenaceae
238	<i>Clerodendrum serratum</i> (L.) Spreng.	C	Verbenaceae
239	<i>Clerodendrum viscosum</i> Vent.	C	Verbenaceae
240	<i>Gmelina arborea</i> Roxb.	C	Verbenaceae
241	<i>Holmskioldea sanguinea</i> Retz.	C	Verbenaceae
242	<i>Lantana camera</i> Linn.	C	Verbenaceae
243	<i>Phyla nodiflora</i> (L.) Greene	C	Verbenaceae
244	<i>Pygmaeopremna herbaceae</i> (Roxb.) Moldenke	C	Verbenaceae
245	<i>Premna latifolia</i> Roxb.	C	Verbenaceae
246	<i>Premna bengalensis</i> Cl.	C	Verbenaceae
247	<i>Vitex negundo</i> Linn.	C	Verbenaceae
248	<i>Anisomeles indica</i> (L.) O. Ktze.	C	Lamiaceae
249	<i>Hyptis suaveolens</i> (L.) Poit.	C	Lamiaceae
250	<i>Leucas indica</i> (L.) E.Br. Ex Vatke.	Sc	Lamiaceae
251	<i>Ocimum sanctum</i> L.	Sc	Lamiaceae
252	<i>Plectranthus ternifolius</i> Don.	C	Lamiaceae
253	<i>Pogostemon auricularius</i> (L.) Hassk.	Un	Lamiaceae
254	<i>Boerhavia diffusa</i> L.	C	Nyctaginaceae
255	<i>Aerva sanguinolenta</i> (L.) Bl.	C	Amaranthaceae
256	<i>Achyranthus aspera</i> Linn.	C	Amaranthaceae
257	<i>Achyranthus prophyristochyo</i> Wall.	C	Amaranthaceae
258	<i>Alternanthera sessilis</i> (L.) DC.	C	Amaranthaceae
259	<i>Alternanthera phylloxeroides</i> .	C	Amaranthaceae
260	<i>Amaranthus graecizans</i> L. ssp. <i>Thellungianus</i> (Nevski) Gurev.	C	Amaranthaceae
261	<i>Amaranthus spinosus</i> L.	C	Amaranthaceae
262	<i>Amaranthus viridis</i> L.	C	Amaranthaceae
263	<i>Amaranthus gracillis</i> Desf.	C	Amaranthaceae
264	<i>Cyathula prostrata</i> (L.) Br. Bijdr.	Un	Amaranthaceae
265	<i>Celosia argentia</i> L.	C	Amaranthaceae
266	<i>Diringia amaranthoides</i> (Lamk.) Merr.	C	Amaranthaceae
267	<i>Polygonum barbatum</i> L.	C	Polygonaceae
268	<i>Polygonum capitatum</i> L.	C	Polygonaceae
269	<i>Polygonum chinensis</i> L.	C	Polygonaceae
270	<i>Polygonum hydropiper</i> L.	C	Polygonaceae
271	<i>Polygonum strigosum</i> R.Br.	Sc	Polygonaceae
272	<i>Houttuania cordata</i> Linn.	Sc	Piperaceae
273	<i>Peperomia pellucida</i> H.B.K.	Sc	Piperaceae
274	<i>Piper longum</i> L.	Sc	Piperaceae
275	<i>Piper mullesua</i> D. Don.	Sc	Piperaceae
276	<i>Actinidaphne obovata</i> (Nees.) Bl. Mus	Sc	Lauraceae
277	<i>Cinnamomum obtusifolia</i> Roxb. Ex Ness.	Sc	Lauraceae
278	<i>Cinnamomum zeylanica</i> .	Sc	Lauraceae
279	<i>Litsea glutinosa</i> (Lour.) C.B. Robins.	Sc	Lauraceae
280	<i>Litsea monopetala</i> (Roxb.) pers.	Sc	Lauraceae
281	<i>Litsea salicifolia</i> (Nees) Hook. f.	C	Lauraceae
282	<i>Cryptocarya amygdalina</i> Nees.	C	Lauraceae
283	<i>Machilus villosa</i> Hook. F.	C	Lauraceae
284	<i>Elaeagnus pyriformis</i> Hook. F.	C	Elaeagnaceae
285	<i>Elaeagnus caudata</i> Schlecht. Ex Momoyama	C	Elaeagnaceae

286	<i>Macrosolen cochinchinensis</i> (Lour.) Van Tiegh.	C	Loranthaceae
287	<i>Bischofia javanica</i> Bl. Bijdr.	C	Euphorbiaceae
288	<i>Bridellia retusa</i> Spreng.	C	Euphorbiaceae
289	<i>Bridellia stipularis</i> (L.) Bijdr.	C	Euphorbiaceae
290	<i>Croton caudatus</i> Greial.	C	Euphorbiaceae
291	<i>Croton roxburghii</i> Balak.	C	Euphorbiaceae
292	<i>Chamaesyce hirta</i> (L.) Millsp.	Un	Euphorbiaceae
293	<i>Emblica officinalis</i> Gaertn.	C	Euphorbiaceae
294	<i>Euphorbia hirta</i> Linn.	Sc	Euphorbiaceae
295	<i>Euphorbia orbiculata</i> H.B.K.	Sc	Euphorbiaceae
296	<i>Glochidion oblatum</i> Hook. F.	Sc	Euphorbiaceae
297	<i>Glochidion assamicum</i> Hook. F.	SC	Euphorbiaceae
298	<i>Hornonoia riparia</i> Lour.	C	Euphorbiaceae
299	<i>Kirganella reticulate</i> (Poir.) Bail.	Un	Euphorbiaceae
300	<i>Macaranga denticulata</i> (Bl.) Muell. - Arg	Sc	Euphorbiaceae
301	<i>Mallotus philippensis</i> (Lamk.) Muell. - Arg.	Sc	Euphorbiaceae
302	<i>Phyllanthus debilis</i> Willd.	C	Euphorbiaceae
303	<i>Phyllanthus niruri</i> L.	C	Euphorbiaceae
304	<i>Phyllanthus virgatus</i> Forst.	C	Euphorbiaceae
305	<i>Phyllanthus urinaria</i> L.	C	Euphorbiaceae
306	<i>Ricinus communis</i> L.	R	Euphorbiaceae
307	<i>Trewia nodiflora</i> L.	C	Euphorbiaceae
308	<i>Trema amboinensis</i> Bl.	C	Ulmaceae
309	<i>Trema orientalis</i> (L.) Benn.	C	Ulmaceae
310	<i>Artocarpus chaplasha</i> Roxb.	Sc	Moraceae
311	<i>Ficus geniculata</i> Kurz.	Sc	Moraceae
312	<i>Ficus racemosa</i> L.	C	Moraceae
313	<i>Ficus heterophylla</i> L.f. var. <i>assamica</i> (Miq.) Corner	R	Moraceae
314	<i>Ficus hispida</i> L. F.	Sc	Moraceae
315	<i>Ficus virens</i> Ait.	Sc	Moraceae
316	<i>Morus indica</i> L.	Sc	Moraceae
317	<i>Morus alba</i> Roxb.	Sc	Moraceae
318	<i>Stebulus asper</i> Lour.	Sc	Moraceae
319	<i>Boehmeria malabarica</i> Wedd.	Sc	Urticaceae
320	<i>Boehmeria glomerulifera</i> Miq.	C	Urticaceae
321	<i>Boehmeria platyphylla</i> Don.	Sc	Urticaceae
322	<i>Elatostemon uniolotum</i> Wieght	Un	Urticaceae
323	<i>Pouzolzia bennettiana</i> Wight.	Sc	Urticaceae
324	<i>Pouzolzia pentandra</i> Benn.	C	Urticaceae
325	<i>Pouzolzia zeylanica</i> (L.) Benn.	C	Urticaceae
326	<i>Quercus lanceaefolia</i> Roxb.	C	Fagaceae
327	<i>Ceratophyllum demersum</i> L.	C	Ceratophyllaceae
328	<i>Cannabis sativa</i> L.	Sc	Cannabaceae
Gymnosperms:			
329	<i>Gnetum montanum</i> M.G.F.	R	Gnetaceae
Monocotyledons:			
330	<i>Ottelia dismoides</i> (L.) Pers.	R	Hydrocharitaceae
331	<i>Vallisneria spiralis</i> (L.) Ktze.	Sc	Hydrocharitaceae

332	<i>Acampe papillosa</i> (Lindl.) Lindl.	R	Orchidaceae
333	<i>Aerides odoratum</i> Lour.	R	Orchidaceae
334	<i>Calanthe angusta</i> Lindl.	R	Orchidaceae
335	<i>Bulbophyllum forrestii</i> Scidenf.	C	Orchidaceae
336	<i>Cymbidium aloifolium</i> (L.) Sw.	R	Orchidaceae
337	<i>Dendrobium densiflorum</i> walk. Exlindl.	R	Orchidaceae
338	<i>Dendrobium moschatum</i> Sw.	R	Orchidaceae
339	<i>Dendrobium aphyllum</i> (Roxb.) C.E.C. Fischer.	R	Orchidaceae
340	<i>Eria pubescens</i> (HK.) Lindl.	C	Orchidaceae
341	<i>Eulophia mannii</i> Hook f.	R	Orchidaceae
342	<i>Geodorum densiflorum</i> (Lamk.) Schltr.	C	Orchidaceae
343	<i>Peristylis goodyeroides</i> (D.Don.) Lindl.	Sc	Orchidaceae
344	<i>Pholidata imbricata</i> (Roxb.) Lindl.	Sc	Orchidaceae
345	<i>Rhyncostylis retusa</i> (L.) Bl.	C	Orchidaceae
346	<i>Phaius tankerville</i>	En	Orchidaceae
347	<i>Vanda teres</i> Lindl.	C	Orchidaceae
348	<i>Alpinia nigra</i> (Geartn.) Burt.	C	Zingiberaceae
349	<i>Costus speciosus</i> (Roem.) Sm.	Sc	Zingiberaceae
350	<i>Curcuma aromatica</i> Salisb.	C	Zingiberaceae
351	<i>Globo clarkei</i> Baker.	R	Zingiberaceae
352	<i>Hedychium coronarium</i> Koem.	R	Zingiberaceae
353	<i>Zingiber capitatum</i> Roxb.	Sc	Zingiberaceae
354	<i>Zingiber zerumbet</i> (L.) Smith.	Sc	Zingiberaceae
355	<i>Phrynium pubinerve</i> Blume.	C	Marantaceae
356	<i>Musa ornata</i> Roxb.	En	Musaceae
357	<i>Ophiopogon intermedius</i> D. Don.	Sc	Haemodoraceae
358	<i>Dioscorea trifoliata</i> H.B.K.	Sc	Dioscoreaceae
359	<i>Smilax ocreata</i> A. & C.	C	Smilacaceae
360	<i>Smilax perfoliata</i> Lour.	C	Smilacaceae
361	<i>Eichornia crassipes</i> (Mort.) Solms.	C	Pontederiaceae
362	<i>Monochoria hastata</i> (L.) Solms.	C	Pontederiaceae
363	<i>Commelina benghalensis</i> L.	C	Commelinaceae
364	<i>Commelina paludosa</i> Bl.	C	Commelinaceae
365	<i>Tonningia axillaris</i> (L.) Kuntze.	Un	Commelinaceae
366	<i>Cyanotis cristata</i> (L.) D. Don.	C	Commelinaceae
367	<i>Floscopa scandens</i> L.	C	Commelinaceae
368	<i>Murdannia nodiflora</i> (L.) Brenum.	C	Commelinaceae
369	<i>Calamus floribundus</i> Griff.	Sc	Araceae
370	<i>Calamus viminalis</i> Willd.	Sc	Araceae
371	<i>Scirpus juncoides</i> Roxb.	C	Typhaceae
372	<i>Lasia spinosa</i> (L.) Thw.	Sc	Araceae
373	<i>Pistia stratiotes</i> L.	C	Araceae
374	<i>Pothos scandens</i> L.	C	Araceae
375	<i>Lemna perpusilla</i> Torrey	R	Lemnaceae
376	<i>Cyperus brevifolius</i> (Rottb.) Hassk.	C	Cyperaceae
377	<i>Cyperus cyperoides</i> (L.) O. Ktze. Var. <i>evolutor</i> (Cl.) Kuk.	Sc	Cyperaceae
378	<i>Cyperus cyperoides</i> (L.) O. Ktze. Var. <i>bengalensis</i> (Cl.) Kuk.	Sc	Cyperaceae
379	<i>Cyperus digitatus</i> var. <i>hookeri</i> (Beeck.) Clarke.	C	Cyperaceae
380	<i>Cyperus diffuses</i> Vahl.	C	Cyperaceae

381	<i>Cyperus difformis</i> L.	Sc	Cyperaceae
382	<i>Cyperus iria</i> L.	C	Cyperaceae
383	<i>Cyperus halpan</i>	Un	Cyperaceae
384	<i>Cyperus kyllingia</i> Endl.	C	Cyperaceae
385	<i>Cyperus pilosus</i> Vahl.	C	Cyperaceae
386	<i>Fimbristylis aestivalis</i>	C	Cyperaceae
387	<i>Fimbristylis dichotoma</i> (L.) Vahl.	C	Cyperaceae
388	<i>Scripus grossus</i> L.	C	Cyperaceae
389	<i>Apluda mutica</i> L.	C	Poaceae
390	<i>Arundinella benghalensis</i> (Spr.) Druce.	Sc	Poaceae
391	<i>Brachiaria villosa</i> (Lamk.) A. Camus.	Sc	Poaceae
392	<i>Chrysopogon aciculatus</i> (Retz.) Trin.	C	Poaceae
393	<i>Cymbopogon exertus</i> (Hack.) A. Camus	C	Poaceae
394	<i>Cynodon dactylon</i> (L.) Pers.	C	Poaceae
395	<i>Cyrtococcum oxyphyllum</i> (Steud.) Stapf.	Sc	Poaceae
396	<i>Cyrtococcum accrescens</i> (Trin.) Stapf	Sc	Poaceae
397	<i>Dendrocalamus hamiltonii</i>	En	Poaceae
398	<i>Digitaria longifolia</i> (Retz.) Pers.	C	Poaceae
399	<i>Digitaria pruriens</i> Burse.	C	Poaceae
400	<i>Eleusine indica</i> (L.) Gaert.	Sc	Poaceae
401	<i>Eragrostis atrovirens</i> (Desf.) Trim ex Steud.	Sc	Poaceae
402	<i>Eragrostis tamella</i> Ros.	C	Poaceae
403	<i>Erianthus futrius</i> Nees ex Steud.	C	Poaceae
404	<i>Hymenachne assamica</i>	Un	Poaceae
405	<i>Imperata cylindrica</i> (L.) P. Beauv.	C	Poaceae
406	<i>Imperata cylindrica</i> (L.) P. Beauv. Var. major (Nees) Hubb.	C	Poaceae
407	<i>Neyraudia reynaudiana</i> (Kunth) Keng ex Hitche	C	Poaceae
408	<i>Oplismenus burmanii</i> Beauv.	C	Poaceae
409	<i>Oplismenus compositus</i> (L.) P. Beauv.	C	Poaceae
410	<i>Panicum colonum</i> L.	C	Poaceae
411	<i>Panicum humidorum</i> Buch-Ham ex Hook.f.	C	Poaceae
412	<i>Paspalum sanguinale</i> Lamk.	C	Poaceae
413	<i>Paspalum scrobiculatum</i> L.	C	Poaceae
414	<i>Phragmites karka</i> (Retze.) Trin ex Steud.	C	Poaceae
415	<i>Pogonatherum crinitum</i> (Thunb.) Kunth.	Sc	Poaceae
416	<i>Pogonatherum panicum</i> (Lamk.) Hack.	Sc	Poaceae
417	<i>Saccharum narenga</i> (Nees ex Steud.) Hack.	C	Poaceae
418	<i>Saccharum arundinaceum</i> Retz.	C	Poaceae
419	<i>Saccharum spontaneum</i> L.	C	Poaceae
420	<i>Saccharum procerum</i> Roxb.	C	Poaceae
421	<i>Sacciolepis indica</i> (L.) A. chase.	Sc	Poaceae
422	<i>Sacciolepis interrupta</i> (Wall.) Stapf.	Sc	Poaceae
423	<i>Setaria biflora</i> L.	C	Poaceae
424	<i>Setaria pumila</i> (Poir.) R. & S.	C	Poaceae
425	<i>Phacelurus zea</i> (Cl.) Clayton.	Sc	Poaceae
426	<i>Themeda villosa</i> (Poir.) A. Camus	C	Poaceae
427	<i>Thysanolaena maxima</i> (Roxb.) O.ktze.	C	Poaceae
428	<i>Thysia zea</i> (C.B.Cl.) Stapf.	Sc	Poaceae
429	<i>Vetiveria zizanoides</i> (L.) Nash	C	Poaceae

Pteridophytes:			
430	<i>Palhinhaea arnua</i> (Linn.) Franco et Vasc.	Sc	Lycopodiaceae
431	<i>Equisetum arvanse</i> D. Don	En	Equisetaceae
432	<i>Equisetum debile</i> Roxb.	En	Equisetaceae
433	<i>Equisetum diffusum</i> D. Don.	En	Equisetaceae
434	<i>Equisetum ramosissimum</i> Desf.	En	Equisetaceae
435	<i>Helminthostachys zeylanica</i> (Linn.) Hook. Et Baur.	Cr En	Ophioglossaceae
436	<i>Lygodium flexuosum</i> (Linn.) Sw.	R	Lygodiaceae
437	<i>Cyathia spinulosa</i> Wall ex Hook.	EN	Cyatheaceae
438	<i>Pteris biaurita</i> Linn.	Sc	Pteridaceae
439	<i>Pteris critica</i> (Linn.) Maxl.	Sc	Pteridaceae
440	<i>Pteris ensiformis</i> Burn.	Sc	Pteridaceae
441	<i>Pteris quadriauta</i> Retz.	C	Pteridaceae
442	<i>Adiantum caudatum</i> Linn.	Sc	Adiantaceae
443	<i>Adiantum philippense</i> Linn.	Sc	Adiantaceae
444	<i>Cyclosorus gongylodes</i> (Schkuhr.) L.	R	Thelypteridaceae
445	<i>Pronephrium nudatum</i> (Roxb.)	R	Thelypteridaceae
446	<i>Ceratopteris thalie troides</i> (Linn.) Brorgrn.	R	Parkeriaceae
447	<i>Antrophyum plantagineum</i> (Cav.) Kaiulf.	R	Vittariaceae
448	<i>Antrophyum reticulatum</i> (Forst.) Kaiulf.	R	Vittariaceae
449	<i>Villaria elongata</i> Sw.	En	Vittariaceae
450	<i>Atyrogramma calomelanes</i> (Linn.) Linn.	Un	Hemionitidaceae
451	<i>Diacalpe aspidioides</i> Bhome.	Un	Aspidiaceae
452	<i>Dryopteris khasyana</i> (clarke) C.	R	Aspidiaceae
453	<i>Diptazium esculentum</i> (Retz.) Sw.	Un	Athyriaceae
454	<i>Onchium siliculosum</i> (Desv.) C. chr.	En	Cryptogrammaceae
455	<i>Drymaria quercifolia</i> (Linn.)	C	Polypodiaceae
456	<i>Drymoglossum heterophyllum</i> (Linn.) Trimen.	R	Polypodiaceae
457	<i>Microsorium membranaceum</i> (D. Don.) Ching.	R	Polypodiaceae
458	<i>Microsorium punctatum</i> (Linn.) Copel.	C	Polypodiaceae
459	<i>Pyrrosia adnascens</i> (Sw.) Cheng.	Sc	Polypodiaceae
460	<i>Pyrrosia flocculosa</i> (D. Don.) Ching.	Sc	Polypodiaceae
461	<i>Pyrrosia mollis</i> (Kunze) Ching.	Sc	Polypodiaceae
462	<i>Pyrrosia nuda</i> (Gies) Ching	Sc	Polypodiaceae

C : Common
R : Rare
En : Endangered
Cr En : Critically endangered
Sc : Scattered
Unknown : Un

Appendix - 9

A Checklist of Mammals of Manas

CLASS: MAMMALS

<u>English name</u>	<u>Scientific Name</u>	<u>Schedule</u>
A. APES MONKEYS, LEMURS :		
1. Capped langur	<i>Presbytis pileatus</i> (Blyth)	C
2. Golden langur	<i>Presbytis geei</i> (Gee)	C
3. Assamese Macaque	<i>Macaca assamensis</i> (Mc Clelland)	C
4. Rhesus Macaque	<i>Macaca mulatta</i> (Zinunerman)	C
B. CAT :		
5. Tiger	<i>Panthers tigris</i> (Linnaeus)	R
6. Leopard	<i>Panthera pardus</i> (Linnaeus)	R
7. Golden Cat	<i>Felis temmincki</i> (Vigors & Horsfield)	R
8. Clouded leopard	<i>Neofelis nebulosa</i> (Griffith)	R
9. Fishing cat	<i>Felis viverina</i> (Bennett)	R
10. Leopard cat	<i>Felis bengalensis</i> (Kerr)	R
11. Jungle Cat	<i>Felis chaus</i> (Güldenstaedti)	R
C. CIVET :		
13. The small India civet	<i>Viverricula indica</i> (Desmarest)	
14. Common palm civet or Toddy cat	<i>Paradosurus hermaphroditus</i> (Pallas)	
15. Himalaya plam civet	<i>Paguma larvata</i> (Hamilton-smith)	
16. Binturong or Bear-cat	<i>Arctictis binturong</i> (Raffles)	
D. MONGOOSE :		
17. Common mongoose	<i>Herpestes edwardsi</i> (Geoffroy)	
18. Small Indian mongoose	<i>Herpestes auropunctatus</i> (Hoggson)	
E. DOG :		
19. Jackal	<i>Canis aureus</i> (Linnaeus)	
20. Dhole	<i>Cuon alpinus</i> (Pallas)	
21. India fox	<i>Vulpes bengalensis</i> (Shaw)	
F. BEARS :		
23. Himalayan black bear	<i>Selenarctos thibetanus</i> (G. Cuvie)	
24. Sloth bear	<i>Melursus ursinus</i> (Shaw)	I
G. WEASEL :		
25. Smooth Indian otter	<i>Lutra perspicillata</i> (1. Geoffroy)	
26. Yellow throated Martens	<i>Martes flavigula</i> (Boddaert)	
27. Chinese Badger	<i>Melogale moschata</i> (Grey)	
28. Yellow bellied weasel	<i>Mustela kathiah</i> (Hodgson)	
H. PANGOLIN :		
29. Indian Pangolin	<i>Manis crassicaudata</i> (Gray)	I

L. BAYTS :

- 30. Bearded sheathrailed bat
- 31. Fulvous Fruit bat
- 32. Indian flying fox
- 33. Shortnosed fruit bat

Taphozous melanop gon (Temminek)
Rousettus lescheneulu (Dosmarest)
Pteropus giganteus (Brunnich)
Cynopterus sphinx (Vahl)

J. RODENTS :

- 34. Treestriped palm squirrel
- 35. Fivestriped palm squirrel
- 36. Malayan giant squirrel
- 37. Hoarybellied Himalayan squirrel
- 38. Bay Bamboo rats
- 39. Himalayan stripped squirrel
- 40. Particoloured Flying squirrel
- 41. Indian porcupine

Funambulus palmarub (Linnaeus)
Funambulus pennanti (Wroughton)
Ratufabicolor (Sparnano)
Pygerythrus (Geoffrpy)
Cannomys ba ius (Hodgson)
Callosciurus macelellandi (Horsfield)
Hylopetes alboniger
Hystrie India (Kerr)

I

K. HARE, RABITS:

- 42. Rufoustailed Hare
- 43 Hispid Hare

Kepus nrgricollis rujicaudatus (Geoffroy)
Caprolagus hispidus (Pearson)

L. ELEPHANT :

- 44. The Indian Elephant

Elephas maxim us (Linnaeus)

M. RHINOCEROS:

- 45. The Great Indian one rhinoceros

Rhinoceros unicornis (Linnaeus)

N. WILD OX, SHEEP, GOATS :

- 46. The Gaur or Indian Bison
- 47. The Asiatic water buffalo

O. DEER:

- 48. Sambar
- 49. Hog deer
- 50. Muntjak or Barking deer
- 51. Swamp deer

Cervus unioclor (Kerr)
Axis porcinus (Zimmerman)
Muntiacus muntjak (Zimmerman)
Rucervus duvauceli ranjitsinghi (Cuvier)

P. PIG etc:

- 52. Wild boar
- 53. Pygmy hog

Sus scrofa (Linnaeus)
Sus salvanius (Hodgson).

Appendix - 10
A TENTATIVE CHECKLIST OF BIRDS of MANAS

CLASS : AVES (BIRDS)	ZOOLOGICAL NAME
01. Little grebe	<i>Podiceps rufficoljis</i>
02. Spot - billed pelican	<i>Pelecanus philipensis</i>
03. Large Cormorant	<i>Phalacrocorax carbo</i>
04. Little Cormorant	<i>Phalacrocorax niger</i>
05. Darter	<i>Anhinga rufa</i>
06. Gray heron	<i>Ardea cinerea</i>
07. Purple heron	<i>Ardea purpurea</i>
08. Pond Heron	<i>Ardeola grayii</i>
09. Little green Heron	<i>Butorides striatus</i>
10. Night Heron	<i>Nycticorax nycticorax</i>
11. Cattle Egret	<i>Bubllcus ibis</i>
12. Large Egret	<i>Egretta alba</i>
13. Intermediate Egret	<i>Egretta intermedia</i>
14. Little Egret	<i>Egretta garzetta</i>
15. Chestnut Bittern	<i>Ixobrychus cinnamoneus</i>
16. Black Bittern	<i>Dupetor flavicollis</i>
17. Little Green Bittern	<i>Butorides striatus</i>
18. White-necked stork	<i>Ciconia episcopus</i>
19. Black Stork	<i>Xenorhynchus asiaticus</i>
20. Black necked stork	<i>Ciconia nigra</i>
21. Lesser Adjutant stork	<i>Leptoptilos javanicus</i>
22. Greater Adjutant Stork	<i>Leptotilos dubius</i>
23. Bar-headed Goose	<i>Anser indicus</i>
24. Lesser whistling Teal	<i>Dendrocygnaj avanica</i>
25. Ruddy Shelduck	<i>Tadorna ferruninea</i>
26. Pintail	<i>Anas acuta</i>
27. Common Teal	<i>Anas crecca</i>
28. Garganey	<i>Anas querquedula</i>
29. Spotbill	<i>Anas poecilorhyncha</i>
30. Mallard	<i>Anas platyrhynchos</i>
31. Gadwall	<i>Anas strepra</i>
32. Eurasion Wigeon	<i>Anas penelope</i>
33. Shoveler	<i>Anas cypeata</i>
34. Red-crested pochard	<i>Netta ruffian</i>
35. Common pochard	<i>Aythya ferina</i>
36. Cotton Teal	<i>Nettapus coromandelianus</i>
37. Merganser	<i>Mergus merganser</i>
38. Black-crested Baza	<i>Aviceda leuphotes</i>
39. Brahminy Kite	<i>Haliasture Indus</i>
40. Pariah or Black kite	<i>Milvus migrans</i>
41. Sparrow Hawk	<i>Accipiter nisus</i>
42. Shikra	<i>Accipiter badius</i>
43. Crested Serpent Eagle	<i>Spilornis cheela</i>
44. Bonelli's Eagle	<i>Hieraettis fasciatus</i>
45. Tawny Eagle	<i>Aquila rapax</i>
46. Steppe Eagle	<i>Aquila nipalensis</i>

47. Pallas's Fishing Eagle
 48. Osprey
 49. Black vulture
 50. White-backed vulture
 51. Indian Griffon
 52. Pied Harrier
 53. Marsh Harrier
 54. Hen Harrier
 55. Larger Falcon
 56. Shahin Falcon
 57. Oriental Hobby
 58. Crested Honey Bazzard
 59. Buzzard
 60. Eurasian Kestrel
 61. Black partridge
 62. Swamp Partridge
 63. Common Bustard quail
 64. Common peafowl
 65. Red Jungle Fowl
 66. Kalij pheasant
 67. White breasted Waterhen
 68. Coot
 69. Indian Gallinule
 70. Bengal Florican
 71. Pheasant-tailed Jacana
 72. Bronze-winged Jacana
 73. Red-wattled Lapwing
 74. Spur-winged Lapwing
 75. Greater sand Plover
 76. Little Ring Plover
 77. Kentish Plover
 78. Lesser sand Plover
 79. Curlew
 80. Black-tailed Godwit
 81. Greenshank
 82. Common Redshank
 83. Common sandpiper
 84. Temminck's stint
 85. Pintail Snipe
 86. Fantail Snipe
 87. Painted snipe
 88. Avocet
 89. Eurasian Thick Knee
 90. Great Thick Knee
 91. Small Pratincole
 92. Black-headed Gull
 93. Common Tern
 94. Black-bellied Tern
 95. Little Tern
 96. Indian River Tern

Haliaeetus leucoryphus
Pandion haliaetus
Torgos calvus
Gyps bengalensis
Gyps indicus
Circus melanoleucos
Circus aeruginosus
Circus cyaneus
Falco jugger
Falco peregrinus peregrinator
Falco sevenus
Pernisptilor hynchus
Buteo buteo
Falco tinnunculus
Francolinus francolinus
Francolinus gularis
Turnix suscitator
Pavo cristatus
Gallus gallus
Polhura leucomelana
Amaurornis phoenicurus
Fulica atra
Gallinula chloropus
Eupodotis bengalensis
Hydrophasianus chirurgus
Metopidius indica
Vanellus indicus
Vanellus spinosus
Charadrius leschenaultii
Charadrius dubius
Charadrius aloxandrinus
Charadrius mongolus
Numenius arquata
Limosa limosa
Tringa nebularia
Tringa tetanus
Tringa hypoleucos
Calidris temminckii
Capella stunera
Capella gallinago
Rostratula benghalensis
Virostra avosetta
Burhinus oedicephalus
Esacus magnirostris
Glareola lactea
Larus ridibundus
Sterna hirundo
Sterna acuticauda
Sterna albifrons
Sterna aurantia

97. Pintail Green Pigeon
98. Wedge-tailed Green Pigeon
99. Gray-fronted Green Pigeon
100. Bengal Green Pigeon
101. Imperial pigeon
102. Blue Rock Pigeon
103. Thick billed green Pigeon
105. Long-tailed Cuckoo Dove
106. Rufous turtle Dove
107. Red Turtle Dove
108. Indian Ring Dove
109. Little Brown Dove
110. Spotted Dove
111. Emerald Dove
112. Rose-ringed parakeet
113. Large parakeet
114. Blossom-headed parakeet
115. Slaty-headed parakeet
116. Pied Crested Cuckoo
117. Large Hawk Cuckoo
118. Common Hawk Cuckoo
119. Indian Cuckoo
120. Plaintive Cuckoo
121. Red winged crested cuckoo
122. Large Green billed Malkoha
123. Koel Cuckoo
124. Small Coucal
125. Large Coucal
126. Barn Owl
127. Great Homed Owl
128. Forest Eagle Owl
129. Indian Scops Owl
130. Spotted scops Owl
131. Brown Fish Owl
132. Jungle Owlet
133. Spotted Owlet
134. Long-tailed Night jar
135. Jungle Night jar
136. Red-headed Trogon
137. Indian Roller
138. Hoopoe
139. Small Pied Kingfisher
140. Stork-billed Kingfisher
141. White-breasted Kingfisher
142. Ruddy Kingfisher
143. Chestnut-headed Bee-eater
144. Blue-bearded Bee-eater
145. Green Bee-eater
146. Pied Hornbill
147. Great Indian Hornbill

Treron apicauda
Treron sphenura
Treron pompadora
Treron phoeniceptera
Ducula badia
Columba livia
Treron bicinta
Macropygia unchall
Streptopelia orientalis
Streptopelia tranquebarica
Streptopelia decaocto
Streptopelia senegalensis
Streptopelia chinensis
Chalcophaps indica
Psittacula krameri
Psittacula eupatria
Psittacula cyanocephala
Psittacula himalayana
Clamator jacobinus
Cuculus sparverioides
Cuculus varius
Cuculus micropterus
Cacomantis merulinus
Clamator coromandus
Rhopodytes tristis
Eudynamys scolopaceo
Contropus toulou
Centro pus sinensis
Tyto alba
Bubo bubo
Bubo nipalensis
Otus scop
Otus spilocephalus
Bubo zeylonsis
Glaucidium radiantum
Athene brama
Caprimulgus macrurus
Caprimulgus indicus
Harpactes erythrocephaus
Coracia bengalensis
Upupa epops
Ceryle rudis
Pelargopsos capensis
Halcyon smyrnensis
Halcyon coromanda
Merops leschenaulti
Nyctyornis athertoni
Merops orientalis
Anthraceroceros malabaricus
Buceros bicornis

148. Rufous necked Hornbill	<i>Aceros nipalensis</i>
149. Wreathed Hornbill	<i>Rhyticeros undulates</i>
150. Great Himalaya Barbet	<i>Megalaima virens</i>
151. Green Barbet	<i>Megalaima zeylanica</i>
152. Lineated Barbet	<i>Megalaima lineata</i>
153. Blue throated barbet	<i>Megalaima asiatica</i>
154. Crimson Breasted Barbet	<i>Megalaima haemacephala</i>
155. Small scaly bellied Woodpecker	<i>Picus xanthophygaus</i>
156. Lesser Golden backed Woodpecker	<i>Dinopium bengalensis</i>
157. Large Golden backed Woodpecker	<i>Chrysocoloptes lucidus</i>
158. Grey Crowned Pygmy Woodpecker	<i>Dendocopos canicapillus</i>
159. Small Yellow napped Woodpecker	<i>Picus chloropolhus</i>
160. Large yellow napped Woodpecker	<i>Picus flavinucha</i>
161. Black napped green Woodpecker	<i>Picus canus</i>
162. Indian Pitta	<i>Picus canus</i>
163. Green Breasted or Hooded Pitta	<i>Pitta sordida</i>
164. Blue napped pitta	<i>Pitta nipalensis</i>
165. Blur pitta	<i>Pitta cyanea</i>
166. Bush Lark	<i>Mirafra assamica</i>
167. Sand Lark	<i>Calaudrellaraytal</i>
168. House swift	<i>Apus affinis</i>
169. Palm Swift	<i>Cypsiurus parvus</i>
170. Alpine Swift	<i>Apus melba</i>
171. Sand Martin	<i>Riparia paludicola</i>
172. Eurasian House Martin	<i>Delichon urbica</i>
173. Nepal House Martin	<i>Delichon nipalensis</i>
174. Wire tailed Swallow	<i>Hirundo smithii leach</i>
175. Barn Swallow	<i>Hirundo rustica</i>
176. Black headed or Rufous beaked shrike	<i>Lanius schach</i>
177. Brown Shrike	<i>Lanium schach</i>
178. Lesser Wood-Shrike	<i>Tephrodprnis pondiceianus</i>
179. Large Wood-Shrike	<i>Tephrodornis gularis</i>
180. Large Cuckoo-shrike	<i>Coracina novaehollandiae</i>
181. Black-headed Oriole	<i>Oriolus xanthornus</i>
182. Golden Oriole	<i>Oriolus oriolus</i>
183. Black-naped Oriole	<i>Oriolus chinensis</i>
184. Small Racquet-tailed Drongo	<i>Dicrurus remifer</i>
185. Large Racquet-tailed Drongo	<i>Dicrurus paradise</i>
186. Hair-crested Drongo	<i>Dicrurus hottentottus</i>
187. Ashy Drongo	<i>Dicrurus Leucophaeus</i>
188. Black Drongo	<i>Dicrurus adsimillis</i>
189. Little Bronzed Drongo	<i>Dicrurus aeneus</i>
190. Crow-billed Drongo	<i>Dicrurus annectans</i>
191. Gray-headed Myna	<i>Sturn us malabaricus</i>
192. Eurasian Starling	<i>Sturnus vulfaris</i>
193. Pied Myna	<i>Sturn us contra</i>
194. Common Myna	<i>Acridotheres tritis</i>
195. Jungle Myna	<i>Acridotheres fuscus</i>
196. Hill Myna or Grackle	<i>Gracula religiosa</i>
197. Green Magpie	<i>Cissa chinensis</i>

198. Indian Tree pie	<i>Dendrocitta vagundunda</i>
199. Himalaya Tree pie	<i>Dendrocitta formosae</i>
200. House crow	<i>Corvus splendens</i>
201. Jungle Crow	<i>Corvus macrothynchos</i>
202. Long-tailed Minivet	<i>Pericrocotus ethologus</i>
203. Scarlet Minivet	<i>Pericrocotus flammeus</i>
204. Rosy Minivet	<i>Pericrocotus roseus</i>
205. Lora	<i>Aegithina tiphia</i>
206. Orange-bellied Leaf Bird	<i>Chloropsis harbwickh</i>
207. Fairy Bluebird	<i>Irena puella</i>
208. Black-headed yellow Bulbul	<i>Pycnonotus melanicterus</i>
209. White-cheeked Bulbul	<i>Pycnonotus leucogenys</i>
210. Red-vented Bulbul	<i>Pycnonotus cafer</i>
211. Red whiskered Bulbul	<i>Pycnonotus jocosus</i>
212. White throated Bulbul	<i>Criniger flaceilus</i>
213. Brown eared Bulbul	<i>Hypsipete sflavalus</i>
214. Grau Bulbul	<i>Hypsipetes madagascariensis</i>
215. Spotted babbler	<i>Pellorueum rujiceps</i>
216. Rufous-necked Scimitar Babbler	<i>Pomatorhinus rujicollis</i>
217. Yellow-breasted Babbler	<i>Macronous gularis</i>
218. Yellow-eyed Babbler	<i>Chrysomma sinensis</i>
219. Common Babbler	<i>Turdoides caudatus</i>
220. Jungle Babbler	<i>Turdoides striatus</i>
221. White-bellied Yuhina	<i>Yuhina zantholenea</i>
222. Sooty Flycatcher	<i>Muscicapa sibiria</i>
223. Brown Flycatcher	<i>Muscicapa latirstris</i>
224. Small Niltava	<i>Muscicapa macgrigoriae</i>
225. Verditer Flycatcher	<i>Muscicapa thalassina</i>
226. Brook's Flycatcher	<i>Muscicapa poliogenys</i>
227. Wite-throated Fantail Flycatcher	<i>Phipidura albicollis</i>
228. Gray-headed Flycatcher	<i>Culicicapa ceylensis</i>
229. Black-naped Flycatcher	<i>Manarchda azurea</i>
230. Blanford's Bush Warbler	<i>Cettia pallidipes</i>
231. Jungle Prinia	<i>Prinia sylvatica</i>
232. Tailor Bird	<i>Orthotomus sutorius</i>
233. Blyth's Reed Warbler	<i>Acrocephalus dumetorum</i>
234. Brown Leaf Warbler	<i>Phylloscopus collybita</i>
235. Plain Leaf Warbler	<i>Phylloscopus inornatus</i>
236. Tickell's leaf Warbler	<i>Phylloscopus offinis</i>
237. Pallas's leaf Warbler	<i>Phylloscopus proregulus</i>
238. Yellow-rumped leaf warbler	<i>Phylloscopus pulcher</i>
239. Gray-headed Warbler	<i>Seicercus Xanthoschistos</i>
240. Shama	<i>Copsychus malabaricus</i>
241. Robin Dayal	<i>Copsychus saularis</i>
242. White capped River Chat	<i>Chaimarronis leucocephalus</i>
243. Brown Dipper	<i>Cinclus pallash</i>
244. Plumbeous Redstart	<i>Ryacornis fuliginosus</i>
245. Hodgson's Redstart	<i>Phoenicurus hodgsoni</i>
246. Black Redstart	<i>Phoenicurus ochruros</i>
247. Spotted Forktail	<i>Enicurus maculates</i>

248. Black backed Forktail	<i>Enicurus immaculatus</i>
249. Collared Bush Chat	<i>Saxicola torquata</i>
250. Dark-gray Bush Chat	<i>Saxicola forrea</i>
251. Pied Bush Chat	<i>Saxicola caprata</i>
252. Blue Rock Thrush	<i>Monticola solitarius</i>
253. Gray-winged Blackbird	<i>Turdus boulboul</i>
254. Whistling Thrush	<i>Myiophoneus careuleus</i>
255. Malabar whistling Thrush	<i>Myiophoneus horsejildii</i>
256. Lesser Necklaced laughing Thrush	<i>Garrulax moniligerus</i>
257. Plain colored laughing thrush	<i>Garrulax subunicolor</i>
258. Yellow breasted laughing thrush	<i>Garrulax delesserti</i>
259. Started laughing thrush	<i>Garrulax striatus</i>
260. White-throated laughing thrush	<i>Garrulax albogularis</i>
261. Sultan Tit	<i>Melanochlora sultanea</i>
262. Gray Tit	<i>Parus major</i>
263. Red-headed Tit	<i>Agithalos concinnus</i>
264. Green backed Tit	<i>Parus monticolus</i>
265. Black spotted yellow Tit	<i>Parus spilonotus</i>
266. Chestnut-bellied Nuthatch	<i>Sitta castanea</i>
267. Velvet-fronted Nuthatch	<i>Sitta frontalis</i>
268. White tailed Nuthatch	<i>Sitta himalayanensis</i>
269. Wall Creeper	<i>Tichodroma muraria</i>
270. Yellow Wagtail	<i>Motacilla flava</i>
271. Grey Wagtail	<i>Motacilla cas pica</i>
272. Pied Wagtail	<i>Motacilla alba</i>
273. Large pied Wagtail	<i>Motacilla maderapatensis</i>
274. Yellow-headed Wagtail	<i>Motacilla citreola</i>
275. Thick-billed Flower-peeker	<i>Dicaeum agile</i>
276. Plain colored flower-pecker	<i>Dicaeum concolor</i>
277. Yellow vented flower-pecker	<i>Dicaeum chrysorrheum</i>
278. Scarlet backed flower-pecker	<i>Dicaeum cruentatum</i>
279. Scarlet-breasted sunbird	<i>Aethopyga siparaja</i>
280. Black-breasted sunbird	<i>Aethopygagouldiae</i>
281. Purple Sunbird	<i>Nectarinia asiatica</i>
282. Mrs. Gould's Sunbird	<i>Aethopygagouldiae</i>
283. Rubycheek	<i>Anthreptes singalensis</i>
284. Streaked Spiderhunter	<i>Archnothera magna</i>
285. House Sparrow	<i>Passer domesticus</i>
286. Tree Sparrow	<i>Passer montanus</i>
287. Baya Weaver	<i>Ploceus phillipinus</i>
288. Eastern finch baya	<i>Ploceus spp</i>
289. Spotted Munia	<i>Lonchura punctulata</i>
290. Common Rose Finch	<i>Corpodacus erythrinus</i>
291. Chestnut Bunting	<i>Emberiza rutila</i>
292. Yellow-breasted Bunting	<i>Emberiza aureola</i>
293. Little Bunting	<i>Emberiza pusilla</i>
294. Gold Fronted Chloropsis	<i>Chloropsis aurifrons</i>
295. Wryneck	<i>Jyntorquilla</i>
296. White eye	<i>Zosterops palpebroso</i>
297. Himalaya Barwing	<i>Actinodura agertoni</i>

Appendix – 11

LIST OF FISHES FOUND IN MANAS NATIONAL PARK

A. Fish fauna: (Relatively low temp)

Family - Cyprinidae

Schizothoracichthys progastus

Crossocheilus latius latius

Acrossocheilus hexagonolepsis

Garra gotyla gotyla

Tor putitora

Tor progenies

Puntius tetrapagus

Barilius barila

Barilius bendelisis var chedra

Danio aequipinnatus

Aspidoparia morar

Aspidoparia jaya

Noemacheilus beavani

Noemacheilus savona

Barilius bola

Tor tor

Semiplotus semiplotus

Barilius bama

Orichthys cosuatis

Rasbora daniconius

Puntius ticto

Danio devario

Labeo dyocheilus

Garra lamta

Family - Bagridae

Mystus cavasius

Family - Ophiocephalidae

Channa gachua

Family - Nalitoridae

Acantholobitis botia

Erethistes spp

Nagra Viridescons

Family - Nandidae	<i>Gagata cenia</i>
Family - Olyridae	<i>Badis badis</i>
Family - Amblycipitidae	<i>Olyra longicaudata</i>
Family - Cobitidae	<i>Amblyceps mangois</i>
	<i>Botia dario</i>

LIST OF FISHES FOUND IN BETWEEN 4.7 TO 23.7 °C

Family - Cyprinidae	<i>Ladeo boga</i>
	<i>Ladeo gonius</i>
	<i>Ladeo rohita</i>
	<i>Ladeo calbasu</i>
	<i>Ladeo data</i>
	<i>Puntius tielo</i>
	<i>Danio devario</i>
	<i>Cirrhinus mrigala</i>
	<i>Cirrhinus reba</i>
	<i>Osteobarma cotio</i>
	<i>Catla catla</i>
Family - Cobitidae	<i>Lepidocephalichthys guntea</i>
Family - Siluridae	<i>Wallago attu</i>
	<i>Ompok pabo</i>
Family—Bagridae	<i>Mystus vittatus</i>
	<i>Mystus tengara</i>
Family—Ambassidae	<i>Ambassis nama</i>
	<i>Ambassis ranga</i>
Family—Nandidae	<i>Nandus nandus</i>
Family—Gobiidae	<i>Glossogobius giuris</i>

Appendix - 12

A checklist of Butterflies of Manas

Sl. No.	Family/Subfamily	Species	Status in MBR	Status in IWPA
	Family: Papilionidae			
1	Sub-Family-Papilioninae	Chain Swordtail- <i>Pathysa aristus antirates</i> (Doubleday) 1846	R	Schedule-II
2		Common Jay- <i>Graphium doson axion</i> (Felder, C. & R.) 1864	C	-
3		Tailed Jay- <i>Graphium agammemnon agammemnon</i> (Linnaeus) 1758	C	-
4		Common Bluebottle- <i>Graphium sarpedon sarpedon</i> (Linnaeus) 1785	C	-
5		Glassy Bluebottle- <i>Graphium cloanthus</i> (Westwood) 1841	C	-
6		Common Rose – <i>Pachliopta aristolochiae aristolochiae</i> (Fabricius) 1775	R	-
7		Common Birdwing- <i>Troides helena cerebarus</i> (C & R Felder) 1865	C	-
8		Golden Birdwing- <i>Troides aeacus</i> (C & R Felder) 1865	C	-
9		Great Windmill- <i>Atrophaneura dasarada dasarada</i> (Moore) 1857	C	-
10		Common Batwing- <i>Atrophaneura varuna astorion</i> (Westwood) 1842	R	-
11		Lesser Batwing- <i>Atrophaneura aidoneus</i> (Doubleday) 1845	VR	-
12		Common Mime- <i>Chilasa clytia clytia</i> (Linnaeus) 1758	C	Schedule-I
13		Common Mormon- <i>Prinsepis polytes romulus</i> (Cramer) 1775	C	-
14		Great Mormon- <i>Prinsepis memnon agenor</i> (Linnaeus) 1758	C	-
15		Common Raven- <i>Prinsepis castor polas</i> (Jordan) 1909	R	-

16		Yellow Helen- <i>Princeps nephelus chaon</i> (Westwood) 1845	C	-
17		Red Helen- <i>Princeps helenus helenus</i> (Linnaeus) 1758	R	-
18		Paris Peacock- <i>Princeps paris paris</i> (Linnaeus) 1758	R	-
19		Blue Peacock- <i>Princeps arcturus arcturus</i> (Westwood) 1842	R	-
20		Lime Butterfly- <i>Princeps demoleus</i> (Linnaeus) 1758	C	-
21		White Dragontail- <i>Leptocircus curius</i> F.	VR	-
22		Spotted Zebra- <i>Paranticopsis megarus megarus</i> Wd.	R	-
	Family: <i>Lycaenidae</i>			
23	Sub-family- <i>Curetinae</i>	Angled Sunbeam- <i>Curetis dentata</i> Moore 1882	C	-
24	Sub-family <i>Polyommatainae</i>	Forget Me Not- <i>Catochrysops straso</i> (Fabricius) 1793	R	-
25		Silver Forget Me Not- <i>Catachrysops lithargyria</i> M. Evans	R	
26		Plains Cupid- <i>Edales pandava</i> (Horsfield)1892	C	-
27		Small Cupid- <i>Edales contracta nila</i> Evans	C	-
28		Common Pierrot- <i>Castalius rosimon rosimon</i> Fruhstorfer	C	Schedule-I
29		Dark Pierrot- <i>Tarucus ananda</i> (De Niceville)1883	R	Schedule-III
30		Gram Blue- <i>Euchrysops cnejus pura</i> (Fabricius) 1798	C	-
31		White Cerulean- <i>Jamides cleodus pura</i>	R	Schedule-II
32		Common Cerulean- <i>Jamides celeno celeno</i> (Cramer) 1775	C	-
33		Dark Cerulean- <i>Jamides bochus</i> Stoll(Cramer) 1767	R	-
34		Metallic Cerulean- <i>Jamides alceto euryasces</i> Fruhstorfer	C	

35		Glistening Cerulean- <i>Jamides elpis palissa</i> Fruhstorfer	R	
36		Lime Blue- <i>Chilades laius laius</i> (Cramer) 1780.	C	-
37		Tailless Lineblue- <i>Prosotas dubiosa sivoka</i> Evans	C	-
38		Pale Hedge Blue- <i>Celeastrina cardina dilecta</i> (Moore) 1879	C	-
39		Large 4 Line Blue- <i>Nacaduba pactolus continentalis</i> Fruhstorfer	C	Schedule-II
40		Violet 4 Line Blue- <i>N. pavana vajuva</i> Fruhstorfer	C	-
41		Dark Grass Blue- <i>Zizeeria knyasna</i>	C	-
42		Opaque 6 Line Blue- <i>Nacaduba beroe gythion</i> Fruhstorfer	C	-
43		Pale Grass Blue- <i>Pseudozizeeria maha</i> (Kollar)	C	-
44		Quaker- <i>Neopithecops zalmora</i> Butler	C	
45		Chequered Blue- <i>Polymatus vicrama cashmirans</i> M	R	
46		Common Hedge Blue- <i>Acetolepis puspa gisca</i> Fruhstorfer	C	
47		Margined Hedge Blue- <i>Lycaenopsis marginata</i> (De Niceville) 1883	R	-
48		Peablu- <i>Lampides boeticus</i> Linnaeus 1767	R	Schedule-II
49	Sub-Family-Lycaeninae	Golden Sapphire- <i>Heliophorus brahma</i> Moore	C	Schedule-I
50		Purple Sapphire- <i>Heliophorus epicles indicus</i> Fruhstorfer	C	Schedule-I
51	Sub-Family-Theclinae	Whitebanded Royal- <i>Ancema (pratapa) cotys</i> (Hewitson) 1865	C	Schedule-I
52		Bi-spot Royal- <i>Ancema ctesia</i> (Hewitson) 1865	C	-
53		Common Acacia Blue- <i>Surendra quercetorum quercetorum</i> (Moore) 1857	R	-

54		Centaur Oakblue- <i>Nilasera centaurus pirithous</i> (Moore)1883	R	-
55		Hewitson's Dull Oakblue- <i>Narathura aenea</i> Hewitson 1869	C	Schedule-II
56		Dark Broken Banded Oakblue- <i>Amblypodia atrax</i> Evans.	C	-
57		Longbanded Silverline- <i>Spindasis lohita himalayanus</i> Moore	R	-
58		Common Red Flash- <i>Rapala jarbas</i> (Fabricius) 1787	C	-
59		Fluffy Tit- <i>Zeltus amasa</i> (Fabricius)	C	-
60		Yamfly- <i>Loxura atymnus continentalis</i> Fruhstorfer.	R	-
61		Orchid Tit- <i>Chliaria othona</i> (Hewitson) 1865	VR	Schedule-I
62		Common Guava Blue- <i>Virachola isocrates</i> (Fabricius) 1793	R	Schedule-I
63		Common Tit- <i>Hypplycaena erylus himavantus</i> Fruhstorfer	C	-
64		Common Imperial- <i>Cheritra freja freja</i> (Fabricius) 1793	C	-
65		Common Onyx- <i>Horaga onyx onyx</i> (Moore) 1857	R	Schedule-II
66	Sub - Family-Riodininae	Punchinello- <i>Zemeros flegyas indicus</i> Frbricius 1897	C	-
67		Palm Judy- <i>Abisara echerius suffusa</i> Moore 1878	R	-
	Family: Nymphalidae			
68	Sub-family-Satyrinae	Chumbi Wall- <i>Chonala masoni</i> (Elwes) 1897	C	-
69		Common Evening Brown- <i>Melanitis leda ismene</i> (Cramer) 1775	C	-
70		Dark Evening brown- <i>Melanitis phedima bela</i> Moore 1875	C	-
71		Common Palmfly- <i>Elymnias hypermnestra undularis</i> (Drury) 1773	C	-

72		Spotted Palmfly- <i>Elymnias malelas malelas</i> (Hewitson) 1863	C	-
73		Lilacine Bushbrown- <i>Mycalesis franscica santana</i> Moore 1857	C	-
74		Brighteye Bushbrown- <i>Mycalesis nicotia</i> Westwood 1850	C	-
75		Banded Treebrown-Neope <i>confusa confusa</i> Aurivillius 1898	C	-
76		Common Bushbrown- <i>Mycalesis perseus blasius</i> (Fabricius) 1798	C	-
77		Darkbrand Bushbrown- <i>Mycalesis mineus mineus</i> (Linnaeus) 1765	C	-
78		Nigger- <i>Orsotrioena medus medus</i> (Fabricius) 1775	C	-
79		Himalayan fivering- <i>Ypthima sakra sakra</i> Moore 1857	C	-
80		Common Three Ring- <i>Y. asterope maharatta</i> Moore 1884	C	-
81		Common Four Ring- <i>Y. hubenri hubenri</i> Kirby 1871	C	-
82		Common Fivering- <i>Ypthima baldus baldus</i> (Fabricius) 1775	C	-
83	Sub-family-Charaxinae	Tawny Rajah-Charaxes <i>polyxena hierax</i> Felder 1867	C	-
84		Scarce Tawny Rajah-Charaxes <i>aristogiton</i> Felder 1867	R	-
85		Yellow Rajah- <i>Charaxes marmax</i> Westwood 1848	C	-
86		Common Nawab- <i>Polyura athmas athamas</i> (Drury) 1770	C	-
87		Pallid Nawab- <i>Polyura arja</i> (Felder & Felder) 1867	R	-
88		Statelty Nawab- <i>Polyura dolon magniplaga</i> Fruh.	R	Schedule-II
89		Great Nawab- <i>Polyura e. eudamippus Db.</i>	R	Schedule-II

90	Sub-family-Apaturinae	Eastern Courtier- <i>Sephisa chandra</i> (Moore) 1857	R	Schedule-I
91		Constable- <i>Dichorragia nesimachus</i> Bdv.	R	-
92	Sub-family-Nymphalinae	Common Castor- <i>Ariadne merione assama</i> (Evans)	C	-
93		Angled Castor- <i>Ariadne ariadne pallidior</i> (Frusthorfer)	C	-
94		Vagrant- <i>Issoria sinha sinha</i> (Kollar) 1844	C	-
95		Common Leopard- <i>Phalanta phalantha</i> (Drury) 1770	C	-
96		Common Yeoman- <i>Cirrochroa tyche mithila</i> Moore 1872	C	-
97		Large Yeoman- <i>Cirrochroa aoris oaris</i> Doubleday 1847-48	C	-
98		Indian Fritillary- <i>Argyreus hyperbius hyperbius</i> , (Johanssen) 1764	R	-
99		Peacock Pansy- <i>Precis almana almana</i> (Linnaeus) 1758	C	-
100		Yellow Pansy- <i>P. hierta magna</i> Evans 1923	C	-
101		Lemon Pansy- <i>Precis lemonias lemonias</i> (Linnaeus) 1758	C	-
102		Grey Pansy- <i>Precis atlites atlites</i> (Johanssen) 1764	C	-
103		Chocolate Soldier- <i>Precis iphita iphita</i> (Cramer) 1779	A	-
104		Great Eggfly- <i>Hypolimnas bolina</i> (Linnaeus) 1758	C	-
105		Wizard- <i>Rhinopalpa poyinice birmana</i> Fruh.	R	-
106		Common Jester- <i>Symbrenthia lilaea khasiana</i> Moore 1874	C	-
107		Common Sailer- <i>Neptis hylas varmona</i> Moore 1872	C	-

108		Common Sailer - <i>Neptis sappho astola</i> Moore 1872	C	-
109		Yellow Sailer - <i>Neptis ananta ochracea</i> Evans 1924	R	Schedule-II
110		Himalayan Sailer - <i>Neptis mahendra</i> Moore 1872	C	
111		Yerburi,s Sailer - <i>Neptis yerburi sikkima</i> Evans	R	-
112		Clear Sailer - <i>Neptis clinia susruta</i> Moore 1872	R	Schedule-II
113		Sullied Sailer - <i>Neptis soma soma</i> Moore 1858	R	Schedule-II
114		Short banded Sailer - <i>Phaedyra columella ophiana</i> , (Moore) 1872	R	Schedule-I
115		Common Lascar - <i>Pantoporia hordonia hordonia</i> , (Stoll) 1791	C	-
116		Common Sergeant - <i>Parathyma perius</i> (Linnaeus) 1758	C	-
117		Orange Staff Sergeant - <i>Parathyma cama</i> (Moore) 1857	C	-
118		Colour Sergeant - <i>Parathyma nefte inara</i> (Doubleday and Hewitson) 1850	C	-
119		Knight - <i>Lebadea martha martha</i> (Fabricius) 1787	R	-
120		Grey Count - <i>Tanaecia lepidea miyana</i> Frash	C	-
121		Grey Count - <i>Tanaecia lepidea lepidea</i> (Butler)	C	
122		Commodore - <i>Limenitis danava</i> (Moore) 1857	C	
123		Common Baron - <i>Euthalia aconthea suddhodana</i> Frusthorfer	C	
124		Great Arcduke - <i>Adolias cyanipardus</i> But	R	
125		Common Map - <i>Cyrestis thyodamus thyodamus</i> Bdv.	R	-

126		Common Maplet- <i>Chersonesia risa</i> Db.	VR	-
127	Sub-family- <i>Heliconiinae</i>	Leopard Lacewing- <i>Cethosia cyane</i> Drury 1770	C	-
128		Red lacewing- <i>C. biblis tisamena</i> Fabricius 1770	R	-
129	Sub-family- <i>Danainae</i>	Blue Tiger-Tirumala <i>limniace</i> <i>leopardus</i> (Butler) 1866	R	-
130		Dark Blue Tiger- <i>Tirumala</i> <i>septrionis</i> (Butler)	R	-
131		Chocolate Tiger- <i>Parantica melaneus</i> <i>platiniston</i> (Fruhstorfer) 1910	C	-
132		Common Tiger- <i>Danaus (Salathura)</i> <i>genutia</i> (Cramer) 1779	C	-
133		Plain Tiger- <i>Danaus</i> (Anosia) <i>chrysippus</i> (Linnaeus) 1758	R	-
134		Glassy Tiger- <i>Parantica aglea</i> <i>melanoides</i> (Moore) 1883	C	-
135		Stripped Blue Crow- <i>Euploea mulciber</i> <i>mulciber</i> Crammer 1777	R	Schedule- III
136		<i>Blue King Crow-</i> <i>Euploea klugii klugii</i> Moore 1858	R	
137		Common Crow- <i>Euploea core core</i> Cramer 1790	C	Schedule- III
138		Commodore- <i>Limenitis danava</i> (Moore) 1857	C	-
	Family: <i>Hesperiidae</i>			
139	Sub - family- <i>Pyrginae</i>	Water Snow Flat- <i>Tagides litigiosa</i> <i>litigiosa</i> (Moschler) 1878	C	-
140		Common Snow Flat- <i>Tagiades atticus</i> <i>hasiana</i> M	C	-
141		Fulvous Pied Flat- <i>Ciladenia dan festa</i> (Evans)	C	-
142		Fulvous Pied Flat- <i>Ciladenia dan dan</i> F.	R	-
143		Spotted Angle- <i>Caprona agama agama</i> Moore 1857	R	-

144		Chestnut Angle- <i>Odontoptilum angulata angulata</i> (Felder) 1862	R	-
145	Sub-Family-Coeliadinae	Orange Awlet- <i>Bibasis jaina jaina</i> Moore 1865	R	-
146		Pale Green Awlet- <i>Bibasis gomata gomata</i> (Moore) 1865	VR	-
147		Common Awl- <i>Hasora taminatus</i> Fruhstorfer 1911	C	-
148	Sub-Family-Hesperiinae	Indian Skipper- <i>Syrechtus galba</i> (Fabricius) 1793	C	-
149		Bush Hopper- <i>Ampittia dioscorides</i> F	R	-
150		Chestnut Bob- <i>Lambrix salsala salsala</i> (Moore) 1865	C	-
151		Chocolate Demon- <i>Ancistroides nigrita diocles</i> (Moore)1865	C	-
152		Spotted Demon- <i>Notocrypta fiesthamelii alysos</i> Moore 1865	C	-
153		Grass Demon- <i>Udaspes folus</i> (Cramer) 1775	C	
154		Common Banded Demon- <i>Notocrypta paralyson alysia</i>	C	-
155		Tree Flitter- <i>Hyarotis adrastus praba</i> (Moore) 1865	C	-
156		Purple and Gold Flitter - <i>Zographetus satwa</i>	C	-
158		Giant Redeye- <i>Gangara thyrsis thyrsis</i> (Fabricius) 1775	C	-
159		Common Red Eye- <i>Matapa aria</i> (Moore) 1865	C	-
160		Himalayan Dark Dart- <i>Potanthus dara (danna)</i> (Moore) 1878	C	-
161		Common Dart- <i>Potanthus sita</i> Evans 1932	C	-
162		Wax Dart- <i>Cupitha purreea</i> Moore 1877	R	-

163		Blank Swift- <i>Caltoris kumara moorei</i> Evans 1926	C	-
164		<i>Colon Swift- Baores cahira</i> Evans	C	-
165		<i>Large banded Swift-Pleopidas sinensis</i> (Mabille)	C	-
166		Rice Swift- <i>Borbo cinnara</i> (Wallace) 1866	C	-
167		Common Dartlet- <i>Oriens gola</i> <i>pseudolus</i> (Mabille)1883	R	-
168		Coon- <i>Sancus pulligo subfasciatus</i> M	R	-
	Family: Pieridae			
169	Sub-family-Pierinae	Psyche- <i>Leptosia nina nina</i> (Fabricius) 1793	R	-
170		Indian Cabbage White- <i>Pieris canidia</i> <i>indica</i> Evans 1926	R	-
171		Chocolate Albatross- <i>Appias lyncida</i> <i>elenora</i> (Boisduval) 1836)	C	-
172		Common Albatross- <i>Appias albina</i> <i>darada</i> (C, & R. Felder) 1865	R	Schedule-II
173		Common Gull- <i>Cepora nerissa nerissa</i> (Fabricius) 1775	R	-
174		Yellow Orangetip- <i>Ixias pyrene</i> <i>familiaris</i> Butler 1898	C	-
175		Great Orangetip- <i>Hebomoia glaucippe</i> <i>glaucippe</i> (Linnaeus) 1758	C	
176		Common Zezebel- <i>Delias eucharis</i> (Drury) 1773	C	-
177		Red Spot Zezebel- <i>Delias descombesi</i> <i>descombesi</i> (Boisduval) 1836	C	-
178		Redbase Jezebel- <i>Delias aglaia</i> (Linnaeus) 1758	C	-
179		Painted Zezebel- <i>Delia hypareta indica</i> Wallace 1867	R	-
180	Sub-family-Coliadinae	Common Emigrant- <i>Catopsilia</i> <i>pomona</i> (Fabricius) 1775	C	-

181		Mottled Emigrant- <i>Catopsilia pyranthe</i> (Linnaeus) 1758	C	-
182		Tree Yellow- <i>Gandaca herina assamica</i> Moore 1906	R	-
183		Chocolate Grass Yellow- <i>Eurema sari sodalis</i> (Moore) 1886	R	-
184		Common Grass Yellow- <i>Eurema hecabe contubernalis</i> (Moore) 1886	C	-
185		One Spot Grass Yellow- <i>Eurema andersoni andersoni</i> (Moore) 1886	C	Schedule-II
186		Three Spot Grass Yellow- <i>Eurema blanda silhetana</i> (Wallace) 1867	C	-
187		The Small Grass Yellow- <i>Eurema brigitta rubella</i> (Wallace) 1867	C	-

Appendix - 13

Administration Infrastructure (List of Buildings):-

1. Field Director's Office Building at Barpeta Road
2. Field Director's Residence at Barpeta Road
3. Range Officer's Office Building at Bansbari
4. Forest IB at Bansbari
5. Forest IB at Mathanguri
6. Range Officer's Office Building at Panbari
7. Range Officer's Residence at Panbari
8. Transit Camp at Maina (Bori Saurang, Panbari)
9. Range Officer's Office Building at Bhuyanpara
10. Range Officer's Residence at Bhuyanpara
11. Beat Officer's Office Building (UNESCO), Barpeta Road
12. Transit Camp at Barpeta Road

Appendix - 14**LIST OF ANTIPOACHING CAMPS IN MANAS NATIONAL PARK:-****Bansbari Range:-**

01. Kahitama	02. Mathanguri
03. Sidajhar	04. Latajhar
05. Buraburijhar	06. Uchila
07. Kuribeel	08. Second Gate
09. Rhino camp	10. Palsigur
11. Kahibari	12. Bhatgali
13. Katajhar	14. Bispani Ghat camp.
15. Bongale Haat Dhua (Fort)	16. Chorphuli
17. Magurjani	18. Bispani (Watch tower)
19. Tinimail	20. New Buraburi
21. Barengabari	22. Bhalaguri
23. Sidhajhar	24. Narayanguri
25. Uchila Bund	26. Gundaribeel
27. Mora Gyati	28. Songlapani

Bhuyanpara Range:-

01. Dhonbeel	02. Rupahi (Chika-gondha)
03. Kanchanbari	04. Makhibaha
05. Doimari	06. Digjari
07. Khoirbari	08. Agrang
09. Betbari	10. Panda camp
11. Kokilabari	12. Sewali camp
13. Kalpani (Semajhora)	14. Kaljhar.
15. Tangunmara	16. Kaljhar
17. Rupahi	18. Kakilabari Seed Farm
19. Sikhaganda	20. Podumpukuri
21. Sengmari	22. Agrang
23. Rabang	

Panbari Range:-

01. Saurang	02. Kuhighat
03. Maina camp (Bori-Saurang)	04. Ghogehaga
05. Lafasari	06. Roumari camp
07. Bonsoom Bagan (Sikhlaijhar)	08. Panbari Range
09. Lakhijhora Beat	10. Sourang Beat
11. Bonsoom Bagan Beat	12. Kuhighat Beat
13. Ghogehaga Beat	14. Kachubil
15. Kheroni	16. Ouguri
17. Sahabghat	18. Ranighat

Appendix - 15**List of names of blocks in Manas National Park**

Bansbari Range	
1. Sidajhar	12. Chorfully
2. Lotajhar	13. Rabang
3. Mathanguri	14. Doimari
4. Uchila	15. Bhaoraguri
5. Buraburijhar	16. Kapurpura
6. Katajhar	17. Roisingla
7. Katajhar	18. Kuribeel
8. Bhatgali	19. Kahibari
9. Magurjani	20. Palsiguri
10. Bhalaguri	21. Songlapani
11. Narayanguri	
Panbari Range	
22. Sukanjani	29. Badaribeel
23. Siklaijhar	30. Lafasari
24. Gabharukhunda	31. Bonsumbagan
25. Kachubeel	32. Morapagla
26. Jalabari	33. Bori Sourang
27. Roumari	34. Garam pani
28. Surja nala	35. Lakhijhara
Bhuyanpara Range	
36. Rupahi	45. Makhibaha
37. Koroibari	46. Agrang
38. Semajhora	47. Daolabeel
39. Satarupa	48. Kaljhar
40. Digjhari	49. Khoirbari
41. Betbari	50. Alabari
42. Panda Camp	51. Kalpani
43. Tangonmara	52. Koklabari
44. Bhalukdaba	53. Sikagondha.

Appendix - 16**List of vehicles Manas National Park:**

Sl. No.	Type of vehicle	Registration No.	Remarks
1	Scorpio SXL	AS-16-A-1668	Old & repair is expensive
2	Ambulance (Mahindra)	AS/01BC/3446	Running
3	Bolero SLX	AS-16A-3798	Old & regular is required
4	Bolero GLX	As-15-A/2297	Old & dilapidated
5	TATA(S)Truck	AMA-7096	Oldest vehicle in Manas. Not usable.
6	Maruti Gypsy	AS-25/8084	Old & dilapidated
7	407 Mini Truck (TATA)	AS-16-A-3114	Old & dilapidated
8	Max PickupVan	AS-15-A/0029	Old & dilapidated
10	TATA Mobile	AS-16/9704	Old & dilapidated
11	Bolero SLX	AS-15-C-0460	Running
12	Maruti Gypsy	AS-01/A-9568	Running
13	Bolero Camper	AS-15B/6560	Old & dilapidated
14	L & T JCV		Running
15	Canter	AS-15/0208	Old & dilapidated
16	Max Pickup Van	AS-15A/0028	Old & dilapidated
17	Bolero Camper	AS-28/0021	Old & dilapidated

List of boats in Manas National Park: -

Type	No.	Year	Condition
Rubber boats	2		Running
Rubber boats	2		Condemned
Country boats	2		Running
Country boats	2		Need major repairing
Wooden engine boats	2		Running

Appendix - 17**List of captive elephants in Manas National Park-**

Sl. No.	Elephant Stud No	Name of Elephant	Age/Date of birth	Sex	History/Source of Elephant	Microchip No	Remarks
1	MNP3	Purnima	03/11/1963	Female	Captive born D/O Sundari	00064F11E3	
2	MNP4	Rukmini	01/06/1964	Female	Captive born , D/O Monimala	000659173B	
3	MNP5	Radhika	07/07/1969	Female	Captive born. D/O Monimala	0006590835	
4	MNP6	Normada	30/30/1973	Female	Captive born D/O Jamuna	0006585065	
5	MNP7	Urvasi	01/09/1975	Female	Captive born, D/O Sundori	000652B171	
6	MNP8	Pramila	1976	Female	Purchases	000647B803	Birth male calf 26/01/2018
7	MNP9	Usha	1976	Female	Captive born D/O Girimala	0006593AA2 27/11/2015	
8	MNP10	Sakuntala	01/03/1979	Female	Captive born, D/O Ratnamala	000CD643F	
9	MNP11	Menoka	03/03/1985	Female	Captive born D/O Purnima	000659168B	
10	MNP12	Manashi	02/02/1986	Female	Captive born, D/O Dalimi	0006591D14	
11	MNP13	Doimalu	28/02/1988	Male	Captive born S/O Jamuna	000659077A	
12	MNP14	Chameli	19/08/1990	Female	Captive born, D/O Manimala	0006591864	
13	MNP15	Jasoda	10/12/1997	Female	Captive born D/O Purnima	000647B49E	
14	MNP16	Meera	1998	Female	Captive born D/O Radhika	0005685604	
15	MNP17	Gaurishankar	03/01/1999	Male	From Orang NP	00065897A3	
16	MNP18	Ramu	01/07/2001	Male	Rescued on 2001	00064F1305	
17	MNP19	Panchali	15/06/2002	Female	Captive born D/O Jamuna	0006585473	
18	MNP20	Mridula	25/10/2002	Female	Captive born D/O Radhika	0006590835	
19	MNP22	Panimala	30/11/2002	Female	Captive born, D/O Purnima	000658560B	
20	MNP23	Ganga	15/04/2004	Female	Rescued 2004	00065853CC	
21	MNP25	Mahon	Rescued	Male	WTI	0006CDCE67	
22	MNP26	Pinku	Rescued	Male	WTI	0006CDED3 27/11/2015	
23	MNP28	Lakhi	DOB 2008	Male	S/O Purnima	00064F1E3	
24	MNP29	Swarasati	DOB 2008	Female	Captive born S/O Manashi	0006590F2A	
25	MNP31	Dada	20/10/2010	Male	Captive born S/O Meera	0006CD5162	
26	MNP32	Rabi Prasad	07/12/2010	Male	Captive born	0006CD25B	

					S/O Narmada		
27	MNP33	Kartik	27/04/2012	Male	Captive born S/O Sakuntala	0006CDE54C	
28	MNP34	Protima	Age on Oct 2012,5 Yrs.	Female	FromState Zoo 25/10/2012	0006CDC166	
29	MNP36	Boloram	31/12/2012	Male	Captive born S/O Panchali	0006CD4316	Training 07/12/2017
30	MNP37	Leela	25/02/2013	Female	Captive born D/O Rukmini	0006CDCCF7 29/11/2015	Training 07/12/2017
31	MNP38	Daiboki	09/04/2013	Female	Captive born D/O Purnima	0006CB134 29/11/2015	Training 07/12/2017
32	MNP39	Munish	31/07/2013	Male	Captive born S/O Manashi	0006CD4C8E 29/11/2015	Training 07/12/2017
33	MNP40	Bhaiti	17/12/2013	Male	Captive born S/O Meera	0006CDAA39	
34	MNP41	Narendra	26/05/2014	Male	Captive born S/O Sakuntala	0006CDAC38	
35	MNP42	Pandid	29/11/2014	Male	Captive born S/O Panimala		
36	MNP43	Rashmi	24/12/ 2015	Female	D/O Radhika		
37	MNP44	Madhumala	31/08/2016	Female	D/O Usha		
38	MNP45	Maidangsri	05/02/2017	Female	D/OMeera		
39	MNP45	Tora	WTI/CWRC	Female	Rescue by WTI		Training 07/12/2017
40	MNP46	Iragdao	26/01/2018	Male	S/O Pramila		
41	MNP47	Manalisha	31/10/2018	Female	S/O Chameli		

Appendix - 18**Wireless and communication network in Manas**

Item/Type	Nos.	Year of purchase	Remarks
G.M.-300 (Motorola Fixed sets)	3	1997	Working except 5 nos. which are repairable.
	9	1997	
	2	1998	
	33	1998	
	22	2008	
	15	2010	
	12	2010	
Simoco (Fixed sets)	16	2010	Working
G.M.- 300 (Motorola Fixed sets)	10	2011	Working
G.P.- 300 (Motorola Mobile hand held sets)	2	1997	Working except 8 which are repairable.
	10	1998	
	20	1998	
	72	2008	
	20	2009	
HYT (Mobile hand held sets)	28	2010	Working but very satisfactory
G.P.- 300 (Motorola Mobile hand held sets)	10	2011	Working
D.C. Power Supply Units	3	1998	Working except 2 numbers (repairable).
	5	1998	
Battery Charger	2	-	Non working & not repairable.
	2	1998	

Appendix - 19

Natural waterholes/water bodies of Manas National Park

Panbari Range:

01. Gambeel	02. Badaribeel
03. Palangshi	04. Simlabeel
05. Betbari	06. Ajarbeel
07. Kanchanbeel	08. Gamaribeel.
-

Bansbari Range:

01. Chorphuli Pukhuri	02. Dhalai Pukhuri (Buraburijhar)
03. Khonkhrabeel (Panbarijhar)	04. Kot Pukhuri (Bangale hat dhuwa)
05. Eta Pukhuri (Bangale Hat Dhuwa)	06. Kuchiabeel (Bhatgali)
07. Bhumuk	08. Kuribeel
09. Dui Kuribeel	10. Nalbari Pukhuri (Kuribeel area)
11. Bhatgali Nala	12. Gothaibari Nala
13. Ali Khanda Pukhuri (Kuribeel)	14. Roisingla Pukhuri
15. Kadam Pukhuri (Roisingla area)	16. Mathanguri Pukhuri
-

Bhuyanpara Range:

01. Padumpukhuri (near Digjhari)	02. Seothaibeel (Betbari)
03. Daolabeel (North of Tangunmara)	04. Khaisipukhuri (Tangunmara)
05. Makhibaha (east)	06. Goroibeel (Makhibaha south)
07. Gandabeel (near Narayanguri bund)	08. Chengmari Nala
09. Hatikopra (Makhibaha west)	10. Torabari
11. Abaidara.	

Appendix - 20

Water sources of Manas National Park (rivers/streams/nallahs)

Rivers and nallahs with perennial water -

01. Bispani (Beki)	11. Angulichinga/Semajhora/Satarupa
02. Kasimdoha	12. Doimari
03. Madulijhora	13. Hakua
04. Fotika	14. Mora Manas
05. Bhatgali	15. Burisuta
06. Pahumara	16. Garabdara
07. Rupahi	17. Mora pagla
08. Dhonbeel	18. Jia pagla
09. Digjari	19. Lafasari
10. Agrang	20. Kanya Santi Nala

The rivers and streams in bhabar zone without water during dry spell -

01. Jongrong	09. Kalanadi
02. Songrong	10. Simbhu
03. Giyati	11. Teklai
04. Garuchara	12. Maoji-gendri
05. Rabang	13. Garumara
06. Betbari	14. Alabari
07. Disami	15. Pota River
08. Doimari	16. Gabharukhunda

Appendix - 21**SANCTIONED STAFF POSITION OF MANAS NATIONAL PARK****STAFF STRENGTH AS ON 10 /05/2019**

Sl.No.	Category of post	Sanction Strength	Man in Position	Vacant	Transfer vacant	Excess
1	2	3	4	5	6	7
1	FDTP	1	1			
2	Dy. Director	1	1			
3	A.C.F.	1	1			
4	Research Officer	1	-		1	
5	Superintendent	1	1			
6	V.A.S.	1	1			
7	U.D.A. (Director Level)	2	2			
8	U.D.A. (Dvn. Level)	1	1			
9	L.D.A. (Director Level)	5	4	1		
10	Record Keeper	1	1			
11	Range Asstt.	3	3			
12	V.F.A.	1	1			
13	Steno	1	1			
14	Forest Ranger	3	5			2
15	Dy. Ranger	4	3		1	
16	Forester- I	33	33			
17	Forester- II	12	16			4
18	Forest Guard	180	111	13	56	
19	Mahut	22	17	5		
20	Game Watcher	44	33	10	1	
21	Driver	8	6	2		
22	Office Peon	4	-	4		
23	Chowkidar	9	7	2		
24	Handiman	3	3			
25	Grass Cutter	23	11	11	1	
26	Boat Man	10	3	7		
27	Sweeper	1	-	1		
28	Attendant	1	1			
29	Laboratory Attendant	1	1			
30	Duk Runner	1	1			
31	Mali	1	1			
32	Paniwala	1	1			
33	Bearer	1	1			
		382	272	56	60	6

Appendix - 22

CATEGORIES OF MANPOWER AVAILABLE**IN MANAS NATIONAL PARK**

Sl. No.	Category of Manpower	Availability
1	Regular Park Staff	272
2	Van Mazdoor (CL) supported by NTCA	140
3	Computer Operator supported by NTCA	1
4	Field Biologist supported by NTCA	1
5	Field Biologist supported by Biosphere	1
3	Service Provider supported by BTC Govt.	135
4	Home Guard supported by IRV	15
5	Armed Home Guards supported by NTCA	140
6	Assam Forest Protection Force (AFPF)	51
TOTAL =		756

Appendix – 23**List of (position of) arms and ammunition in Manas**

Type of arms	Number/ units	Ammunitions
.315 Rifles	132	1164
DBBL Guns	48	510
.303 Rifle	18	446
Tranquilization Guns	3	-
.32 Revolver	4	-

Appendix - 24

GOVERNMENT OF ASSAM
ENVIRONMENT AND FORESTS DEPARTMENT
DISPUR, GUWAHATI.

ORDER BY THE GOVERNOR
NOTIFICATION

No. FRW.73/2008/239

Dated Dispur the 31st Oct/2015

In the Interest of public service, the Governor of Assam is pleased to revise the rate of entry fee, elephant safari, camera fee etc. in Kaziranga National Park as shown below with immediate effect and until further orders:-

Sl. No.	Item	Existing Rate in Rupees		Revise Rate in Rupees	
		Indian	Foreigner	Indian	Foreigner
1	Entry fee per person day	50.00	500.00	100.00	650.00
2	Fee for elephant seat per trip	450.00	1,000.00	750.00	1,250.00
3 a	Toll for road per trip per day	300.00	300.00	300.00	300.00
3 b	Toll for river cruise per trip per day	300.00	300.00	1,000.00	1,000.00
4	Camera Charges:-				
4 a	Mobile and Smart Phone			FREE	FREE
4 b	Still Photography	50.00	50.00	100.00	200.00
4 c	Movie/Video Camera	500.00	1,000.00	1,000.00	1,000.00
4 d	Still photography (Professional)	500.00	2,000.00	1,000.00	3,000.00
4 e	Movie/ Video Camera (Professional)	5,000.00	20,000.00	10,000.00	30,000.00
5.	Film/Documentary shooting per day				
5 a	Feature Film	5,000.00	25,000.00	1,00,000.00	2,00,000.00
5 b	Documentary Film	5,000.00	25,000.00	15,000.00	75,000.00
5 c	Security money for feature film	5,000.00	25,000.00	1,00,000.00	2,00,000.00
5 d	Security money for documentary film per day	5,000.00	25,000.00	15,000.00	75,000.00

This has been issued with the approval of the Competent Authority.

Sd/- D.J. Hazarika, IAS
Secretary to the Govt. of Assam
Environment & Forest Department

Contd.....

Memo No. FRW.73/2008/239-A

Dated Dispur the 31st Oct/2015

Copy to:-

1. The Principal Chief Conservator of Forests & Head of Forest Force, Assam, Rehabari, Guwahati-08
2. The Principal Chief Conservator of Forests (Wildlife) Bashistha, Guwahati-29
3. The Director, Kaziranga National Park, Bokakhat.
4. P.S. to the Hon'ble Minister, Environment & Forests, Assam, Dispur, Guwahati-6.
5. P.S. to the Addl. Chief Secretary, Environment & Forests, Assam, Dispur, Guwahati-6.
6. The Deputy Director, Govt. Press, Bamunimaidan, Guwahati-21 for favour of publication of the above notification in the next issue of the Assam Gazette.

By order etc.

Joint Secretary to the Govt. of Assam.
Environment & Forests Department.

Appendix - 25**Visitors and revenue statistics of Manas National Park**

Years	Total Visitors			Total Revenue (In Rs.)
	India	Foreign	Total Visitors	
2000-01	1005		1005	
2001-02	3219	11	3230	231441.00
2002-03	300	21	321	166510.00
2003-04	215	88	303	327200.00
2004-05	13648	234	13882	981995.00
2005-06	24596	289	24885	2494432.00
2006-07	11760	69	11829	1398650.00
2007-08	9546	239	9785	64370.00
2008-09	17774	139	17913	334135.00
2009-10	9734	503	10237	1747745.00
2010-11	16867	129	16996	1591778.00
2011-12	24030	177	24207	2374655.00
2012-13	18328	91	18419	2488065.00
2013-14	22840	325	23165	3093075.00
2014-15	9786	475	10261	3347583.00
2015-16	40559	614	41173	7369007.00
2016-17	36201	351	36552	7624053.00
2017-18	37592	480	38072	8130830.00
2018-19	42340	650	42990	10663500.00

Appendix - 26

List of roads and patrolling paths of Manas National park:

Panbari Range:

1. Southern Boundary Road	: 11 km.
2. Panbari – Gabharukhunda Road	: 24 km.
3. Sikhlaijhar (Ouguri) – Gabharukhunda Road	: 30 km.
4. Lakhijhora – Badaribeel – Gabharukhunda Road	: 28 km.
5. South Boundary to Lafasari Road	: 12 km.
6. Ghogehaga to Kunhighat Road	: 07 km.
7. Ghogehaga to Roumari Road	: 03 km.
8. Lafasari to Badaribeel Road	: 07 km.
9. Lafasari to Sikhlaijhar (old) Road	: 07 km.
10. Sikhlaijhar to Sukanjan Road	: 15 km
11. Roumari to Kunhighat Road	: 06 km
12. Kunhighat to Gabharukhunda Road	: 15 km.
13. Panbari to Ghogehaga Road	: 05 km.
14. Ghogehaga to Teteliguri Road	: 05 km.
15. Teteliguri to Sikhlaijhar Road	: 04 km.
16. Saurang – Lafasari – Gabharukhunda Road	: 28 km.
17. Lafasari to Sukanjan Road	: 16 km.
18. Saurang to Kunhighat Road	: 15 km.

Bansbari Range:

1. Bansbari – Mathanguri Road	: 21 km.
2. Southern Boundary Road	: 22 km.
3. Bansbari – Buraburi	: 09 km
4. Bansbari – Kuribeel	: 12 km
5. Bansbari – Buraburi – Uchila	: 16 km
6. Kuribeel – Uchila	: 04 km
7. Latajhar – Chorphuli – Uchila	: 06 km
8. Uchila – Katajhar	: 04 km
9. Uchila – Dighaltari – Dhonbeel – Bhuyanpara	: 11 km
10. Uchila – Roisingla – Mathanguri	: 14 km
11. Mathanguri – Mora Gyati – Doimari	: 18 km
12. Roisingla – Garuchara	: 05 km

Bhuyanpara Range:

1. Bhuyanpara – Makhibaha	: 18 km
2. Southern Boundary Road	: 22 km.
3. Doimari – Kokilabari	: 14 km
4. Makhibaha – Semajhora – Panda Camp	: 16 km
5. Agrang – Semajhora – Makhibaha	: 11 km
6. Kokilabari – Nanglam Road	: 16 km

Appendix – 27

Past Expenditure under Project Tiger, Biosphere and Elephant Reserve in Manas National Park

1. Project Tiger: Details of funds received since 2006-07:

Year	Amount Sanctioned	Released by State Govt. (1 st Instalment)		Released by State Govt. (2 nd Instalment)		Remarks
		Central Share	State Share	Central Share	State Share	
2006-07	30.00	30.00	-	-	-	Allotment is grossly inadequate as Manas requires special attention.
2007-08	53.70	53.70	-	-	-	Allotment is grossly inadequate as Manas requires special attention.
2008-09	773.6945	50.00	-	-	-	50.00 Lakhs against APO
2009-10	-	51.00 + 697.0945	-	-	-	Revalidated amount of the year 2008-09. Rs.51.00 Lakhs for works and Rs. 646.0945 Lakhs for Village Relocation. No fresh allotment. (From allotment of the year 1 st instalment-Central Share)
2010-11	356.08 197.50	237.504	-	-	-	1 st instalment-Central Share
2011-12	694.85	479.62	73.42	-	-	1 st instalment-Central Share
2012-13	342.77	273.176	8.65	-	-	Unspent adjusted
2013-14	496.85	372.9185	24.855	99.0765	-	Unspent adjusted
2014-15	370.960	323.144	-	-	-	Released Rs.328.199 by state Govt. of Rs. 140.00 + 183.144 = 323.144 and balance amount to be release 5.055 lakh
2015-16	339.800	259.8596	-	-	-	Fresh released of Rs. 54.5706 + Revalidated amount Rs. 205.289 = 259.8596 lakh
2016-17	718.944	512.585	42.177	-	-	1 st instalment-Central Share
2017-18	617.830	439.79	44.48	-	-	1 st instalment-Central Share
2018-19	668.560	475.055	47.00	-	-	Release including unspent balance amount of Rs. 5.055 lakh

2. Project Elephant: Details of funds received since 2006-07:

Year	Fund allotment (Rs in lakhs)	Fund received (Rs in lakhs)	Remarks
2006-07	4.248	4.248	
2007-08	4.809	4.80,9	
2008-09	5.268	5.268	
2009-10	Nil	Nil	
2010-11	4.11	4.11	
2011-12	3.43	3.43	Received from DFO, Kaziranga
2012-13	11.17	11.17	Received from DFO, Zoo, Guwahati
2013-14	-	-	
2014-15	-	-	
2016-17	-	-	
2017-18	25.365	25.365	
2018-19	-	-	

3. Biosphere: Details of fund received since 1995-96:

Year	Amount Sanctioned	Released by State Govt. (1 st Instalment)		Released by State Govt. (2 nd Instalment)		Remarks
		Central Share	State Share	Central Share	State Share	
1995-96	13.45	-	-	-	-	-
1996-97	47.00	60.45	-	-	-	Including revalidated amount
1997-98	30.00	-	-	-	-	Not released
1998-99	30.00	29.9999	-	-	-	Revalidated amount
1999-2000	-	26.50	-	-	-	Revalidated amount
2000-01	25.00	24.99	-	-	-	-
2001-02	-	-	-	-	-	No fund was sanctioned & released
2002-03	-	-	-	-	-	
2003-04	-	-	-	-	-	
2004-05	39.50	12.79	-	-	-	
2005-06	19.75	19.75	-	-	-	Revalidated amount
2006-07	-	-	-	-	-	
2007-08	-	-	-	-	-	
2008-09	100.46	-	-	-	-	
2009-10	-	40.00	-	-	-	
2010-11	-	-	-	-	-	
2011-12	-	-	-	-	-	
2012-13	-	-	-	60.46	-	Released 2 nd Instalment during the year 2008-09
2013-14	-	-	-	-	-	
2014-15	-	-	-	-	-	
2015-16	110.876	-	-	-	-	
2016-17	-	88.7008	-	-	-	Revalidated amount (1 st Instalment) during the year 2015-16
2017-18	67.70	-	-	-	-	Not released
2018-19	-	-	-	-	-	

Appendix- 28

List of research/studies undertaken and publications

Under tiger monitoring exercise-

Tigers across Borders: *Tigers in Indo-Bhutan Transboundary Manas Conservation Complex*. 2012. Technical report. New Delhi, India: MNP, RMNP, WWF-India, Aaranyak, ATREE, UWICE and Bhutan Foundation Evaluating abundance and density estimates for leopard and clouded leopard in Manas National Park, India: Conservation implication for rare carnivores. *Oryx*: in press. 2013

Diversity of carnivores in Manas National Park - a World Heritage Site, Assam, India. 2012. *Cat news*.

Species and habitats:-

Choudhury, A.U. 2006: Birds of Manas National Park, Gibbon Books and the Rhino Foundation for Nature in NE India.

Pranjal Bezbarua (2007): Study of plant diversity status in Manas Biosphere Reserve with special reference to community structure, Gauhati University.

Bibhuti P. Lahkar (2008): Ecology and Management of Grassland with special reference to Grass and Bird Communities in Manas National Park, Assam, Gauhati University

Jyoti P. Das (2011): Habitat utilization pattern and habitat suitability modeling of Asian elephant *Elephas maximus* in Manas National Park, India, North Orissa University

Naba K. Nath (2011): Study on Human-Elephant Conflict in Manas Tiger Reserve, Assam: Magnitude, Spatial Distribution and Mitigation Methods, North Orissa University

Brahma, N (2009). Bengal Florican Conservation and Research Initiative in BTAD, India. A technical report of Aaranyak.

Nath, N. K. (2009). Status survey of Hispid hare *Caprolagus hispidus* in the North Bank Landscape (Assam and Arunachal Pradesh), India. A Technical Report. Pp: 58.

Brahma N., Lahkar, B. P, (2011). Short-eared Owl *Asio flammeus*: a first record for Manas National Park, Assam. *Indian Birds* 7 (1): 20

Nath, N.K., B.P. Lahkar, N. Brahma, S. Dey, J.P Das, P.K. Sarma & B.K. Talukdar (2009). An assessment of human-elephant conflict in Manas National Park, Assam, India. *Journal of Threatened Taxa* 1(6): 309-316.

Sarma, P.K., Lahkar, B.P., Ghosh, S., Rabha, A., Das, J.P., Nath, N.K., Dey, S. and Brahma, N. (2008): Land-use and land cover change and future implication analysis in Manas National Park, India using multi-temporal satellite data, *Current Science* Vol 95, No. 2, 223-228.

Dr. J. Kalita and Dr. P. K. Saikia: Insect diversity of Manas BR, Dept. of Zoology, Gauhati University, Assam.

Dr. C. K. Barua: Floristic composition of Manas BR , Dept of Botany, Gauhati University

Dr. Dilip Chetry & Dr. J. Biswas: Status of Golden langur & their habitat ecology, Primate Research Centre, Guwahati.

Appendix- 29**Details of deaths/poaching of rhino during ethnic agitation-****Detected during 1990 to 2001**

Year	Sl. No.	Date of Detection	Place of Occurrence	Sex	Status of Horn	Cause of Death	Remarks
1	2	3	4	5	6	7	8
1990							
1990	BB/1	29-05-90	Garuchara Nala	Female	Recovered	Due to fighting	Horn 0.95 grams
	BB/2	29-06-90	do	Female	Missing	Poaching	-
	BB/3	25-10-90	Kasimdaha	Male	Recovered	Due to old age	Horn 810 grams
	BB/1	08-12-90	Near Rupahi	Unknown	Not developed	Not known	-
1991							
1991	BB/1	28-01-91	Near Ajarbari	Female	Missing	Poaching	-
	BB/2	19-10-91	Mora Hakua	Female	Recovered	Poaching	Horn 305 grams
	BB/3	23-10-91	Garuchara	Male	Recovered	Poaching	Horn 690 grams
	BB/4	18-11-91	Saltree Nala	Male	Recovered	Natural	Horn 1375 grams
	BB/5	21-12-91	Giati Nadi	Unknown	Not developed	Natural	-
1992							
1992	BB/1	21-01-92	Kasimdaha	Male	Recovered	Tiger predation	Horn 150 grams
	BB/2	24-01-92	Near Giati bridge	Male	Recovered	Old age	Horn 265 grams
	BB/3	18-08-92	-do-	Male	Missing	Poaching	-
	BB/4	02-06-92	Daimukh	Female	Missing	Poaching	-
	BB/5	13-07-92	Near Pigmy Hog breeding centre	Female	Recovered	Tiger predation	Horn 88 grams
	BB/6	18-08-92	Uchila Beat	Unknown	Missing	Poaching	-
	BB/7	13-09-92	Near Rabhanama river	Unknown	Missing	Poaching	-
	BB/8	24-09-92	Garuchara	Unknown	Missing	Poaching	-
	BB/9	27-09-92	Kasimdaha	Unknown	Missing	Poaching	-
	BB/10	06-10-92	Giati Nadi	Male	Recovered	Natural	Horn 849 grams
	BP/1	10-02-92	Ghilajhar	Female	Missing	Poaching	-
	BP/2	01-05-92	Kanchanbari	Male	Missing	Poaching	-
	BB/3	07-05-92	Dighaljar	Unknown	Missing	Poaching	-
	BP/4	19-06-92	Rupahi	Female	Missing	Poaching	-
	BP/5	21-09-92	Betbari	unknown	Missing	Poaching	-
1993							
1993	BB/1	07-01-93	Ghoge-haga	Female	Missing	Poaching	-
	BB/2	16-01-93	Near Roisingla Beat	Unknown	Not developed	Tiger predation	-
	BB/3	01-02-93	Pahumara Nala	Female	Missing	Poaching	-
	BB/4	04-02-93	-	Unknown	Missing	Poaching	-
	BB/5	09-02-93	-	Unknown	Missing	Poaching	-
	BB/6	19-02-93	Near Bansbari Road	Unknown	Missing	Poaching	-
	BB/7	23-02-93	Rabhanama river	Unknown	Missing	Poaching	-
	BB/8	04-03-93	Narasimghajan	Unknown	Missing	Poaching	-
	BB/9	07-03-93	Latajhar-Uchila Road	Mother & Calf	Missing	Poaching	-
	BB/10						
	BB/11	10-03-93	Pahumara	Unknown	Missing	Poaching	-
	BB/12	12-03-93	Near Uchila Beat	Unknown	Recovered	Poaching	Horn 1620 grams
	BB/13	14-03-93	Buraburi Jhar	Unknown	Missing	Poaching	-
	BB/14	15-03-93	Giati Nala	Unknown	Missing	Poaching	-
	BB/15	16-03-93	Bansbari Mathanguri Road	Unknown	Missing	Poaching	-

1	2	3	4	5	6	7	8
1993							
1993	<i>BB/16</i>	17-03-93	Near Uchila Beat	Unknown	Missing	Poaching	-
	<i>BB/17</i>	19-03-93	Latajhar-Uchila Road	Unknown	Missing	Poaching	-
	<i>BB/18</i>	19-03-93	Buraburi-Uchila Road	Unknown	Missing	Poaching	-
	<i>BB/19</i>	24-03-93	Near Giati Beat	Unknown	Missing	Poaching	-
	<i>BB/20</i>	30-03-93	Near Latajhar	Unknown	Missing	Poaching	-
	<i>BB/21</i>	14-05-93	Latajhar	Unknown	Missing	Poaching	-
	<i>BB/22</i>	21-05-93	Near Pahumara river	Female	Missing	Poaching	-
	<i>BB/23</i>	23-12-93	Uchila	Unknown	Missing	Poaching	-
	<i>BP/1</i>	24-01-93	Makhibaha	Sub-adult male	Missing	Poaching	-
1994							
1994	<i>BB/2</i>	16-04-94	Pahumara	Male	Missing	Poaching	-
	<i>BB/3</i>	09-06-94	Gundabeel	Male	Missing	Poaching	-
	<i>BB/4</i>	29-09-94	Panbarijhar	Unknown	Missing	Poaching	-
	<i>BB/1</i>	09-04-94	Latajhar	Unknown	Missing	Poaching	-
	<i>BB/2</i>	16-04-94	Pahumara	Male	Missing	Poaching	-
	<i>BB/3</i>	09-06-94	Gundabeel	Male	Missing	Poaching	-
	<i>BB/4</i>	29-09-94	Panbarijhar	Unknown	Missing	Poaching	-
1995							
1995	<i>BB/1</i>	19-03-95	Kuribeel	Male	Missing	Poaching	-
1996							
1996	<i>BB/1</i>	23-05-96 (up to 31-08-96)	North East from Giati Beat	Male	Recovered	Not known	Horn 550 grams
2001							
2001		10/03/2001	Nabin Barnagar	Unknown	Missing	Poaching	

Appendix - 30

DETAILS OF ELEPHANT DEATHS/ POACHINGS IN MANAS DURING ETHNIC AGITATION – during the period from 1990 to 2006

Year	Sl. No.	Date of Detection	Place of Occurrence	Sex	Status of Tusks	Cause of Death	Remarks
1	2	3	4	5	6	7	8
1990							
1990	BB/1	19-01-90	Gabharukhunda	Male	Recovered		-
	BB/2	24-01-90	Roisingla	Makhna	Recovered	Due to fighting	-
	BP/1	29-09-90	Digjari	Female	Missing	Poaching	-
	BP/2	30-12-90	Kokilabari	Female	Missing	Not known	-
1991							
1991	BB/1	23-03-91	Kokilabari	Male	Missing	Poaching	
1992							
1992	BB/1	01-09-92	Pahumara	Male	Recovered	Poaching	-
	BB/2	23-09-92	Katajhar	Male	Missing	Poaching	-
	BB/3	12-03-92	Garuchara	Male	Recovered	Not known	-
1993							
1993	BB/1	03-02-93	Sourang	Female	Recovered	Natural	-
	BB/2	27-02-93	Pigmy Hog centre	Male	Recovered	Old wound	-
	BB/3	11-03-93	Bansbari Range	Female	Recovered	Departmental Elephant	-
	BB/4	31-03-93	Kahitama	Tusker	Recovered	Poaching	-
	BB/5	25-07-93	Latajhar	Tusker	Recovered	Natural	-
1994							
1994	BB/1	21-12-94	Kasimdaha	Tusker	Recovered	Poaching	-
	BP/1	31-12-94	Dhonbeel	Male	Missing	Poaching	-
	BP/2	31-12-94	Dhonbeel	Female	Missing	Poaching	-
1995							
1995	BB/1	14-03-95	Roisingla	Tusker	Missing	Poaching	-
	BB/2	30-03-95	Doimukh	Male	Recovered	Old wound	-
	BB/3	23-06-95	Bansbari Range	Male	Recovered	Not known	-
	BB/5	16-09-95	Ghogehaga	Unknown	Recovered	Poaching	-
	BB/6	27-12-95	Songlapani	Tusker	Recovered	Poaching	-
	BP/1	23-04-95	Ghogehaga	Unknown	Recovered	Poaching	-
	BP/2	31-10-95	Katajhar	Male	Recovered	Poaching	-
1996							
1996	BB/1	25-01-96	Mahut camp	Female	Departmental Elephant	Natural	-
	BB/2	04-02-96	Sidajhar	Male	Missing	Natural	-
	BB/3	10-04-96	Ghogehaga	Unknown	Missing	Poaching	-
	BB/4	06-04-96	Garuchara	Female	Missing	Poaching	-
1997							
1997		12-03-97	Bhuyanpara Range	Male	Missing	Poaching	
		22-03-97	Mathanguri Beat	Unknown	Missing	Poaching	
		25-08-97	Bhutan Road	Unknown	Missing	Poaching	
1998							
1998		13-02-98	Panbarijhar	Female	Missing	Poaching	
		03-03-98	Uchila Beat	Tusker	Missing	Poaching	

1	2	3	4	5	6	7	8
2000							
2000	<i>BB/TP/35/31 Dt.21/1/2000</i>	19-01-2000		Male, Female & Female	Not developed	Poaching	
	<i>BB/TP/61/76 Dt.6/2/2000</i>	04-02-2000	Giati, Kuribeel	Male 10-12 year	Missing	Poaching	
	<i>BB/TP/61/76 Dt.14/2/2000</i>	06-02-2000	Uchila Beat	Female	Missing	Poaching	
	<i>BB/TP/61/ Dt.</i>	29/02/2000	Buraburijhar	Calf Unknown	Missing	Poaching	
		15/03/2000	Latajar	Unknown	Missing	Poaching	
		07/04/2000	Uchila Beat			Poaching	
2001							
2001		27/03/2001	Latajhar camp	Male 17 years	Missing	Poaching	
2002							
2002		15/01/2002	Kahitama area	Tusker 7-8 years	Missing	Poaching	
2003							
2003		16/04/2003 17/04/2003	R.O. Bansbari Beljhar area	Tusker 30 years	Missing	Poaching	
2004							
2004		17/04/2004	Latajhar area	Male 6 years	Missing	Poaching	
2005							
2005	<i>R.O.lettter No.BB/TPFI R/969-70, dt.2/3/05</i>	03/02/2005 01/03/2005 03/03/2005	Latajhar area	Female 6-11 years	Missing	Poaching	
2006							
2006		16/01/2006	Kanchanbari	Tusker 25 years	Missing	Poaching	
		19/01/2006 20/01/2006	Purana Narayanguri Beat area	Female 6-7 years	Missing	Poaching	

Appendix - 31

List of forest perssonnels killed while on duty during ethnic agitation from 1989 to 1999 in Manas National Park

Sl. No.	Name of Person	Date	Location
1	Late Akshay Rajbongshi, G/w S/O: - Sri Jiban Rajbongshi, Vill & P/O: - Murmala, P/S: - Tihu, Dist: - Nalbari, Assam.	16-02-1989	Lafasari
2	Late Atowa Munda, Mahut, S/O: - Sri Robet Munda, Mouza: - Gobardhana, P/S: - Barpeta Road, Dist: - Barpeta, Assam.	16-02-1989	Lafasari
3	Late Dinesh Lahkar, Forest Guard, M/o. Smt. Maitaru Lahkar, P/O: - Barengabari, P/S: - Kayan, Dist: - Kamrup, Assam.	04-04-1989	Doimari
4	Late Dilip Bezbaruwa, Fr.- I, Vill: - Ariakuchi (Morowa), P/S & Dist: - Barpeta, Assam.	23-08-1990	Bhuyanpara
5	Late Monomahan Nath, G/W H/O: -Smt. Purnima Bala Nath, Vill: -Labdanguri (Gossai Bhitha), P/O: - Rupahi, P/S: - Sorbhog, Dist: - Barpeta, Assam.	08-10-1992	Uchila
6	Late Suren Basumatary, Mahut, H/O: - Smt. Sankari Basumatary, Vill: - Kadamtala, P/S: - Barama, Dist: - Barpeta, Assam.	08-10-1992	Uchila
7	Late Bareque Haque Khandakar, Boatman, H/O: - Smt. Ayesha Begam, P/S: - Sorbhog, Dist: - Barpeta, Assam.	30-06-1996	Bansbari Range
8	Late Ibrahim Ali Khan, Forest Ranger, H/O: - Mosha Surja Bhanu Beowa, P/O: - Vill: - Mairajhara, Dist: -Barpeta, Assam.	06-08-1997	Bengtoll
9	Late Bimal Ch. Kalita, Forest Guard, H/O: - Smt. Dipti Kalita, C/O: - Lony Karkhana, L.N.B. Road, Dist: - Nalbari, Assam.	20-08-1998	Kahitama Beat
10	Late Bentik Sangma, Havildar, H/O: - Smt. Lakhima Marak, Vill: - Campatoli, P/O: - Hahim, P/S: - Boko. Dist: - Kamrup, Assam.	20-8-1998	Kahitama Beat
11	Late Chandra Kishore Gogoi, Constable, H/O: - Smt. Mamani Gogoi, Vill: - Bahalharam-gaon, P/O: - Kukuramara. P/S: - Sadiya, Dist: - Tinsukia, Assam.	20-08-1998	Kahitama Beat

Appendix - 32

List of chronological incidents of destructions in Manas during ethnic agitation from 1989 to 1999 at glance –

- 16-02-1989: The Bodo extremists attacked Lafasari Beat located in the interior area under Panbari Range and all the three houses were burnt down. Late Akhshay Rajbangshi, Forest Guard, and Late Atowa Munda, Mahut laid their lives due to severe injuries of bullets and arrows. Sri Bhupen Nath, Forest Guard, wounded seriously by arrow managed to reach Gabharukhunda and then to Mathanguri. He was saved somehow.
- 17-02-1989: The armed extremists attacked Panbari Range Office at about 9:30 pm. About 500 men ransacked the office complex with guns, bows and arrows. One section of A.F.P.F. (Assam Forest Protection Force) and Forest staffs took shelter in a bunker and exchanged fire with the extremists. Firing continued till next morning while a Magistrate with a Company of APBN (Assam Police Battalion) arrived on 18-02-1989 and rescued the staffs. Entire Range complex was set on fire after being looted by the extremists.
- 02-03-1989: Bhalaguri Beat under Bansbari Range was burnt down partly by the extremist.
- 05-03-1989: Kahitama and Bhalaguri Beat under Bansbari Range were burnt down and properties looted by the extremist.
- 08-03-1989: Gabharukhunda Beat located at Indo-Bhutan boundary area under Panbari Range was destroyed by the extremist.
- 26-04-1989: Bhalaguri Beat under Bansbari Range was destroyed and personal property of staff looted.
- 03-04-1989: Rupahi Beat was burnt down and property looted.
- 04-04-1989: Doimari Beat under Bhuyanpara Range was attacked, set on fire and Rabang sub-beat under Bansbari Range was also burnt down on the same day. Both the two camps are located at Indo-Bhutan boundary area. Properties looted by the extremist. Sri Dinesh Lahkar, Forest Guard, was shot dead near Makhibaha Beat.
- 08-04-1989: Kapurpura House Boat along with the anti-poaching camp under Bansbari Range and Doimari Beat under Bhuyanpara Range were burnt down and properties looted by extremist.
- 30-04-1989: Extremist destroyed Khoirbari Beat under Bhuyanpara Range.
- 01-05-1989: Digjari Beat under Bhuyanpara Range was set on fire and destroyed which was damaged partly on 02-04-1989 by the extremist.

- 30-06-1989: Palsiguri Beat under Bansbari Range and Sikhilaihar Beat, Badaribeel Beat, Sukanjani Beat and Lakhijhora Beat under Panbari Range were burnt down and properties looted by the extremist.
- 01-07-1989: Photika bridge was destroyed, cut into three pieces, piles, deckings removed. On the same day Bhalaguri Beat was set on fire and the Beat house partly destroyed.
- 06-07-1989: The extremist damaged Sukanjan bridge in Panbari Range. On the same day Kahibari bridge under Bansbari Range was cut into two pieces and removed the deckings and piles.
- 26-07-1989: Katajhar Beat under Bansbari Range destroyed.
- 01-08-1989: Koroibari Beat under Bhuyanpara Range destroyed.
- 03-08-1989: Rupahi Beat under Bhuyanpara Range attacked and destroyed.
- 23-08-1989: Bhuyanpara Range complex was attacked; all the houses were burnt down, Govt. and personal properties looted. 12 nos. Rifles and 12 nos. Guns with one V.H.F. set looted. Late Dilip Bezbaruah, Forester Grade-I, was shot dead by the extremists in the incident.
- 12-09-1989: Rabang Beat under Bansbari Range attacked and destroyed.
- 12-10-1989: Sidajhar Beat under Bansbari Range destroyed.
- 12-11-1989: Garuchara Beat under Bansbari Range destroyed.
- 16-01-1990: Gabharukhunda Beat under Panbari Range destroyed.
- 12-02-1990: Alabari Beat under Bhuyanpara Range destroyed.
- 15-08-1990: Koroibari Beat under Bhuyanpara Range was burnt down and properties looted.
- 19-08-1990: Kokilabari Gate under Bhuyanpara Range was destroyed and removed by the extremist.
- 20-08-1990: Syamajhora Beat under Bhuyanpara Range was destroyed for the first time.
- 23-08-1990: Bhuyanpara Range complex ransacked, looted and razed to the ground for the second time. Altogether 17 buildings were destroyed. One Game Watcher and a casual worker were killed in the attack.
- 07-10-1992: Semajhora Beat under Bhuyanpara Range abandoned after being fired indiscriminately.
- 08-10-1992: Extremists ambushed patrolling party of Uchila moving towards Latajhar in between the stretch of Uchila and Chorphuli. Late Manomahan Nath, Game Watcher, lost his life on the spot due to multiple bullet injury. Late Suren Basumatary, Mahoot, was recovered in sub-conscious state with bullet injuries on his head on 09-10-1992 and expired later on 11-10-1992 at Guwahati

Medical College Hospital. The departmental elephant “Premlal” also laid his life due to severe bullet injuries.

- 10-10-1992: Extremists burnt down Semajhora Beat Office under Bhuyanpara Range and destroyed for the second time.
- 07-11-1992: Semajhora Beat was destroyed for the third time. Kaljhar Beat was burnt down and property looted by the extremist on the same day.
- 19-10-1992: Kuhighat Beat under Panbari Range was abandoned after repeated threats.
- 03-03-1992: Extremists attacked Bansbari Range Office complex. Sri A.K. Brahma, Range Officer, Bansbari Range, was wounded seriously. Nine Rhino horns (4.627 kg), 4 nos. 0.315 rifles, 5 nos. DBBL guns, 3 nos. SBBL guns (all unserviceable) and cash amounting Rs. 2,20,000.00 were looted.
- 09-09-1993: Pahumara bridge under Bhuyanpara Range burnt down and destroyed.
- 20-09-1993: Makhibaha Beat staff threatened and looted. Some infrastructure destroyed.
- 21-09-1993: Extremists raided and looted one walkie-talkie from Giati Beat (Buraburijhar) under Bansbari Range.
- 09-10-1992: Semajhora Beat under Bhuyanpara Range destroyed which was reconstructed in September 1990.
- 11-11-1993: Gyati bridge along Buraburijhar-Uchila road under Bansbari Range was burnt down.
- 28-04-1994: Extremists snatched away five 0.315 Rifles and 57 rounds of ammunitions from Katajhar Beat of Bansbari Range.
- 30-06-1996: Late Barek Haque Khandakar, Boatman, was shot by the extremist while on duty on elephant back near Kasimdoha under Bansbari Range and shifted to the Guwahati Medical College Hospital in a serious condition and later died on the same day.
- 06-08-1997: Late Ibrahim Ali Khan, Range Officer, Panbari Range, was kidnapped on 04-06-1997 and later shot dead on 06-08-1997.
- 18-09-1997: Kokilabari Beat under Bhuyanpara Range was attacked and looted 7 Rifles along with 72 rounds of ammunitions and a VHF (wireless) set.
- 21-09-1997: Kokilabari Beat under Bhuyanpara Range was attacked again and partly burnt down.
- 24-09-1997: A gang of miscreants entered the Bhuyanpara Range complex and destroyed and looted Range properties.
- 20-12-1998: Kahitama Beat under Bansbari Range attacked. Looted 13 nos. 0.303 Rifles along with 212 rounds of ammunitions and 6 nos. 0.315 Rifles along with 30 rounds of live ammunitions, one wireless Base set and Rs. 55, 000.00. Late Bimal Chandra Kalita, Forest Guard, laid his life in the encounter with

extremists. Havildar Late Bentik Sangma, AFPF and Constable Late Chandra Kishore Kunwar of AFPF (Assam Forest Protection Force) died after multiple bullet injuries while fighting with the extremists valiantly.

- 23-09-1997: Iron sheets of temporary structures and properties of Bhuyanpara Range taken away forcibly by the extremists.
- 02-03-1998: Forest staff of Kokilabari Beat under Bhuyanpara Range threatened and compelled to spent the night in the jungle.
- 02-05-1998: Panbari Range complex attacked and looted accessories of wireless sets.
- 07-05-1998: BSF personnel camping at Panbari market detected and recovered 12 numbers of hand made guns kept hidden by extremists from Kuhighat area of Panbari RF.
- 31-01-1999: Bhutan vehicle was obstructed by armed miscreants on Bansbari-Mathanguri road near Mora Giati rivar and looted.
- 24-05-1999: Uchila Beat (chang bungalow) under Bansbari Range burnt down and destroyed completely.

Appendix – 33

Meteorological data from Mathanguri, Manas National Park

STATION :- Mathanguri

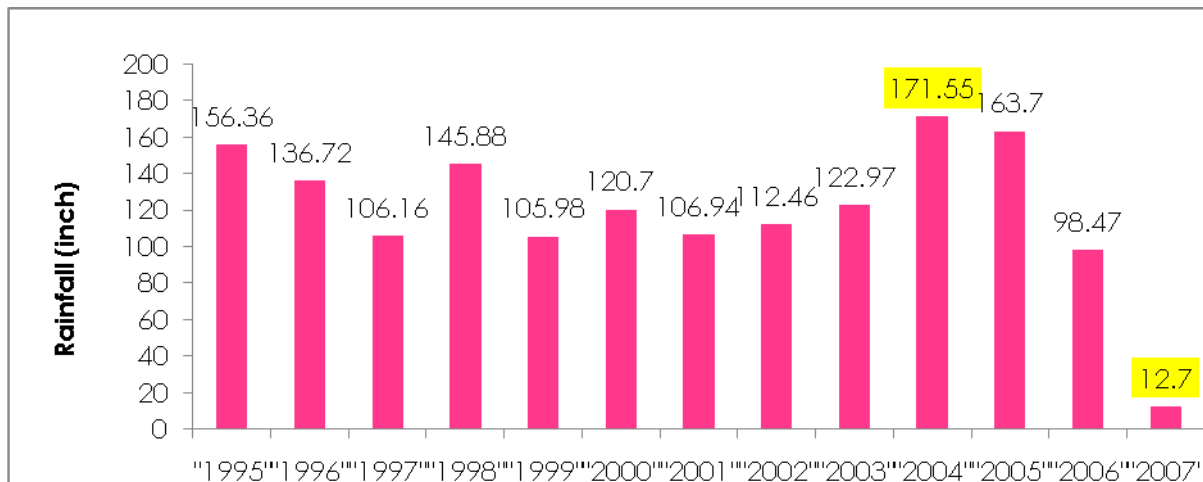
PARAMETER :- Monthly Total Rainfall in Millimeters.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
2003	2.4	13	18.4	296	326	578	653.8	59	212	254	34.8	9
2004	22.8	93.8	93.8	398	533.2	643.7	1187.2	149.8	475	87.6	3.8	18.6
2005	5.4	2	78.8	182	275.6	584.6	922.5	354.4	266	311.6	0.4	0
2006	0	17.6	0	252.6	120.6	622.4	387.2	108.6	493.3	71.8	29.6	11
2007	0.0	65.2	8.6	206.4	214.0	614.4	635.2	473.6	607.2	65.4	7.2	0.0

Annual Rainfall in inch

Year	Rainfall	1995		1996		1997		1998		1999		2000	
"1995"	156.36	month	rainfall	month	rainfall	month	rainfall	month	rainfall	month	rainfall	month	rainfall
"1996"	136.72	Jan	0.07	Jan	0.65	Jan	0.43	Jan	0.05	Jan	0	Jan	0
"1997"	106.16	Feb	2.32	Feb	0	Feb	1.68	Feb	1.45	Feb	0	Feb	0.4
"1998"	145.88	Mar	1.11	Mar	1.46	Mar	2.03	Mar	4.19	Mar	2.28	Mar	2.76
"1999"	105.98	Apr	8.13	Apr	2.7	Apr	4.57	Apr	5.9	Apr	15.51	Apr	6.6
"2000"	120.7	May	26.71	May	26.52	May	9.65	May	10.21	May	11.82	May	15.8
"2001"	106.94	Jun	25.57	Jun	20.02	Jun	51.19	Jun	37.99	Jun	21.87	Jun	35.36
"2002"	112.46	Jul	31.95	Jul	56.92	Jul	10.7	Jul	33.31	Jul	24.59	Jul	21.73
"2003"	122.97	Aug	30.11	Aug	12.76	Aug	8.72	Aug	27.08	Aug	11.76	Aug	24.39
"2004"	171.55	Sep	22.37	Sep	9.42	Sep	13.36	Sep	18.34	Sep	9.25	Sep	11.48
"2005"	163.7	Oct	4.09	Oct	6.27	Oct	1.1	Oct	7.36	Oct	8.83	Oct	1.32
"2006"	98.47	Nov	3.77	Nov	0	Nov	0.29	Nov	0	Nov	0	Nov	0.86
"2007"	12.7	Dec	0.16	Dec	0	Dec	2.44	Dec	0	Dec	0.07	Dec	0
"2009"			156.36		136.72		106.16		145.88		105.98		120.7

2001		2002		2003		2004		2005		2006		2007	
month	rainfall	month	rainfall	month	rainfall	month	rainfall	month	rainfall	month	rainfall	month	rainfall
Jan	0.61	Jan	0.44	Jan	0.05	Jan	1.41	Jan	0.56	Jan	0.05	Jan	0.05
Feb	1.04	Feb	0.3	Feb	2.63	Feb	1.11	Feb	1.4	Feb	2.89	Feb	2.89
Mar	1.4	Mar	3.51	Mar	4.51	Mar	5.88	Mar	8.69	Mar	0.3	Mar	0.3
Apr	12.14	Apr	11.4	Apr	14.59	Apr	15.06	Apr	19.16	Apr	9.46	Apr	9.46
May	24.51	May	7.47	May	12.55	May	27.12	May	15.21	May	0	May	0
Jun	11.63	Jun	26.2	Jun	24.72	Jun	27.89	Jun	28.3	Jun	0	Jun	0
Jul	24.58	Jul	29.22	Jul	30.56	Jul	57.93	Jul	28.61	Jul	0	Jul	0
Aug	12.4	Aug	10.79	Aug	7.56	Aug	11.17	Aug	34.84	Aug	0	Aug	0
Sep	8.9	Sep	17.1	Sep	12.24	Sep	12.05	Sep	12.82	Sep	0	Sep	0
Oct	8.57	Oct	4.89	Oct	11.48	Oct	10	Oct	13.86	Oct	0	Oct	0
Nov	0.99	Nov	0.87	Nov	1.72	Nov	0.34	Nov	0.25	Nov	0	Nov	0
Dec	0.17	Dec	0.27	Dec	0.36	Dec	1.59	Dec	0	Dec	0	Dec	0
	106.94		112.46		122.97		171.55		163.7		12.7		12.7



Average Annual Rainfall

129.99 inch.

3276.35 mm.

Appendix – 34**Meteorological data from Borjhar, Guwahati****STATION :- Guwahati****PARAMETER :- Maximum temperature in Degree Celcius.**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
2003	21.7	25.8	27.6	29.6	31.6	31.7	32.5	33.3	32.3	29.9	27.6	24.4
2004	22.9	26.5	31.2	27.5	31.7	31.9	30.9	33.5	32.0	29.4	27.9	24.8
2005	23.0	27.3	29.0	30.0	30.0	33.0	32.6	32.6	33.5	29.5	28.0	25.8
2006	23.3	28.8	32.6	31.3	32.4	31.4	33.7	34.1	32.6	31.9	27.9	25.5
2007	24.4	25.0	30.7	30.8	33.7	32.9	32.6	34.0	32.6	31.9	29.8	26.4

PARAMETER :- Minimum temperature in Degree Celcius.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
2003	10.2	13.2	16.1	20.8	22.8	25.1	26.3	26.6	25.8	23.3	18.1	13.7
2004	11.5	12.6	18.4	20.6	23.3	25.6	25.7	26.5	25.4	21.7	16.7	12.5
2005	11.3	14.4	17.8	20.6	22.5	25.9	26.3	26.3	25.7	22.7	17.9	12.7
2006	11.1	15.8	16.8	20.6	23.7	25.6	26.8	26.2	25.2	22.1	17.9	12.8
2007	9.9	13.4	16.1	20.7	24.4	25.7	26.2	26.5	25.4	23	18.2	12.9

PARAMETER :- Relative Humidity at 0830 hrs IST in %.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
2003	91	83	78	81	79	85	84	83	83	92	85	89
2004	94	79	70	84	78	83	86	82	84	82	82	86
2005	90	76	76	76	83	81	85	85	81	86	84	84
2006	92	84	63	75	77	84	81	79	81	81	86	89
2007	89	84	67	77	75	82	85	83	82	82	83	87

PARAMETER :- Relative Humidity at 1730 hrs IST in %.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
2003	74	64	59	70	68	79	78	76	83	81	81	75
2004	74	55	52	74	67	78	81	83	84	82	78	87
2005	71	53	60	66	73	75	79	83	78	82	76	65
2006	71	61	43	64	66	78	77	75	79	74	74	76
2007	67	67	46	65	68	76	83	75	80	77	74	77

Appendix – 35**Meteorological data from Dhubri station****STATION :- Dhubri****PARAMETER :- Maximum temperature in Degree Celcius.**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
2003	19.3	24.1	27.0	28.6	30.3	29.7	30.3	32.2	31.1	27.9	25.3	22.4
2004	20.3	24.7	30.4	26.8	29.9	30.4	29.1	31.9	29.7	27.3	25.3	22.9
2005	21.4	25.6	28.3	28.5	29.0	30.8	30.6	31.0	31.7	27.5	25.6	23.5
2006	21.0	26.5	31.0	29.1	31.4	30.2	32.4	33.3	30.2	29.6	25.8	22.9
2007	21.4	23.1	29.4	30.3	33.0	31.3	30.3	32.1	30.4	29.2	26.5	22.7

PARAMETER :- Minimum temperature in Degree Celcius.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
2003	9.8	13.8	16.6	20.6	21.8	23.6	24.5	25.5	24.5	22.0	17.8	15.1
2004	12.6	14.8	20.9	21.0	23.6	25.3	25.2	26.9	25.4	22.6	18.3	14.6
2005	12.8	16.5	19.6	21.2	22.5	24.7	25.9	26.3	26.3	22.7	18.6	14.3
2006	12.8	17.2	19.3	21.6	24.0	25.2	26.8	27.0	25.4	22.9	18.9	14.8
2007	12.0	15.2	18.2	21.7	24.7	25.4	26.1	26.6	26.0	24.0	19.2	14.0

STATION :- Dhubri**PARAMETER :- Relative Humidity at 0830 hrs IST in %.**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
2003	89	82	76	83	83	89	88	90	85	87	84	81
2004	88	76	70	83	83	88	91	82	88	85	80	82
2005	86	74	75	79	84	91	88	89	85	89	83	84
2006	89	84	66	79	82	89	85	80	87	82	85	87
2007	87	85	72	79	79	89	91	88	88	90	82	88

PARAMETER :- Relative Humidity at 1730 hrs IST in %.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
2003	76	66	64	77	73	86	85	83	83	86	79	76
2004	75	61	61	79	79	81	89	83	87	85	76	72
2005	72	59	67	78	80	85	87	89	82	87	76	65
2006	74	70	52	73	76	88	84	81	85	79	79	74
2007	70	71	54	70	72	84	88	83	83	80	74	73

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Details of Rhinos Translocated to Manas WWF- India:- Details of rhinos translocated under Indian Rhino Vision-2020

Sl. No.	Capture Date	Capture area	Microchip No.	Radio collar No.	Release Site	Release Date
Rhino-1	11/4/2008	Pobitora WLS (Pagladoba)	00064F2B70	148.70	Buraburi	12/4/2008
Rhino-2	11/4/2008	Pobitora WLS (Nekerahabi)	000647E8A3	148.21	Buraburi	12/4/2008
Rhino-3	12/27/2012	Pobitora WLS (Tamuli Doba)	0006c D4A7C	148.78	Buraburi	12/28/2012
Rhino-4	12/27/2012	Pobitora WLS (Tamuli Doba)	0006CD58A8		Buraburi	12/28/2012
Rhino-5	1/17/2011	Pobitora WLS (Pagladoba)	0006c DDD6A	148.32	Buraburi	1/18/2012
Rhino-6	1/17/2011	Pobitora WLS (Tamuli Doba)	0006c DBEBB	148.72	Buraburi	1/18/2012
Rhino-7	1/17/2011	Pobitora WLS (Tamuli Doba)	0006c DE42F	149.32	Buraburi	1/18/2012
Rhino-8	1/17/2011	Pobitora WLS (Tamuli Doba)	0006c DC367	148.383	Rhino Camp	1/18/2012
Rhino-9	8/1/2012	Pobitora WLS (Pagladoba)	0006c DDA 2A	148.851	Buraburi	9/1/2012
Rhino-10	8/1/2012	Pobitora WLS (Pipolati))	0006c DD 13D	149.273	Buraburi	9/1/2012
Rhino-11	2/19/2012	KNP-Bagori (Dunga)	0006c DDI A8	148.26	Buraburi	2/20/2012
Rhino-12	2/19/2012	KNP-Bagori (Dunga)	0006c D32 B6	150.51	Buraburi	2/20/2012
Rhino-13	2/19/2012	KNP-Bagori (Dunga)	0006c DB3 96	150.27	Buraburi	2/20/2012
Rhino-14	2/19/2012	KNP-Bagori (Dunga)	0006c DCF EF	148.39	Buraburi	2/20/2012
Rhino-15	11/3/2012	KNP-Bagori (Dunga)	0006c DB65D	150.07	Buraburi	12/3/2012
Rhino-16	11/3/2012	KNP-Bagori (Dunga)	0066c DDECE	149.2416	Buraburi	12/3/2012
Rhino-18	11/3/2012	KNP-Bagori (Dunga)	0006c DAFBD	150.29	Buraburi	12/3/2012
WTI:-Details of Rhinos translocated under rescue and rehabilitation programme:-						
Mainao-1	Rescued on 28/2/2002	From Bagori Range, Kaziranga	Swept away by flood & separated from mother		Translocated to Manas on 21/2/2008	Released from boma on 28/11/2008
Ganga-2 "Manasi"	Rescued on 14/7/2004	From Baghmari, Bagori Range, Kaziranga	Swept away by flood & separated from mother		Translocated to Manas on 28/1/2007	Released from boma on 27/11/2008
Jamuna-3 "Rosy"	Rescued on 22/7/2004	From Baguri Range, Kaziranga	Swept away by flood & separated from mother		Translocated to Manas on 28/1/2007	Released from boma on 27/11/2008
Unnamed Female Calf	Rescued on 22/9/2007	Rescued at Hatikhli TE, near Kohora Range, KNP	Orphan. Mother killed by poacher		Translocated to Manas on 23/2/2008	Killed by a male rhino inside boma on 16/10/2008
Raja-4	Rescued on 31/1/2008	Rescued in Bagori Range, KNP.			Rhino Camp	Not yet released
Maju-5	Rescued on 9/2/2009	Rescued in Kohora Range, KNP			Rhino Camp	Not yet released

Appendix- 37

List of functioning camp and sanctioning strength of man power at Barnadi Wildlife Sanctuary

**BODOLAND TERRITORIAL COUNCIL
OFFICE OF THE DIVISIONAL FOREST OFFICER, DHANSIRI FOREST DIVISION,
UDALGURI**

Memo No. A/DDU/CSS-Project Tiger/ 588

Date. 20/05/2019

To,

✓ The Field Director,
Manas Tiger Project, Barpeta Road,
Barpeta.

Subject:- Submission of list functioning camp and sanctioning strength of man power at Barnadi Wildlife Sanctuary.

Ref:- Letter No. FA/TP/APO/1968, dt.16.05.2019.

Sir,

With reference to the above, I have the honour to submit herewith the list functioning camp and sanctioning strength of man power at Barnadi Wildlife Sanctuary for favour of your kind information and necessary action.

(1) List of function Camp:-

- (i) Bamuninala Anti-Poaching Camp
- (ii) Ghopakona Anti-Poaching Camp
- (iii) Nalapara Anti-Poaching Camp
- (iv) Bogamati Anti-Poaching Camp
- (v) Alonjhar Camp
- (vi) Bamuninala Camp

(2) Sanctioning strength of Staff and Van Mazdoor (CL):-

- (i) Sanctioning strength of Staffs :- 40 (forty) Nos. as per APO for the year 2019-20.
- (3) Van Mazdoor (CL) :- 20 (twenty) Nos. as per APO for the year 2019-20.

Yours faithfully


Divisional Forest Officer,
Dhansiri Forest Division, Udalguri

Appendix- 38

1st Addition to Manas National Park notification

পঞ্জীভুক্ত নম্বৰ – ৭৬৮/৯৭
768/97

Registered No.



অসম ৰাজপত্ৰ

THE ASSAM GAZETTE

অসাধাৰণ

EXTRAORDINARY

প্ৰাপ্ত কৰ্তৃত্ব দ্বাৰা প্ৰকাশিত

PUBLISHED BY THE AUTHORITY

নং 276 দিশপুৰ, শুক্ৰবাৰ, 12 আগষ্ট, 2016 শাওণ, 1938 (শক)
No. 276 Dispur, Friday, 12th August, 2016, 21st Sravana, 1938 (S.E.)

GOVERNMENT OF ASSAM

ORDERS BY THE GOVERNOR

ENVIRONMENT AND FOREST DEPARTMENT

NOTIFICATION

The 1st August, 2016

No.FRS 86/2015/215.- In exercise of the power conferred under Section 35 of the Wildlife (Protection) Act, 1972 (as amended up to date) the Governor of Assam is pleased to declare that land described in the schedule below as the National Park with effect from the date of publication in the official Gazette.

Schedule – A

District:	Chirang (BTAD)
Sub-Division:	Bijni
Revenue Circle:	Bijni
Name of the Division:	Chirang Division
Area of the land:	350 sq. km.

Name of the Forest:	First addition to Manas National Park
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Schedule – B

The proposed “First addition to Manas National Park” is the eastern part of the Monas Reserved Forest (RF) notified vide Govt. notification No. 1886R dated 11th July, 1927, adjacent to the Manas NP (copy enclosed as *Annexure – I*)

Boundary description: The northern boundary of the proposed “First addition to Manas National Park” is the International boundary of Bhutan and India. Where as the eastern side of the proposed NP is the western boundary of Manas NP notified vide Govt. notification No. FRW. 55/86/64 dated 7th September, 1990.

Reference point of the proposed NP is the International Boundary Pillar No. 176 (Latitude 26°48'09.9" N, Longitude 90°35'22.3" E) located on the right bank of Sukanteklai river on the Indo Bhutan border. Thence the boundary of the proposed NP runs eastwards along the international boundary as –

North:

Boundary Pillar			Boundary Pillar	
No.	Lat	Long	To	No.
176	26°48'09.9" N	90°35'22.3" E	to	177
177	26°47'59.05" N	90°36'21.60" E	to	178
178	26°47'48.38" N	90°37'16.34" E	to	179
179	26°47'38.69" N	90°38'00.75" E	to	180
180	26°46'36.83" N	90°38'46.24" E	to	181
181	26°46'50.54" N	90°39'43.90" E	to	182
182	26°47'02.60" N	90°40'35.59" E	to	183
183	26°46'14.91" N	90°41'37.50" E	to	184
184	26°46'10.10" N	90°42'14.51" E	to	185
185	26°46'06.60" N	90°43'01.36" E	to	186
186	26°46'21.00" N	90°43'55.57" E	to	187
187	26°46'29.41" N	90°45'01.93" E	to	188
188	26°46'33.79" N	90°45'34.47" E	to	189
189	26°46'36.50" N	90°46'23.77" E	to	190
190	26°46'37.04" N	90°47'22.99" E	to	191
191	26°46'38.18" N	90°48'11.47" E	to	192
192	26°46'38.72" N	90°48'46.23" E	to	192/3
192/3	26°46'40.87" N	90°49'30.25" E	N-west corner of Manas NP	

East: The eastern boundary runs from the International BP No. 192/3 (Lat 26° 46' 40.87" N, Long 90° 49' 30.25" E) southwards along the left bank of Sukanjan river, i.e. the western boundary of Manas NP notified during 1990 (as mentioned above). Thence

the boundary of the proposed NP runs southwards along the western boundary of Manas NP till it meets BP No. 1 (Lat 26° 38' 29.56" N, Long 90° 51'

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02.33" E) of proposed first addition to Manas NP located on the left bank of Sukanjan river on Manas road. Thence the boundary runs along the Manas road towards west as follows –

South: From the BP No. 1 of the proposed NP the boundary runs as follow -

Boundary Pillar			To	Boundary Pillar No.
No.	Lat	Long		
1	26°38'29.56" N	90°51'02.33" E	to	2
2	26°38'30.66" N	90°50'39.47" E	to	3
3	26°38'33.70" N	90°49'46.06" E	to	4
4	26°38'38.22" N	90°48'46.29" E	to	5
5	26°38'43.34" N	90°47'22.34" E	to	6
6	26°38'44.89" N	90°47'00.67" E	to	7
7	26°38'45.61" N	90°46'39.24" E	to	8
8	26°38'49.06" N	90°45'44.22" E	to	9
9	26°38'51.92" N	90°45'14.57" E	to	10
10	26°38'51.92" N	90°44'41.11" E	to	11
11	26°38'52.04" N	90°44'22.66" E	to	12
12	26°38'53.11" N	90°43'51.10" E	to	13
13	26°38'53.46" N	90°43'45.39" E	to	14
14	26°38'54.18" N	90°43'33.24" E	to	15
15	26°38'55.85" N	90°43'16.69" E	to	16
16	26°38'56.92" N	90°42'53.83" E	to	17
17	26°38'57.39" N	90°42'38.47" E	to	18
18	26°38'57.39" N	90°42'27.63" E	to	19
19	26°38'57.87" N	90°42'16.91" E	to	20
20	26°39'00.13" N	90°41'55.72" E	to	21
21	26°39'01.80" N	90°41'14.88" E	to	22
22	26°39'03.70" N	90°40'43.32" E	to	23
23	26°39'03.94" N	90°40'27.01" E	to	24
24	26°39'04.18" N	90°40'18.08" E	to	25
25	26°39'05.13" N	90°39'55.09" E	to	26
26	26°39'06.20" N	90°39'32.47" E	to	27
27	26°39'07.99" N	90°39'47.94" E	to	28

28	26°39'08.47" N	90°38'16.74" E	to	29
29	26°39'09.54" N	90°37'48.40" E	to	30
30	26°39'09.54" N	90°37'13.63" E	to	31

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31	26°39'10.25" N	90°36'45.29" E	to	32
32	26°39'10.97" N	90°36'18.85" E	to	33
33	26°39'10.49" N	90°36'02.90" E	to	34
34	26°39'12.39" N	90°35'48.85" E	to	35
35	26°39'12.00" N	90°35'39.76" E	to	36
36	26°39'12.00" N	90°35'33.85" E	to	37
37	26°39'11.18" N	90°35'27.90" E	to	38
38	26°39'11.07" N	90°35'12.97" E	to	39
39	26°39'12.00" N	90°34'55.78" E	SW corner of proposed NP	

West: The western boundary runs from southwestern corner of the proposed NP from BP No. 39 as follows -

Boundary Pillar			To	Boundary Pillar No.
No.	Lat	Long		
39	26°39'12.00" N	90°34'55.78" E	to	40
40	26°39'36.35" N	90°35'07.35" E	to	41
41	26°39'44.44" N	90°35'13.86" E	to	42
42	26°39'49.74" N	90°35'16.66" E	to	43
43	26°39'57.12" N	90°35'22.60" E	to	44
44	26°40'10.08" N	90°35'30.77" E	to	45
45	26°40'14.81" N	90°35'32.34" E	to	46
46	26°40'20.18" N	90°35'35.06" E	to	47
47	26°40'35.72" N	90°35'40.94" E	to	48
48	26°40'48.54" N	90°35'45.16" E	to	49
49	26°40'58.85" N	90°35'48.24" E	to	50
50	26°41'32.65" N	90°36'00.28" E	to	51
51	26°41'34.37" N	90°35'47.81" E	to	52
52	26°41'35.23" N	90°35'25.18" E	to	53
53	26°41'35.44" N	90°35'19.88" E	to	54

54	26°41'36.09" N	90°35'08.06" E	to	55
55	26°41'35.94" N	90°34'54.24" E	to	56
56	26°41'35.30" N	90°34'51.09" E	to	57

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57	26°41'54.99" N	90°34'45.57" E	to	58
58	26°42'51.71" N	90°35'16.16" E	to	59
59	26°43'21.65" N	90°35'25.90" E	to	60
60	26°43'41.99" N	90°35'37.86" E	to	61
61	26°44'08.91" N	90°35'43.30" E	to	62
62	26°44'52.67" N	90°35'20.38" E	to	63
63	26°46'13.27" N	90°35'27.74" E	to	64
64	26°46'30.37" N	90°35'17.75" E	to	65
65	26°48'10.75" N	90°35'16.54" E	176. i.e. the international BP, Lat - 26°48'09.9" N, Long - 90°35'22.3" E	

S. KUMAR,

Principal Secretary to the Government of Assam,
Environment and Forest Department.

APPENDIX 39

Key features of Phase-IV monitoring: -

- Annual monitoring of tiger source populations using capture-recapture methods based on individual identification of tigers from camera trap data or faecal DNA.
- Minimum sampling area of 400 sq. km. at a time, with a sampling intensity of 1,000 trap nights with at least 25 pairs of camera traps per 100 sq. km. to be attained.
- Annual camera traps survey to be completed in 45-60 days to avoid overestimation.
- If deployment of camera traps in an entire reserve, or parts of it, is not feasible for any reason, faecal DNA samples may be collected over a 45 to 60-day survey period and analysed to arrive at reserve wide tiger numbers using capture-recapture methods.
- Protocols have also been laid down for estimating prey densities using line transect surveys following design and analysis methods prescribed in DISTANCE software.
- The protocol enables state forest departments to formally collaborate with qualified scientists to derive rigorous estimates.

The minimum standards for camera trapping in Phase-IV monitoring are: -

- Camera trap density: One pair per 4-5 sq. km.
- Minimum trap nights of a 1000 per 100 sq. km. (i.e. 25 pairs of cameras in 100 sq km for 40 days).
- Minimum area coverage of 400 sq. km.
- Closure period of 40 to 60 days.
- Entire reserve needs to be sampled. Each sampling occasion should cover minimum area of 400 sq. km. (100 pairs of cameras) and in case of larger reserves, the area should be covered by dividing the area into 400 sq. km. blocks and camera trapping should be done successively, within the closure period of 60 days.
- Closure period is 40 to 60 days, although the sampling could continue beyond this period, but truncation of the closure period could be done during analysis.

Following it up in Manas: -

- 2 x 2 grids were overlaid on map of Manas National Park to effectively cover the 3 ranges for camera trapping. 120 camera trap pairs were used in 2 blocks to cover 480 sq. km. area.
- Each 4 sq. km. grid had a pair of camera trap within it in the best possible location.
- Block 1 covering 2 ranges, was sampled for 60 days, while block 2 covering 1 range was sampled for 44 days, to maintain closure assumptions.
- The minimum number of tiger individual was calculated based on the different stripe pattern of each individual.
- Due to inclement weather and shortage of manpower, transect walk to estimate prey density could not be carried out simultaneously.

Number of Tigers estimates in Manas Tiger Reserve (Ref: State Forest Report Assam, 2006-07 and Jhala et.al. 2008; 2011)

Year	Males	Females	Cubs	Unidentified	Total
1972	10	0	0	-	10
1975	20	16	5	-	41
1976	28	17	6	-	51
1988-89	18	31	4	-	53
1991-93	32	37	12	-	81
1994-95	29 (4)	44(8)	7 (2)	-	80 (core) 14 (buffer)
1996-97	27	54	8	-	89
2000-01	22	38	5	-	65
2006-07	-	-	-	-	~31
2009-10	4	5	-	-	9 (National Park)
2010-11	4	5	-	-	9
2011-12	6	9	-	3	18
2012-13	3	8	-	1	13
2013-14	4	7	1	-	11
2014-15	8	7	1	-	15
2015-16	4	7	-	-	11
2016-17	12	12	-	1	25
2017-18	10	19	1	-	29

(Note: population estimates from Year 1972-2000 are based on pugmarks census technique; 2008 number is derived from tiger occupancy estimation carried out for 455 km² of MTR (Jhala et.al.2008); 2011 data is obtained using camera traps in an area of ~500 km² for a period of 60 days (Jhala et.al., 2011)

APPENDIX- 40**Details of privately owned small scale fisheries around Manas Tiger Reserve****A. Basbari range:**

Sl. No.	Village						Fishery			Remarks
	Name of Village	GPS coordinates	Population				No. of Private fishery	Name of Owner	GPS coordinates	
			General	ST	SC	OBC				
1	Bispani	N-26°39.35.8’’ E-09°058.19.4’’	116	1	3	Nil	Nil	Nil	Nil	
2.	Elengamari	N-26°38.163’’ E-090°59.379’’	2380	Nil	Nil	Nil	7 Nos.	1.Md.Habibar Rahman 2.Md. Abdush Shattar 3.Md. Abdul Gafur 4.Md. Mahamad Ali 5.Md. Hayat Ali 6.Md. Sariful Islam 7. Md. Jahur Uddin		
3.	Kuthrijhar	N-26°37.50.6’’ E-091°00.27.3’’	840	49	119	77	13 Nos.	1.Sri Ushman Ali 2. Mahiz Uddin 3. Md. Adbul Kasem		

								4. Md. Abdul Kalek 5. Md. Rahman Ali 6. Md. Abdul Kader 7. Md. Abdul Sattr 8. Md. Abdul Hakim 9. Md. Ajar Ali 10. Md. Kamal Uddin 11. Md. Jamir Ali 12. Md. Mahibar Rahman 13. Md. Haidar Ali		
4.	Khagrabari NC	N-26°38.866'' E-090°59.210''	372	Nil	Nil	Nil	10 Nos.	1. Md. Kuddus Ali 2. Md. Asom Uddin 3. Md. Ibrahim Ali 4. Md. Akkabar Ali 5. Md. Amir Ali 6. Md. Suban Ali 7. Md. Fakar Uddin 8. Md. Jahur Uddin		

								9. Md. Habibar Rahman 10. Md. Ibrahim Ali		
5.	Narayanguri	N-26°39.35.8'' E-090°58.19.4''	1842	Nil	Nil	29	Nil	Nil		
6.	Gyatigaon	N-26°39.233' E-090°59.662'	120	150	180	360	2 Nos.	1.Sri Ratul Boro 2.Sri Kalu Pathak		
7.	Raghabeel	N-26°39.109'' E-090°59.742''	3021	121	312	1493	34 Nos.	1.Md. Mahamad Ali 2.Md. Ibrahim Ali 3.Md. Ayn Ali 4.Md. Joynal Uddin 5.Md. Mainal Hoque 6. Md. Sariful Hoque 7.Md. Mafish Uddin 8.Md. Anowar Hussain 9.Md. Jamal Uddin 10. Md. Mahar Ali 11. Md. Abdul Barek 12. Md. Bulbul Hussain		

								13. Md. Taher Ali 14. Md. Rajab Ali 15. Md. Joinal Uddin 16.Md. Abdul Guni 17. Md. Sahid Ali 18. Md. Hoque Mistri 19. Md. Rahim Uddin 20.Md. Hanif Ali 21. Md. Nurul Hoque 22. Md. Ramjan Ali 23. Md. Arsab Ali 24.Md. Atar Ali 25. Md. Kasem Uddin 26. Md. Jasamum Uddin 27. Md.Wash Uddin 28. Md. Riash Uddin 29. Md. Hakim Uddin 30. Md. Samanton Bewa		

								31. Md. Jiyarul Hoque 32. Md. Abdul Salam 33. Md. Mainal Hoque 34. Md. Haser Ali		
8.	Barengabari	N-26°39'07.1'' E-091°01'33.4''	Nil	735	420	826	16 Nos.	1. Sri Manaranjan Das 2. Sri Panaram Das 3. Sri Tikendra Kalita 4. Sri Lakeswar Das 5. Sri Ananda Das 6. Sri Devid Das 7. Sri Ganyashyam Shil 8. Sri Maheswar Sutradahr 9. Sri Chandra Shil 10. Sri Budu Orang 11. Sri Sanath Sutradhar 12. Sri Lukash Basumatary 13. Sri Anla Basumatary 14. Sri Mongal		

								Basumatary 15. Sri Dane Basumatary 16. Sri Nileswar Basumatary 17. Sri Monjay Boro 18. Sri Pradip Basumatary		
9.	Mayangpara	N-26°38'39.6'' E-091°01'45.3''	160	421	192	270	10 Nos.	1.Sri Saitendra Basumatary 2.Sri Tiranjay Basumatary 3. Sri Narayan Basumatary 4. Sri Rajib Basumatary 5. Sri Lankeswar Basumatary 6. Sri Birju Basumatary 7. Sri Dina Nath Gayary 8. Sri Birkang Basumatary 9. Sri Baburam Basumatary		

								10. Sri Rajen Kujur		
10.	Madrihora	N-26°39'22.3'' E-091°02'29.2''	198	510	175	269	12 Nos.	1.Sri Biren Nath 2. Sri Balen Basumatary 3. Sri Rajea Munda 4. Sri Lakan Gayary 5. Sri Tomash Gayary 6.Sri Buddha Basumatary 7. Sri Sargeswar Gayary 8. Sri Sadin Shil 9.Sri Jahalal Munda 10. Sri Albert Lugun 11. Sri Antani Lugun 12.Sri Bijen Wary		
11.	Kahibari	N-26°39'58.1'' E-091°02'52.4''	113	534	132	229	14 Nos.	1.Sri Lakhi Wary 2.Sri Sujit Gayary 3.Sri Mahendra Wary 4.Sri JosyWary 5.Sri Paguni Gayary		

								6.Sri Beldang Gayary 7.Sri Gajen Basumatary 8.Sri Maneswar Gayary 9.Sri Nileswar Basumatary 10.Sri Sarmila Boro 11.Sri Daneswar Basumatary 12.Sri Lankeswar Wary 13.Sri Takur Wary 14.Sri Buddeswar Boro		
12.	Palsiguri	N-26°39'40.6'' E-091°03'19.3''	175	541	110	223	10 Nos.	1.Sri Chakradhar Gayary 2.Sri Mahim Ch. Boro 3. Sri Bijay Boro 4. Sri Lankeswar Gayary 5. Smt. Ratneswari Wary 6. Sri Jakab Gayary 7. Sri Bolo Basumatary 8. Sri Arjun Basumatary		

								9. Sri Biswajit Gayary 10. Sri Dulen Gayary		
13.	Kamalabari	N-26°39'10.5'' E-091°04'53.6''	Nil	137 4	Nil	Nil	21 Nos.	1.Sri Gahin Ramchiary 2.Sri Khagen Swargiary 3.Sri Amarshing Daimary 4.Sri Amar Ramchiary 5.Sri Dhiren Basumatary 6.Sri Binod Swargiary 7.Sri Bipul Basumatary 8.Sri Medhi Narzary 9. Sri Kanteswar Basumatary 10. Sri Halang Boro 11.Sri Surjon Boro 12.Sri Sebla Mochahary 13.Sri Narayan Mohilary 14.Sri Anil Mochahary 15.Sri Haren Daimary	r	

								16.Sri Raben Basumatary 17.Sri Jaleswar Daimary 18.Sri Dampca Daimary 19.Sri Nakul Ch. Boro 20.Sri Gedalu Mohilary 21.Sri Seben Boro		
14.	Gosaibitha	N-26°40'56.1'' E-091°05'15.2''	80	620	30	175	12 Nos.	1.Sri Sansuma Kherkatary 2. Sri Ratan Gayary 3.Sri Sanjay Daimary 4. Sri Sabaram Basumatary 5. Sri Suren Gayary 6. Sri Sarge Basumatary 7. Sri Ganeswam Basumatary 8. Sri Lakhi Ram Basumatary 9. Sri Gopi Daimary 10. Sri Bamwn Gayary 11. Sri Utul Gayary		

								12. Sri Swmkhwr Gayary		
15.	Rajabeel	N-26°40'51.2" E-091°05'03.0"	71	539	35	160	22 Nos.	1.Sri Sambar Basumatary 2.Sri Gems Kherkatary 3.Sri Ramel Basumatary 4.Sri Bimal Basumatary 5.Sri Lumbudhar Basumatary 6. Smt. Alaka Kherkatary 7.Sri Jagen Kherkatary 8. Sri Dipendra Basumatary 9. Sri Rameswar Ramchiary 10.Sri Hemen Ramchiary 11. Sri Himaloy Ramchiary 12. Sri Lamdar Daimary 13. Sri Manil Daimary 14. Sri Samar Basumatary 15. Sri Kanteswar		

								Basumatary 16. Sri Sekar Ramchiary 17. Sri Satish Basumatary 18. Sri Delo Basumatary 19. Sri Jagen Daimary 20. Sri Sukra Daimary 21. Sri Sarna Daimary 22. Sri Kanchon Daimary		
16.	Katajhar									According to Gaobura/Head man there is no village accept Katajhar this village is including Gasaibitha, Kamalabari, Rajabeel villages.

B. Panbari range:

Sl. No.	Name of village	No. of fishery	Name of owner	GPS location of village	GPS location of fishery
1	Lakhijhara No. 1	NIL	N/A	N 26°38'07.6"; E 90°47'45.0"	N/A
2	Dailong No. 1			N 26°37'45.5"; E 90°47'19.8"	
3	Barpathar No. 1			N 26°38'07.6" ; E 90°47'45.0"	
4	Chourang No. 1			N 26°38'12.0"; E 90°49'20.6"	
5	Chourang No. 2			N 26°38'03.5"; E 90°49'48.0"	
6	Chourang No. 4	3	Sri Sanibor Basumatary	N 26°37'54.4"; E 90°50'29.0"	N26°37'54.4"; E 90°50'29.0"
			Sri Didwm Basumatary		N 26°37'39.2"; E 90°50'21.8"
			Sri Labin Basumatary		N 26°37'13.3"; E 90°50'01.8"
7	Kosubeel No. 1	1	Sri Ajit Brahma	N 26°37'15.2"; E 90°50'34.7"	N 26°37'39.4"; E 90°50'52.8"
8	Kosubeel No. 2	1	Sri Omendra Brahma	N 26°37'15.1"; E 90°51'18.9"	N 26°37'15.9"; E 90°51'16.0"
9	Thaisobari No. 1	1	Sri Bhagaram Goyary	N 26°36'35.3"; E 90°50'18.0"	N 26°36'40.4"; E 90°50'20.8"
10	Thaisobari No. 2	1	Sri Charan Daimary	N 26°36'49.2"; E 90°50'45.4"	N 26°36'49.1"; E 90°50'45.2"
11	Burisutta No. 1	1	Sri Madab Basumatary	N 26°36'23.5"; E 90°50'22.1"	N 26°36'23.4"; E 90°50'21.1"
12	Garabdara No. 1	2	Sri Sarbeswar Basumatary	N 26°36'08.4"; E 90°51'17.5"	N 26°36'08.9"; E 90°51'03.1"
			Sri Nabajyoti Roy		N 26°35'58.4"; E 90°50'53.3"
13	Garabdara No. 2	NIL	N/A	N 26°35'30.1"; E 90°51'19.2"	N/A
14	Bogidora	1	Sri Sushil Narzary	N 26°35'30.1"; E 90°51'19.2"	N 26°34'57.7"; E 90°51'36.7"
15	Bhatamari	NIL	N/A	N 26°35'22.4"; E 90°51'35.6"	N/A

C. Bhuyanpara range:

Sl. No.	Name of Fringe village	GPS location	Cast				Gender		Total population	House hold	GPS location of pond	Owner of pond
			General	ST	SC	OBC	Male	Female				
1	Bamunkhal (Kumguri)	N-26°42'22.8'' E-091°06'26.6''	--	yes	--	--	375	275	650			
2	Bhuyanpara	N-26°42'09.2'' E-091°06'09.0''	--	--	--	yes	358	305	663		N-26°41'31.0'' E-091°06'00.6''	Community
3	Koroibari	N-26°41'33.5'' E-091°06'45.0''	--	yes	--	--	248	202	450		N-26°4'24.2'' E-091°06'42.9''	Community
4	Kustratari (Dongpara)	N-26°41'54.8'' E-091°07'27.2''	--	yes	--	--	280	243	523			
5	Borgaon	N-26°41'25.6'' E-091°08'34.4''	--	yes	--	--	515	590	1106			
6	Kalibari N.C	--										
7	Sale Gaon	--										
8	Sarukhagra N.C	-										
	A. Majarmakha	N-26°41'47.9''	--	yes	--	--	138	131	269	47	N-26°41'47.0''	Community

		E-091°09'30.8''									E-091°09'38.6''	
	B. New Borgaon	N-26°41'48.0'' E-091°09'24.2''	--	yes	--	--	221	195	416	78		
	C. Agranguri (Hirapara)	N-26°41'35.4'' E-091°09'25.4''	--	yes	--	--	140	220	360	76		
9	Kurbaha N.C											
	A. Rangidara	N-26°42'26.6'' E-091°09'35.4''	--	yes	--	--	211	213	424	78	N-26°42'23.7'' E-091°09'35.5''	Community
	B. Swmliguri	N-26°42'08.4'' E-091°09'52.4''	--	yes	--	--	154	151	305	65	N-26°42'12.7'' E-091°09'54.3''	Comunity
	C. Salchali	N-26°42'32.5'' E-091°09'52.5''	--	yes	--	--	125	172	297	45		
10	Kaligaon N.C	-										
	A. Lonthibari	N-26°42'32.5'' E-091°09'52.3''	--	yes	--	--	150	160	310	67	N-26°42'25.9'' E-091°09'49.4''	Community
	B. Betbari	N-26°42'57.1''	--	yes	--	--	232	202	434	101	N-26°42'58.5''	Community

		E-091°09'48.5''									E-091°09'39.5''	
	C. Thaijouguri	N-26°42'50.2'' E-091°09'19.2''	--	yes	--	--	173	169	342	73	N-26°42'49.4'' E-091°09'26.2''	Community
	D. New Bheguri	N-26°42'36.7'' E-091°10'22.7''	--	yes	--	--	195	176	371	77	N-26°42'40.1'' E-091°10'14.5''	Community
11.	Borghagra	N-26°42'36.7'' E-091°10'22.7''	--	yes	--	--	459	435	894			
12	Karankata N.C (Dihira)	N-26°44'00.2'' E-091°11'21.8''	--	yes	--	--	780	791	1571			
13	Karankata	N-26°43'53.3'' E-091°11'27.1''	--	yes	--	--	111	113	224			
14	Bargaon N.C	N-26°44'00.3'' E-091°11'21.8''	--	yes	--	--	61	84	145			
15	Bargaon	N-26°44'06.2'' E-091°11'39.3''	--	yes	--	--	187	194	381			
16	Garumara	N-26°45'06.5'' E-091°12'07.6''	--	yes	--	--	252	237	489	110	N-26°44'58.2'' E-091°12'04.9''	Community

17	Kamardaisa											
	A. North Kamardaisa	N-26°45'14.0'' E-091°30'7.1''	--	yes	--	--	356	332	688			
	B. South Kamardaisa	N-26°44'42.6'' E-091°13'15.2''	--	yes	--	--	135	132	267	50		
	C. East Kamardaisa	N-26°44'47.2'' E-091°13'15.9''	--	yes	--	--	118	125	243	48	N-26°45'00.3'' E-091°13'21.5''	Community
18	Kokilabari (2)											
	A. Thuribari	N-26°45'25.4'' E-091°13'07.5''	--	yes	--	--	132	119	251	57	N-26°45'24.0'' E-091°13'25.4''	Community
	B. Randhonipara	N-26°45'20.0'' E-091°12'43.4''	--	yes	--	--	139	114	87	60	N-26°45'21.0'' E-091°12'38.6''	
19	Daodhara											
	A. Hathijan	N-26°45'17.3'' E-091°13'57.3''	--	yes	--	--	178	166	344	68		
	B. Daoharu	N-26°45'13.1''	--	yes	--	--	134	175	309	43	N-26°45'31.2''	Community

		E-091°14'03.3''									E-091°13'56.5''	
	C. Daodhara Adivashi Sangha	N-26°45'10.4' E-091°14'07.7''	--	--	--	yes	111	127	238	40	N-26°45'09.4'' E-091°14'08.5''	Community
	C.Daodhara Nepali Sangha (Gorkhali)	N-26°45'20.1'' E-091°14'01.1''										

D. Kahitema beat:

Sl. No.	Name of fringe village	Population Data				GPS location of fringe village	Private fishery holder	
		General	ST	SC	OBC		Name of owner of Private fishery	GPS location of fishery
1	Kahitama N.C		100%			N-26°63'05.7" E-090°89'39.6"		
2	Kahitama	15%	45%		40%	N-26°62'39.4" E-090°91'60.0"	Sri Basistha Das	N-26°62'38.5" E-090°91'60.6"
3	Kahitama					N-26°62'39.4" E-090°91'60.0"	Sri Mena Basumatary	N-26°62'48.1" E-090°89'95.0"
4	Kahitama					N-26°62'39.4" E-090°91'60.0"	Sri Lautham Basumatary	N-26°62'46.4" E-090°89'94.5"
5	Kahitama Pathar	20%	40%		40%	N-26°62'44.4" E-090°94'14.2"	Sri Bhaben Narzary	N-26°62'43.4" E-090°54'17.0"
6	Kahitama Pathar					N-26°62'44.4" E-090°94'14.2"	Sri Sujuma Narzary	N-26°62'32.3" E-090°94'19.0"
7	Chamthaibari	10%	75%		15%	N-26°60'86.0" E-090°91'52.5"	Sri Shekhar Daimary	N-26°60'83.9" E-090°91'66.5"
8	Chamthaibari					N-26°60'86.0" E-090°91'52.5"	Sri Madan Daimary	N-26°60'87.6" E-090°91'19.0"
9	Oxyguri		80%		20%	N-26°61'46.9" E-090°92'97.0"	Sri Kanu Ram basumatary	N-26°61'48.5" E-090°92'97.6"
10	Oxyguri					N-26°61'46.9" E-090°92'97.0"	Sri Daren Basumatary	N-26°61'28.7" E-090°92'98.6"
11	Oxyguri					N-26°61'46.9" E-090°92'97.0"	Sri Jatin Basumatary	N-26°60'82.1" E-090°92'81.6"
12	Oxyguri					N-26°61'46.9" E-090°92'97.0"	Sri Ratneswar Mashahary	N-26°60'81.8" E-090°92'82.0"

13	Oxyguri					N-26°61'46.9" E-090°92'97.0"	Sri Deben Kachari	N-26°60'75.5" E-090°92'82.5"
14	Oxyguri					N-26°61'46.9" E-090°92'97.0"	Sri Thaneswar Mashahary	N-26°60'63.1" E-090°92'81.1"
15	Labdanguri	20%	20%		60%			
16	Labdanguri Pathar	10%	20%	10%	60%	N-26°61'07.5" E-090°34'97.2"	Sri Khagendra Thakuria	N-26°61'07.7" E-090°34'97.7"
17	Bhalaguri		20%		80%	N-26°62'32.5" E-090°96'08.6"		
18	Bhalaguri Pathar							
19	Kahitama	15%	45%		40%	N-26°62'39.4" E-090°91'60.0"	Sri Dhajen Nath	N-26°62'38.3" E-090°91'66.6"

Appendix- 41

Orchid Diversity of Manas Biosphere Reserve

As per previously reported by Hajra & Jain (1975), the orchid diversity was represented by 15 species under 13 genera. Subsequently, Dey et al (2007) reported 21 species from the region. Sarmah and Borthakur (2009) also recorded 15 orchid species in their floristic work on MNP. Gogoi (2018) reported *Eulophia andamanensis* from Manas National park, a new addition to the orchid flora of India.

In the present study, a total of 45 species belongs to 25 genera with 14 new additions to the Manas Biosphere Reserve viz., *Arundinagraminifolia*, *Bulbophyllum crassipes*, *Calanthe odora*, *Calanthe vaginata*, *Dendrobium anceps*, *Dendrobium chrysanthum*, *Eria tomentosa*, *Eulophia bicallosa*, *Eulophia adabia*, *Nervilia aragoana*, *Nervilia infundibulifolia*, *Pelatantheria insectifera*, *Peristylus constrictus*, and *Tropidia angulos* were reported. In the present study, 39 species has been found growing within the MNP during the field survey, other six species were considered from herbarium and secondary sources. Out 45 species, 17 were terrestrial orchid, 28 were found to be epiphytic herb and one species *Dendrobium densiflorum* grows as both epiphytic and lithophytes. *Dendrobium* was the best represented genus with 8 species, followed by *Eulophia*, *Calanthe* and *Flickingeria* with 5 and 3 species respectively. The Table-1 gives a comparison on the reports by previous worker and other relevant information. The diversity and distribution of the reported orchid species in different forest types of the area is represented in Table-2.

Table-1: Orchid species found in this study juxtaposed with the previous works.

Sl. no.	Scientific Name	Habit	Conservation Status	Previous Record	Present work	Record of Distribution in Assam
1	<i>Acampe praemorsa</i> (Roxb.) Blatt. & McCann	Epiphytic	DI [¥] /EN [€] /P [∞] []	Dey et al (2007), Hajra & Jain (1996)	Recorded	Joypur Reserve Forest, Manas National Park
2	<i>Aerides multiflorum</i> Roxb.	Epiphytic	DI [¥] /EN [€] /P [∞]	Sarmah & Borthakur (2009)	Recorded	Barak Valley, Eastern Assam, Western Assam, Karbi Anglong, Manas National Park
3	<i>Aerides odorata</i> Lour.	Epiphytic	DI [¥] /EN [€] /P [∞]	Dey et al. (2007), Hajra & Jain (1996)	Not recorded	Barak Valley, Eastern Assam, Western Assam, Manas National Park.
4	<i>Arundinagramminifolia</i> Hochr.	Terrestrial	O [¥] /VU [€] /P [∞]	Not reported earlier	Recorded	Barak Valley, Darrang, Golaghat, Sivasagar, Manas National Park, Lakhimpur, Manas National Park
5	<i>Biermanniabimaculata</i> (King & Pantl.) King & Pantl.	Epiphytic	R [¥] /VU [€] /P [∞]	Hajra & Jain (1996)	Not recorded	Kamrup, Golaghat, Manas National Park
6	<i>Bulbophyllum careyanum</i> (Hook.) Spreng.	Epiphytic	DI [¥] /EN [€] /P [∞]	Dey et al (2007)	Recorded	Barak Valley, Bongaigaon, Dibru –

						Saikhowa Biosphere Reserve, Kamrup, Golaghat, Goalpara, Lakhimpur, Manas National Park
7	<i>Bulbophyllum crassipes</i> Hook.f.	Epiphytic	DI ^V /EN ^E /P [∞]	Not reported earlier	Recorded	Bongaigaon, Manas National Park
8	<i>Calanthe odora</i> Griff.	Terrestrial	DI ^V /EN ^E /P [∞]	Sarmah & Borthakur (2009), Dey et al (2007),	Recorded	Manas National Park
9	<i>Calanthe triplicata</i> (Willemet) Ames	Terrestrial	DI ^V /VU ^E /P [∞]	Sarmah & Borthakur (2009)	Not recorded	Manas National Park Sadiya
10	<i>Calanthe vaginata</i> Lindl.	Terrestrial	DI ^V /EN ^E /P [∞] / Endemic	Not reported earlier	Recorded	Manas National Park Sadiya
11	<i>Chiloschista parishii</i> Seidenf.	Epiphytic	DI ^V /EN ^E /P [∞] / Endemic	Dey et al (2007)	Not recorded	Manas National Park
12	<i>Cymbidium aloifolium</i> (L.) Sw.	Epiphytic	DI ^V /EN ^E /P [∞] /	Dey et al (2007), Hajra & Jain (1996)	Recorded	Throughout the Assam
13	<i>Dendrobium acinaciforme</i> Roxb.	Epiphytic	R ^V /EN ^E /P [∞]	Hajra & Jain (1996)	Not recorded	Darrang, Dibrugarh, Lakhimpur, Golaghat, Kazringa National Park, Kamrup, Manas National Park, Panigrahi,

						Sivasagar, Upper Assam
14	<i>Dendrobium anceps</i> Swartz.	Epiphytic	DI [¥] /EN [€] /P [∞] /	Not reported earlier	Recorded	Barak valley, Kamrup, Goalpara, Golaghat, Kaziranga, Manas National Park
15	<i>Dendrobium aphyllum</i> (Roxburgh) Fischer	Epiphytic	DI [¥] /EN [€] /P [∞] /	Dey et al(2007), Hajra & Jain (1996)	Recorded	Throughout the Assam
16	<i>Dendrobium chrysanthum</i> Wallich ex Lindley	Epiphytic	DI [¥] /EN [€] /P [∞] /	Not reported earlier	Recorded	Throughout the Assam
17	<i>Dendrobium densiflorum</i> Lindl.	Epiphytic/ Lithophytes	R [¥] /EN [€] /P [∞] /	Dey et al(2007)	Recorded	Kamrup, Barpeta, Golaghat, Manas National Park
18	<i>Dendrobium jenkinsii</i> Wall. ex. Lindl.	Epiphytic	DI [¥] /EN [€] /P [∞] /	Dey et al(2007)	Recorded	Barak Valley, Bongaigaon, Darrang, Goalpara, Golaghat, Kamrup, Manas National Park
19	<i>Dendrobium lindleyi</i> Steud.	Epiphytic	DI [¥] /EN [€] /P [∞] /	Dey et al(2007)	Recorded	Barak Valley, Golaghat, Kaziranga National Park, Kamrup, Manas National Park, Sivasagar
20	<i>Dendrobium moscha</i>	Epiphytic	O [¥] /EN [€] /P [∞] /	Dey et al(2007), Hajra &	Recorded	Barak Valley, Darrang,

	<i>tum</i> (Buch.-Ham.) Sw.			Jain (1996)		Dibru –Saikhowa Biosphere Reserve, Joypur Reserve Forest, Kamrup, Golaghat, Goalpara, Lakhimpur, Manas National Park, Sivasagar
21	<i>Eria tomentosa</i> (J.König) Hook.f.	Epiphytic	R [¥] /EN [€] /P [∞]	Not reported earlier	Recorded	Barak valley, Kamrup, Manas National Park
22	<i>Eulophia andamanensis</i> Rchb.f.	Terrestrial	NE [€]	Gogoi (2018)	Not recorded	Manas National Park
23	<i>Eulophia bicallosa</i> (D.Don) P.F.Hunt & Summerh.	Terrestrial	R [¥] /EN [€] /P [∞]	Not reported earlier	Recorded	Darrang, Manas National Park
24	<i>Eulophia dabia</i> (D.Don) Hochr.	Terrestrial	DI [¥] /EN [€] /P [∞]	Not reported earlier	Recorded	Orang Wildlife Sanctuary, Manas National Park
25	<i>Eulophia mannii</i> (Rchb.f.) Hook.f.	Terrestrial	R [¥] /EN [€] /P [∞] /Endemic	Dey et al (2007), Hajra & Jain (1996)	Recorded	Kamrup, Manas National Park

26	<i>Eulophia obtusa</i> (Lindl.) Hook.f.	Terrestrial	CR [€]	Sarmah &Borthakur (2009)	Recorded	Manas National Park
27	<i>Flickingeria fimbriata</i> (Blume) A.D.Hawkes	Epiphytic	NE [€]	Hajra & Jain (1996)	Recorded	Manas National Park
28	<i>Flickingeria fugax</i> (Rchb.f.) Seidenf.	Epiphytic	O [¥] /EN [€] /P [∞]	Sarmah &Borthakur (2009)	Recorded	Joypur Reserve Forest, Kamrup, Manas National Park , Nalbari
29	<i>Flickingeria macraei</i> (Lindl.) Seidenf.	Epiphytic	O [¥] /EN [€] /P [∞]	Dey etal(2007)	Recorded	Darrang, Dibru-Saikhowa, Kamrup,Manas National Park
30	<i>Gastrochilus dasypogon</i> (Sm.) Kuntze	Epiphytic	DI [¥] /EN [€] /P [∞]	Hajra & Jain (1996)	Recorded	Manas National Park
31	<i>Gastrochilus inconspicuus</i> (Hook.f.) Kuntze	Epiphytic	DI [¥] /EN [€] /P [∞] / Endemic	Dey etal(2007), Hajra & Jain (1996)	Recorded	Barak Valley, Joypur Reserve Forest, Kamrup,Golaghat, Manas Tiger Reserve
32	<i>Geodorum densiflorum</i> (Lam.) Schltr.	Terrestrial	DI [¥] /EN [€] /P [∞]	Sarmah &Borthakur (2009), Hajra & Jain (1996)	Recorded	Throughout the Assam
33	<i>Nervilia aragoana</i> Gaudich.	Terrestrial	R [¥] /EN [€] /P [∞]	Not reported earlier	Recorded	Kamrup, Manas National Park

34	<i>Nervilia infundibulifolia</i> Blatt. & McCann	Terrestrial	DI [¥] /VU [€] /P [∞]	Not reported earlier	Recorded	Manas National Park
35	<i>Papilionanthe teres</i> (Roxb.) Schltr.	Epiphytic	DI [¥] /VU [€] /P [∞]	Sarmah & Borthakur (2009), Hajra & Jain (1996)	Recorded	Throughout the Assam
36	<i>Pelatantheria insectifera</i> (Rchb.f.) Ridl.	Epiphytic	DI [¥] /EN [€] /P [∞]	Not reported earlier	Recorded	Barak valley, Manas National Park
37	<i>Peristylus constrictus</i> (Lindl.) Lindl.	Terrestrial	R [¥] /VU [€] /P [∞]	Not reported earlier	Recorded	Kamrup, Manas National Park
38	<i>Peristylus goodyeroides</i> (D. Don) Lindley	Terrestrial	DI [¥] /VU [€] /P [∞]	Dey et al (2007), Hajra & Jain (1996)	Recorded	Barak valley, Darrang, Kamrup, Manas National Park, Nogaon
39	<i>Phaius tankervilleae</i> (Banks) Blume	Terrestrial	O [¥] /EN [€] /P [∞]	Dey et al (2007)	Recorded	Bongaigaon, Darrang, Dhemaji, Golaghat, Manas National Park, Sanitpur
40	<i>Pholidota pallida</i> Lindl.	Epiphytic	DI [¥] /VU [€] /P [∞]	Hajra & Jain (1996)	Recorded	Barak Valley Darrang, Kamrup, Manas National Park
41	<i>Pomatocalpa spicata</i> Breda	Epiphytic	DI [¥] /EN [€] /P [∞]	Not reported earlier	Recorded	Manas National Park
42	<i>Rhynchostylis retusa</i>	Epiphytic	R [¥] /VU [€] /P [∞]	Dey et al (2007), Hajra &	Recorded	Throughout the Assam

	(L.) Blume			Jain (1996)		
43	<i>Smitinandiamicrantha</i> (Lindl.) Holtum	Epiphytic	DI [¥] /VU [€] /P [∞]	Hajra & Jain (1996)	Recorded	Kamrup , Manas National Park
44	<i>Tropidiaangulosa</i> (Lindl.) Blume	Terrestrial	DI [¥] /VU [€] /P [∞]	Not reported earlier	Recorded	Manas National Park
45	<i>Zeuxinestrateumatica</i> (Linnaeus) Schlechter	Terrestrial	DI [¥] /EN [€] /P [∞]	Sarmah & Borthakur (2009)	Recorded	Barpeta, Bongaigaon, Darrang, Golaghat, Jorhat, Kamrup, Manas Tiger Reserve, Nalbari, Sivasagar

NB: CR- Critically endangered, EN- Endangered, R-Rare, VU- Vulnerable, NE-Not Evaluated DI- Data Insufficient

¥ - Conservation status of plants of Assam recorded from sources other than IUCN, €- Conservation status of plants of Assam according to IUCN, P[∞]- Plants prohibited for trade by Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

Table 2: Occurrence of Orchids in different forest types of Manas National Park

Sl. No.	Forest type	Orchid taxa
1	Semi Evergreen Forest	<i>Aerides multiflorum</i> , <i>Aerides odorata</i> , <i>Acampepapillosa</i> , <i>Bulbophyllumcareyanum</i> , <i>Bulbophyllumcrassipes</i> , <i>Cymbidium aloifolium</i> , <i>Dendrobium acinaciforme</i> , <i>Dendrobium anceps</i> , <i>Dendrobium densiflorum</i> , <i>Gastrochilusdasypogon</i> , <i>Flickingeria macraei</i> , <i>Geodorumdensiflorum</i> , <i>Phaiustankervilleae</i> , <i>Pelatantheria insectifera</i> , <i>Pomatocalpa spicata</i> , <i>Smitinandiamicrantha</i> , <i>Tropidiaangulosa</i> .
2	Moist Mixed Deciduous Forest (Dense)	<i>Bulbophyllumcareyanum</i> , <i>Biermanniabimaculata</i> , <i>Cymbidium aloifolium</i> , <i>Dendrobium acinaciforme</i> , <i>Dendrobium anceps</i> , <i>Dendrobium aphyllum</i> , <i>Dendrobium chrysanthum</i> , <i>Dendrobium lindleyi</i> , <i>Dendrobium moschatum</i> , <i>Gastrochilus inconspicuus</i> , <i>Geodorumdensiflorum</i> , <i>Pelatantheria insectifera</i> , <i>Pomatocalpa spicata</i> , <i>Tropidiaangulosa</i> ,
3	Moist Mixed Deciduous Forest (Open)	<i>Aerides multiflorum</i> , <i>Cymbidium aloifolium</i> , <i>Dendrobium aphyllum</i> , <i>Dendrobium chrysanthum</i> , <i>Dendrobium jenkinsii</i> , <i>Dendrobium lindleyi</i> , <i>Eria tomentosa</i> , <i>Flickingeria fimbriata</i> , <i>Flickingeria fugax</i> , <i>Gastrochilus inconspicuus</i> , <i>Papilionanthe teres</i> , <i>Pholidotapallida</i> , <i>Rhynchostylisretusa</i> .
4	Scrub Forest	<i>Acampepapillosa</i> , <i>Biermanniabimaculata</i> , <i>Chiloschistaparishii</i> , <i>Cymbidium aloifolium</i> , <i>Dendrobium aphyllum</i> , <i>Dendrobium jenkinsii</i> , <i>Dendrobium lindleyi</i> , <i>Flickingeria fugax</i> , <i>Flickingeria macraei</i> , <i>Papilionanthe teres</i> , <i>Pholidotapallida</i> , <i>Rhynchostylisretusa</i> , <i>Smitinandiamicrantha</i> , <i>Zeuxinestrategumatica</i> .
5	Grassland	<i>Arundinagraminifolia</i> , <i>Calanthe odora</i> , <i>Calanthe triplicate</i> , <i>Calanthe vaginata</i> , <i>Eulophia andamanensis</i> , <i>Eulophia bicallosa</i> , <i>Eulophia dabia</i> , <i>Eulophia mannii</i> , <i>Eulophia obtusa</i> , <i>Peristylusconstrictus</i> , <i>Peristylusgoodyeroides</i> , <i>Phaiustankervilleae</i> , <i>Nerviliaaragoana</i> , <i>Nerviliainfundibulifolia</i> , <i>Zeuxinestrategumatica</i> .

N.B: The List of Data were Submitted to scientific Journal for the Publication.

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