FIRST INTERIM PROJECT PROGRESS REPORT

JULY 2019 - JULY 2020

Status and conservation of tigers and their habitats in hill ranges of Northeast India with special reference to Mishmi Hills, Manipur and Nagaland

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

Disclaimer: Due to COVID-19, the team could not carry forward the work as planned. The remaining work will be carried out in the coming field season i.e., from September 2020-August 2021 (depending on the pandemic situation). The information provided here are preliminary findings and no final inferences are drawn at this preliminary stage. Further data collection and analysis are needed for drawing final inferences.

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Executive Summary:

The project was initiated after the signing of MoU between WII and NTCA on 27.03.2018, and receipt of an initial budget allocation of 20,00,000 out of the total 1st instalment budget of 1,39,85,620. Research permissions were obtained from concerned state governments of Arunachal Pradesh, Manipur and Nagaland. 6 project fellows and 3 project assistants were engaged in the project to work in the selected landscapes. In Arunachal Pradesh three intensive field sites in Mishmi hills *viz.* Dibang Wildlife Sanctuary, Mehao Wildlife Sanctuary, Kamlang Wildlife Sanctuary and Tiger Reserve were chosen for monitoring. In Manipur, Tamenglong and Senapati districts were chosen for monitoring. In Nagaland Intanki National Park and Peren district were chosen for monitoring. As only limited funds were released, we weren't able to do intensive camera trapping based occupancy surveys, we limited our camera trapping exercise (with camera traps resourced from other projects) in Kamlang TR and Mehao WLS. In Dibang WLS, Manipur and Nagaland informal interviews with local people were conducted to understand tiger occurrence and issues concerning them. Each field site progress is given in separate chapters. Chapter 1 deals with Kamlang TR, Chapter 2 deals with Mehao WLS, Chapter 3 deals with Dibang WLS and Chapter 4 deals with Manipur and Nagaland. The fieldwork was initiated in December 2019 and continued until April 2020.

Kamlang Tiger Reserve: The Kamlang tiger reserve with an area of 783 sq.km is a recently notified tiger reserve. During this survey season (December 2019 - April-2020) an area of 144 sq. km out of 196 km^2 in the identified blocks were monitored using Camera traps and sign survey based occupancy survey. Camera traps were deployed in 37 locations with overall survey effort of 2141 trap nights and 63 km of sign survey was conducted at 26 different searches. The area coverage of this season was considerably less due to various field constraints; however, the species richness obtained through camera trapping and its associated surveys, revealed occurrence of 32 mammalian species in the study area. Among carnivores, Yellow-throated marten had the highest Relative Abundance Index (RAI) and among herbivores, RAI was higher for barking deer. We conducted questionnaire based survey in 15 different villages and interviewed 30 respondents in the landscape. We recorded 23 mammalian species through interviews. Majority respondents reported tiger presence/occurrence. The camera trap based occupancy surveys will be intensified in the coming field season.

Mehao Wildlife Sanctuary: The Mehao Wildlife Sanctuary encompass an area of 281.5 km^2 in the Lower Dibang valley district. During this survey season (December 2019 – April 2020) 123 km^2 out of 180 km^2 in the identified blocks were monitored using occupancy based camera traps survey. Camera traps were deployed in 41 different locations of sanctuary with

overall survey effort of 2172 trap nights. We documented 24 mammalian species in the sanctuary. Among carnivore, Yellow-throated Marten had the highest Relative Abundance Index (RAI) and among herbivores, RAI was higher for Mithun. Species like Clouded leopard, Asiatic black bear, Asiatic golden cat and spotted linsang have been reported to be very rare with only one photo capture. We found that Himalayan serow, Indian muntjac and Yellow-throated marten were spatially distributed throughout the study area, while, Asiatic wild dog, Mithun and Indian crested porcupine were confined to a specific site. In small and meso carnivores, Leopard cat, Himalayan palm civet and Large Indian civet exhibit nocturnal pattern activity except Yellow-throated marten show diurnal activity pattern. In herbivores, only Sambar exhibit crepuscular activity whereas Indian muntjac and Himalayan serow shows nocturnal pattern. We did social survey in 7 villages around the periphery of sanctuary and interviewed 37 respondents. Tiger presence was reported from the respondent but we did not capture any tiger images in our camera trap. The camera trap based occupancy will be intensified and local people knowledge will be used to confirm tiger presence locations and maximize the possibility of tiger capture in our camera traps in upcoming field session.

Dibang Wildlife Sanctuary: The Dibang Valley district is one of the largest districts of Arunachal Pradesh with an area of 9,129 km^2 and is one of the least populated district in India. The district encompasses the Dibang Wildlife Sanctuary (DWLS), which covers an area of 4,149 km^2. During this survey, (December 2019 to March 2020) camera trap-based survey was not carried out due to existing resistance between local people and district administration over boundary rationalization of DWLS. Therefore, locals and their representative bodies for deploying camera traps and carrying out sign surveys did not grant permission. However, after considerable deliberation with the Idu Mishmi Elite Society, honourable MLA of Dibang Valley from researchers and forest department officials, permission for the socio-cultural survey was granted. A questionnaire-based survey in 17 different villages was conducted and 110 respondents were interviewed in the study area. 25 mammalian species was recorded through a questionnaire-based survey. The majority of the respondents confirmed the presence/occurrence of tigers in the study area, by narrating their folklore of kinship with the big cat. Tigers are considered as next to human kin by the Idu Mishmi tribe and hunting of tiger and other feline species is strictly forbidden by the tribe due to their Aena (Traditional taboo system). The camera trap-based occupancy surveys will be intensified in the coming field season, intensive questionnaire-based survey, in-depth semi-structured interviews, focus group discussions to document Traditional Ecological Knowledge, attitudes/perceptions towards wildlife and its conservation and identifying the area with high conservation value along with those that are under the threat for tigers, co-predators and its prey species will be executed.

Manipur and Nagaland: We surveyed Tamenglong, Senapati and Peren districts having the maximum forest cover for Manipur and Nagaland. It's connectivity to Intanki National Park, and Assam's Karbi-Anglong forest makes it a high potential area (<5000 km^2) for Tiger presence and other endangered animals. These areas are underexplored considering the undulating terrain, remoteness, poor road conditions, and political extremism. From December 2019 to April 2020, 26 villages were surveyed by conducting questionnaire surveys with the village chairman, elders, traditional healers, and hunters by asking open-ended to semi-structured questions (covering an area of more than 400 km^2. Our findings reported the presence of 27 species of mammals with rare and endangered species like Tigers, Clouded leopard, Bengal slow loris, Hoolock gibbon, Chinese pangolin, and three species of Otters. These animals primarily are hunted for consumption, traditional medicine, and retaliatory killing. Hunting of birds and mammals is done using guns, catapults, air guns, and traditional traps. The local communities of Zeliangrong tribe justified consuming wild meat as an important protein source, and varieties of wild edible plants (more than 20 species) act as dietary supplements to the starchy staple diet. Sighting records of direct and indirect signs of tigers were confirmed from Katangnam, Chingkao, and Zeliadjang villages. In 80% of the villages, human-wildlife conflict was reported for crop raiding (by wild pigs, Serow and Asiatic black bear) and livestock depredation (by Leopard cat, Clouded leopard, and Yellow-throated marten). Villages are aware about the decreasing wildlife and if provided with alternative livelihood options are willing to reduce hunting and actively participate in biodiversity conservation. The impractical and ineffective implementations of laws and policies often results in lack of trust for government initiatives hindering conservation in community owned areas. Two awareness campaigns about the importance of biodiversity conservation with students and elders taking assistance from the Forest Department and local NGOs were conducted. For next season, camera trapping will be carried out in the priority areas of surveyed villages along with more awareness programs. For upcoming surveys, hunting activities will be monitored closely to understand take-over rates of prey species.

Due to COVID 19 pandemic, the work had to be stopped and researchers were sent to their respective hometowns.

Introduction:

The historical range and total numbers of the wild tigers have seen a collapse with less than 3500 individuals left in the wild occupying less than 7% of their historical range. This has led the 13 tiger range countries to come together and pledge to double the wild tiger population by 2022. While, all these countries continue to work towards this goal, the Northeast India offers both opportunities and challenges in achieving this goal. Recent survey results have resulted in documenting wild tigers in the temperate forests of the Mishmi hill ranges (Gopi et al. 2014, Adhikarimayum & Gopi, 2018). This landscape is unique in having tiger population at over 3300 m altitude in a temperate forest ecosystem and represents one of the very few tiger habitats at such an elevation in India. 11 Tigers have been identified so far in an area of 336 km^2 in Dibang Valley district. This area has more tigers than the designated tiger reserves of the state i.e. Pakke, Kamlang and Namdapha and in the country. The next immediate priority must be to ensure this important population is protected; continuously monitored and other promising areas have to be surveyed for identifying key areas for tiger conservation in Mishmi hills and in other prospective areas of Northeast India. There still exists knowledge gaps on the ecology of tigers, co-predators and their prey species which if left unaddressed can hinder conservation efforts and delay in species recovery in the region. This necessitates better understanding of the species population dynamics, habitat associations, species coexistence patterns, food habits and resource partitioning.

Challenges: In the NE region there are probably 5 source populations *viz.* Kaziranga in Upper Assam (150 tigers), Manas in Lower Assam (30 tigers), Pakke and Nameri (8 tigers), Namdhapha (3 tigers) and Dibang Valley (11 tigers). There may be one or more small source populations like Kaziranga and Ingtanki NP. However, in recent years, there have increased incidents of reports of killing of tigers in Nagaland (Medziphema), Manipur (Phalong, Tamenglong district) and Assam and subsequent arrests of poachers and traffickers in the region. This may be attributed to lack of adequate protection to the dispersing tigers from forest department and civil societies. There is an urgent need for monitoring the metapopulation of tigers in the NE hill ranges and floodplain forested landscapes by assessing the functionality of corridors connecting them.

This project aims at working towards both the above opportunities and challenges for ensuring long-term conservation of tigers in the region. Component 1 will strengthen the occurrence records of tigers in the region and Component 2 will deal with strengthening of dispersal corridors connected to the surrounding landscape. To fill the existing information gap, this study is proposed with following objectives to: 1. Determine the distribution and abundance of tigers and associated species in the Mishmi hills (Lower Dibang Valley District,

Dibang Valley District and Kamlang Tiger Reserve in Lohit District), Manipur and Nagaland 2. Evaluate the effects of environmental features and anthropogenic pressure on the tigers and associated species occupancy patterns, 3. Assess local people's knowledge, beliefs, attitudes and perceptions about conservation of tigers, co-predators and their prey species, 4. Identify areas that have high conservation value critical points along the corridors with high probability of negative human-wildlife interface, with the ultimate aim of planning future long term monitoring and conservation strategy. We propose this research to address these issues by integrating aspects of ecology and predictive modeling that will aid in making informed conservation decisions for the tigers and associated species in the intricate and remote forest tracts of NE region. This study intends at exploring avenues to address the following key issues: 1. Conservation planning of tigers, co-predators and their prey is impeded by the paucity of reliable empirical ecological information and 2. Current threat levels will have to be assessed to understand and predict the impacts of anthropogenic pressure on Tigers, co-predators and their prey. There is a substantial deficiency in ecological data for the tigers in this landscape, which this study intends to gather. Limited ecological information exists on tiger ecology in Northeast region in general (Chauhan et al., 2006, Jhala et al., 2008, Jhala et al., 2011., Jhala et al., 2015., Gopi et al., 2012, Selvan et al., 2014, and Pandey et al., 2013).

Objectives

1. Determine the distribution and abundance of tigers and associated species in the Mishmi hills (Dibang Valley district, Lower Dibang district and Kamlang Tiger Reserve in Lohit District), Tamenglong and Senapati districts of Manipur and Dimapur and Peren districts of Nagaland.
2. Evaluate the effects of environmental features and anthropogenic pressure on the tigers and associated species occupancy patterns.
3. Assess local people's knowledge, beliefs, attitudes and perceptions about conservation of tigers, co-predators and their prey species.
4. Identify areas that have high conservation value as well as those that are under threat for tigers, co-predators and their prey species, with the ultimate aim of planning future long term monitoring and conservation strategy.

CHAPTER 1
KAMLANG TIGER RESERVE, LOHIT DISTRICT, ARUNACHAL PRADESH

Study area

Kamlang Tiger Reserve is situated in the Southeastern part of Lohit district of Arunachal Pradesh. The protected area falls in the 96˚ 26´ to 96˚ 55´ East longitude and 27˚ 40´ to 28˚ 00´ North Latitude. This reserve harbours all four big cats: Tiger *Panthera tigris*; Leopard *Panthera pardus*; Clouded Leopard *Neofelis nebulosa* and Snow Leopard *Panthera uncia*. This protected area falls within the sub-tropical zone. The vegetation can be broadly classified into Tropical temperate and Alpine forests. The lower elevations possess Tropical wet evergreen, whereas Alpine vegetation dominates the higher elevations. The reserve is continuous with Namdapha Tiger Reserve, Namsai, and Anjaw forest divisions on respective sides (Figure 1.1). The jurisdiction of the reserve covers an area of 783 km^2 with a core area of 671 km^2 and a buffer area of 112 km^2. The tiger reserve lies in the landscape 'Northeast Kamlang Kane Tale Valley' corridor of Arunachal Pradesh, which is one among the 32 major corridors connecting tiger populations across the country.

Figure 1.1: Map showing forest cover of Kamlang Tiger Reserve and its landscape in Lohit district

Methodology

Considering the feasibility of logistics and terrain features, three different blocks *viz.,* Hawai Block, Lamn Block and Chicgrong and Glow block respectively were chosen for survey during this field season.

Sign Surveys

Occupancy sign surveys were done with three to five spatially different stretches of 2 km each. The spatial configuration of each survey walk and each sign of the indirect evidence of different species were recorded. Geo-coordinates of the recorded information were also obtained using *etrex* 20/30 GPS. The samples for genetic analysis such as scats, kill remains were collected using zip-lock plastic bags containing silica gel for dry samples and stored in container vials with alcohol in case of fresh samples.

Camera trapping

A total area of 196 km^2 as three different blocks were selected for camera trapping and sign survey's as Block 1 i.e., Chigrong and Glow Block of 84 km^2; Block 2 i.e., Lamn Block of 60 km^2 and Block 3: Hawai Block of 52 km^2 respectively (Figure 1.2). For stratification, 4 km^2 grid was laid across the study site to ensure representative sample of the area by placing one camera in each grid cell. Based on the sign survey, we had placed camera traps in a randomized manner in the places where there is a high possibility of photo capture of animals. We aimed at getting a representative sample of the animals in the landscape (Giman et al. 2007).

Socio-economic Survey/ Questionnaire Survey

A semi-structured questionnaire was prepared to record the various aspects of people and their perception towards forest and wildlife. These surveys were carried out in the villages/settlements and towns adjoining Kamlang Tiger Reserve of Lohit district (Fig 1.2).

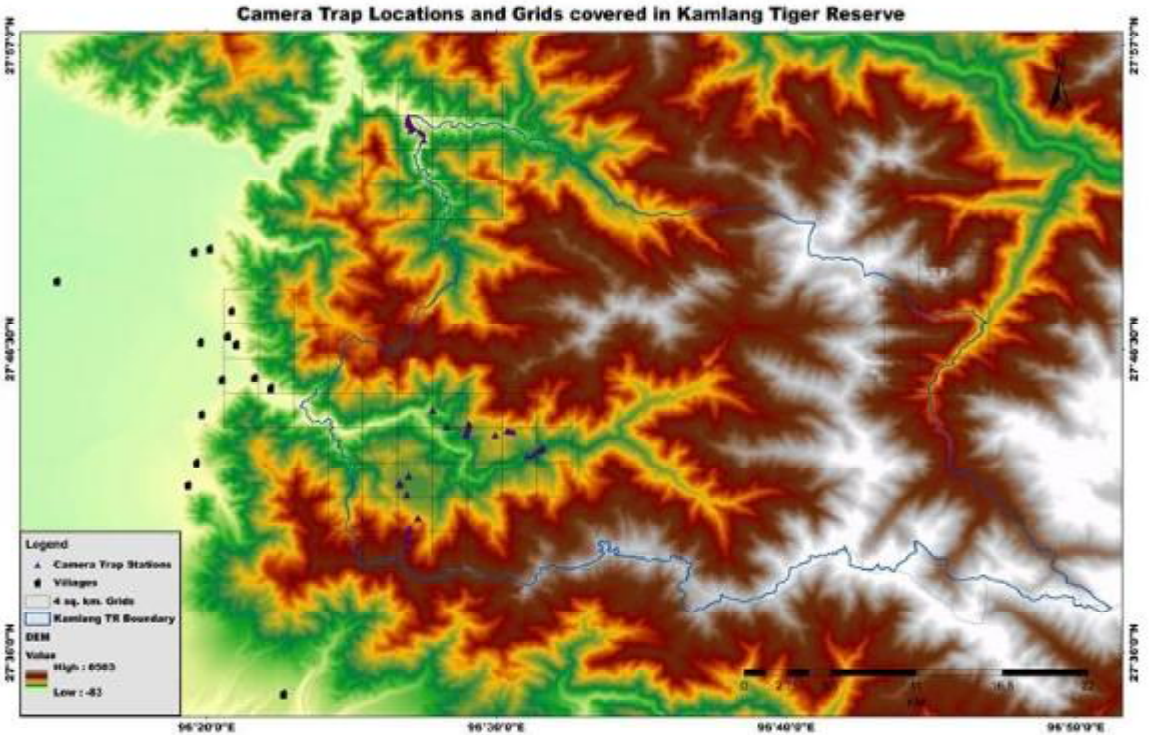


Figure 1.2: Intensive study area in Kamlang Tiger reserve, Lohit district, Arunachal Pradesh

Results and Discussions

Sign Survey

Polygon Search Method (PSM) covering a total area of 63 km with 26 searches for 1-2 km in each grids was carried out. 31 indirect evidences during the total effort were recorded. The signs include pugmark of tiger and footprints of wild dog, bear and other felids. The data will be used for the analysis of detection probability during subsequent surveys. Genetic/Food habit study samples were also collected during the sign surveys and opportunistic samples were collected. The samples include scats of wild dog, unidentified carnivore species and other felids and dung/pellets of takin and few other ungulates (Table 1.1).

Table 1.1: Brief details of genetic samples collected during the study period

Sample Type	No. of samples	Fresh	Old	Very old
Scats	11	3	3	5
Dung/Pellets	7		2	5

Camera Trapping

In the total of 37-camera trap (CT), stations were deployed, 13 in Lamn block and 24 in Chigrong and Glow block. From January to April 2020 (Figure 1.3), the camera trapping accumulated to 2141 trap nights in 37 locations with 1376 events (Figure 1.4) of capture of different species richness (Figure 1.3). Overall 33 mammal species were recorded during the study, out of which 28 mammals were photo captured in camera traps (Table 1.2) belonging to eight different family groups. Out of the recorded species 3 are Endangered (EN), 13 Least Concern (LC), 6 Near Threatened (NT) and 8 are Vulnerable (VU). Based on the relative abundance index (RAI) for the whole study area barking deer was higher along with other few ungulate species, which showed high abundance ranking. The least abundant record was of spotted linsang (Table 1.3).

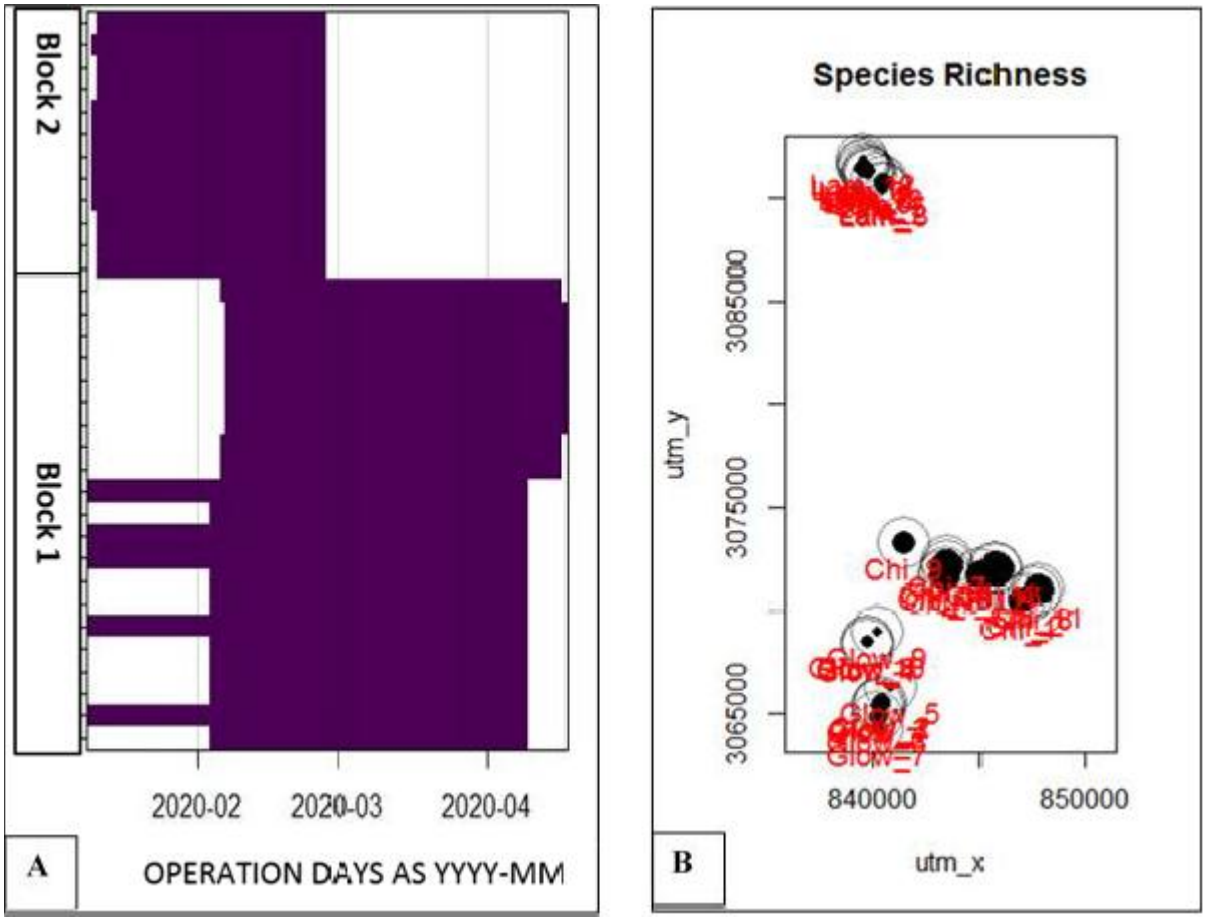


Figure 1.3: (A) Camera Trap Operation Matrix; (B) Species Richness in Monitoring Blocks at KTR

Table 1.2: List of mammalian species recorded in Kamlang Tiger Reserve.

Family	Common Name	Scientific Name	IUCN Status	Mode of Record			
				CT	DS	SS	QS
Felidae	Tiger	*Panthera tigris tigris*	EN	-	-	+	-
	Leopard	*Panthera pardus*	VU	-	+	-	-
	Leopard Cat	*Prionailurus bengalensis*	LC	+	-	-	-
	Marbled Cat	*Pardofelis marmorata*	NT	+	-	-	-
	Asiatic Golden Cat	*Catopuma temminckii*	NT	+	-	-	-
	Clouded Leopard	*Neofelis nebulosa*	VU	+	-	-	-
Ungulates	Barking Deer	*Muntiacus muntjak*	LC	+	-	-	-
	Sambar	*Rusa unicolor*	VU	-	-	-	-
	Himalayan Serow	*Capricornis s. thar*	NT	+	-	-	-

Ungulates	Red Goral	*Naemorhedus baileyi*	NT	+	-	-	-
	Wild Pig	*Sus scrofa*	LC	+	-	-	-
	Mishmi Takin	*Budorcas taxicolor*	EN	+	-	-	-
Ursidae	Asiatic Black Bear	*Ursus thibetanus laniger*	VU	+	-	-	-
	Sun Bear	*Helarctos malayanus*	VU	+	-	-	-
Primates	Eastern hoolock gibbon	*Hoolock leuconedys*	VU	+	+	-	-
	Assamese macaque	*Macaca assamensis*	NT	+	+	-	-
	Stump-tailed Macaque	*Macaca arctoides*	VU	+	-	-	-
	Capped Langur	*Trachypithecus pileatus*	VU	+	+	-	-
Canidae	Wild dog	*Cuon alpinus*	EN	+	-	-	-
Viverridae	Masked Civet	*Paguma larvata*	LC	+	-	-	-
	Common Palm civet	*Paradoxurus hermaphroditus*	LC	+	-	-	-
	Civet sp.	-	-	+	-	-	-
Hystricidae	Asiatic Brush-tailed Porcupine	*Atherurus macrourus*	LC	+	-	-	-
	Malayan Porcupine	*Hystrix brachyura*	LC	+	-	-	-
Small Mammals	Yellow-throated marten	*Martes flavigula*	LC	+	+	-	-
	Eurasian Otter	*Lutra*	NT	-	-	-	+
	Spotted Linsang	*Prionodon pardicolor*	LC	+	-	-	-
	Yellow-bellied Weasel	*Mustela kathiah*	LC	+	-	-	-
Rodents	Himalayan Field Rat	*Rattus nitidus*	LC	+	-	-	-
	Rodent sp.	-		+	-	-	-
Scandentia	Northern Treeshrew	*Tupaia belangeri*	LC	-	+	-	-
Squirrels	Pallas's squirrel	*Callosciurus erythraeus*	LC	+	+	-	-
	Squirrel sp.	-	-	+	+	-	-

Table 1.3: Relative Abundance Index (RAI) of different species based on camera trap record

Sl. No.	Species	RAI
1	Assamese macaque	0.47
2	Barking deer	6.40
3	Bat	0.09
4	Asiatic rrush-tailed porcupine	0.23
5	Capped langur	0.70
6	Clouded leopard	0.19
7	Red goral	0.09
8	Asiatic Black Bear	0.19
9	Masked Palm Civet	0.28
10	Eastern hoolock gibbon	0.05
11	Malayan Porcupine	0.89
12	Leopard Cat	0.61
13	Sun Bear	0.47
14	Marbled Cat	0.23
15	Mishmi Takin	1.59
16	Mithun	1.63
17	Northern Pig-tailed macaque	0.19
18	Rodents	0.70
19	Sambar	0.61
20	Himalayan serow	6.03
21	Spotted Linsang	0.05
22	Squirrel species	0.23
23	Stump-tailed Macaque	3.78
24	Wild pig	0.37
25	Wild Dog	0.42
26	Yellow-throated Marten	0.65

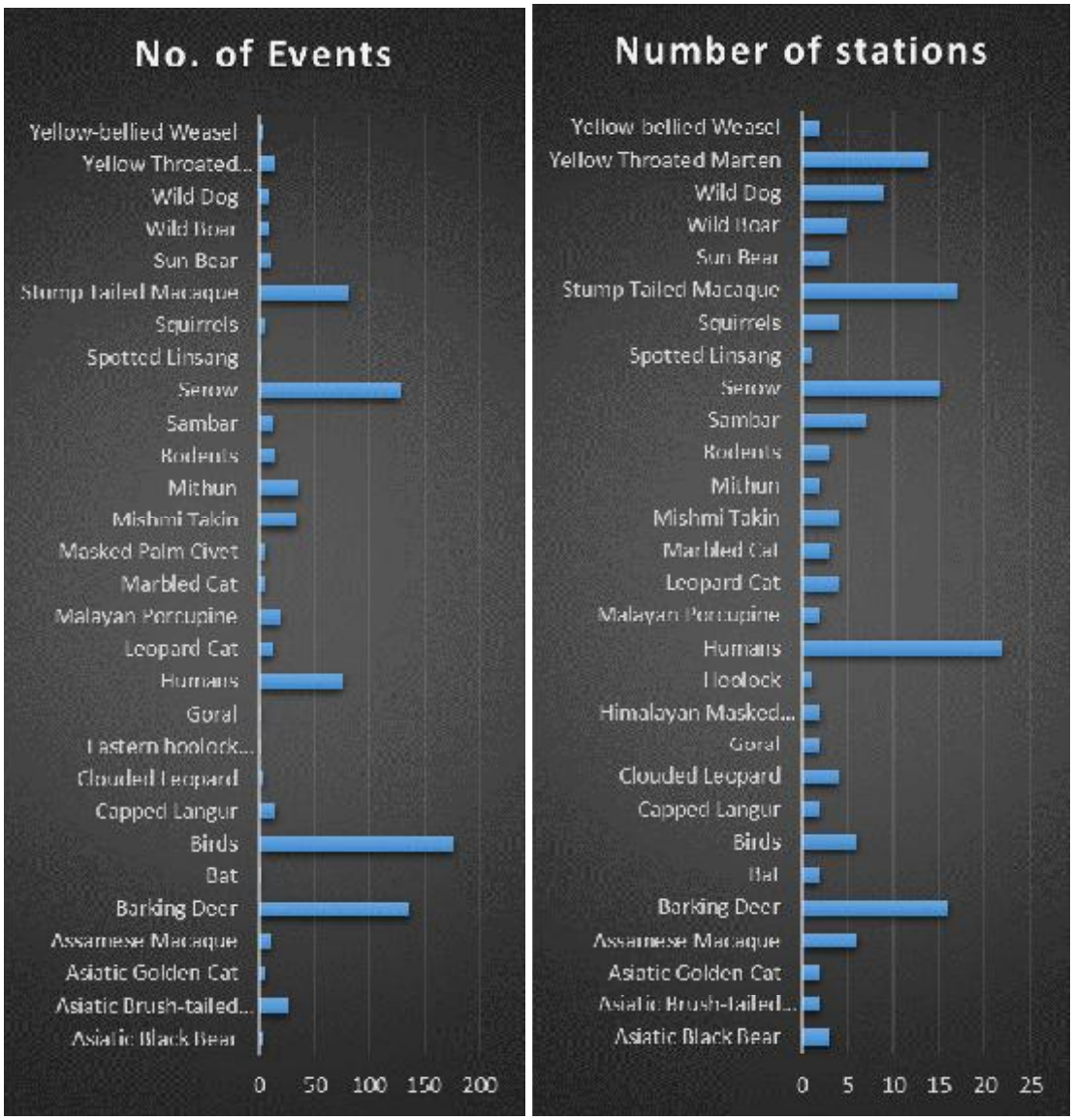


Figure 1.4: Capture events of different species and number of stations species were photo captured

Socio-economic Survey: Human Wildlife Interaction

Individuals from 30 different houses from 15 different villages were interviewed. All the ethics and principles were followed during the collection of information from respondents. The respondents were clearly briefed about our intention to collect this information. Apart from their indigenous knowledge about wildlife in their area, 25 major species were recorded during our interaction with the people based on their traditional ecological knowledge and experience (Table 1.4). Respondents were also asked about the use of plant species collected from wild for various purposes (Table1 .5) which they collect it in the village itself or travel up to 150 km/3 days trek. 27 plant species are reported to be collected as firewood in the range from 5 kg to 30 kg, which includes two species of cultural importance, which is locally called as *taboos* weekly or daily based on the requirement and seasons (Table 1.6).

Seven wild animal species were recorded to play main role in ethno medicine (Table 1.7). Twelve respondents mentioned the uses of plant species for ethno medicine (Table 1.5). Respondents mentioned about human-wildlife conflict, especially about livestock depredation. During our interaction, majority of the respondents mentioned about loss of poultry to Golden jackals and mentioned about the activity of leopard.

Table 1.4: Showing human-wildlife interaction in the study area

Sl. No.	Name of the Wildlife	Sighting	Hunting	Medicinal
1	Barking deer	+	+	-
2	Bear sp.	+	+	+
3	Cat sp.	+	-	-
4	Civet	+	+	-
5	Asiatic wild dog	+	-	-
6	Elephant	+	-	-
7	Flying squirrel	+	-	+
8	Hoolock Gibbon	+	-	-
9	Golden Jackal	+	+	-
10	Common Leopard	+	-	-
11	Mongoose	+	-	-
12	Monitor Lizard	+	+	+
13	Monkey	+	-	-
14	Musk deer	+	+	-
15	Otter	+	+	-
16	Porcupine	+	+	+
17	Sambar	+	+	-
18	Small cat sp.	+	-	-
19	Takin	+	+	-
20	Tiger	+	-	-
21	Wild Pig	+	-	-
22	Yellow-throated Marten	+	+	-
23	Serow	-	+	-
24	Hornbill	+	-	+

Table 1.5: List of medicinal plant reported by the respondents during the questionnaire survey

Sl. No.	Name of plants (Vernacular Names)	Habit	Part collected	Mode of use	Purpose of use	Season	Location	Distance from village
1	*Areysapa*	Mat like	Leaf	Consumption	Healing property	Throughout year	Near house	0
2	*Coptis teeta*	Shrub	Tuber	Consumption	Diarrhoea, stomach pain	Winter	Kamlang TR, Anjaw dist.	3 days trek
3	*Paris polyphylla*	Shrub	Tuber	Grinded or soaked in water	Diarrhoea	Winter	Kamlang TR	2 -3 days trek
4	*Toponung*	Shrub	Tender Leaf	Paste	Wounds, cuts, Kidney stone, to clean stomach, cancer, ulcer & Body pain	All season	Near house	within village
5	*Talukroo*	Climber	Leaf	Paste	Wounds & cuts	Throughout the year	Near house	-
6	*Lamdong*	Shrub	Leaf	Paste	Wounds & cuts	Throughout the year	Near house	-
7	*Mikanin scandens(Talukkru)*	Climbers	Leaf	Paste	Wounds, Cuts, inflammation	Throughout year	Near house	-
8	*Taluk Kru*	Climber	Leaf	Paste	Wounds	All season	Near village	100-200m
9	*Coptis teeta*	Shrub	Tuber	Extract	Stomach pain	Winter	Anjaw Dist	160+km
10	*Toponung*	Shrub	Leaf	Paste	Wound	Winter	Anjaw dist	160+km
11	*Dumka Patta*	NA	Leaf	Paste	Wound	Summer	KTR	1-2km

Table 1.6: List of plants collected as fuelwood and its dependency in the study area.

Sl. no.	Species Name (Vernacular Names)	Availability (H/M/L)	Frequency of collection (D/W/M)	Collected by (M/F/C)	Hrs. spent for collection	Quantity (kg)
1	*Kanimbo*	Medium	Weekly	Male	0.5-2.0	20-30
2	*Thodi*	Low	Monthly	Female	0.5-2.0	5
3	*Asi sang*	Medium	Daily	Male	0.2-0.3	5
4	*Hilika sang*	Medium	NA	Female	NA	NA
5	*Bamboo*	Medium	NA	Children	NA	NA
6	*Rahasang*	Medium	Weekly	All members	0.5-1	5
7	*Lankhit*	Medium	Weekly	NA	NA	NA
8	*Tityu*	Medium	Weekly	NA	NA	NA
9	*Any wood*	High	Weekly	All members	1	5
10	*Kahal*	Medium	Daily	All members	0.5-1	5
11	*Tissong*	Medium	Daily	NA	NA	NA
12	*Bhola*	Medium	Daily	NA	NA	NA
13	*Kahalsung*	Medium	Weekly	All members	1hr	5
14	*Lasung*	Medium	Weekly		NA	NA
15	*Anywood*	Medium	Weekly	All members	1hr	5
16	*Balasung*	Medium	Daily	All members	1hr	5
17	*Tuchaisung*	Medium	NA	NA	NA	NA
18	*Hoolock*	Medium	Daily	NA	NA	NA
19	*Orange Tree*	High	Daily	Everyone	1-2	5
20	*Kri sang*	Medium	Daily	Everyone	1-2	5
21	*Lakhyil sang*	Medium	NA	NA	NA	NA
22	*Chochaisung*	High	Weekly	Everyone	2-3	5
23	*Krisung*	High	Weekly	Everyone	NA	NA
25	*Sambyamsung*	Medium	Weekly	Everyone	1	5
25	*Kri, Maka, Kachang*			Taboo trees		
26	*Gun Sarai taboo wood*					

Table 1.7: List of animal products used in the study area.

Species extracted	Animal part used	How medicine is prepared	Ailment cured
Bear	Fats	Slow heating	Body pain
Flying squirrel	Urine, Tail	Drink or applied on head	Easy delivery during pregnancy
Great Hornbill	Fats	Fats are slow heated	Burns, Body aches, bone fracture
Hornbill	Fats		Body aches, bone fracture
Jackal	Meat, Blood	Eaten	T.B and asthma
Monitor Lizard	Tail end, some organ near stomach		Stops puss from coming out from children's ears
Porcupine	Fats	Fat is collected	Malaria

Way Forward in Kamlang TR

1. The Hawai Block, which was not surveyed this season, will be monitored through camera trapping and associated methodologies in coming seasons.
2. Other areas within the tiger reserve will be surveyed extensively so that all the blocks and the monitoring area will be increased.
3. Occupancy survey by sign surveys will also be carried out in Namsai Forest Division, which adjoins Kamlang Tiger Reserve, as there are promising information about presence of tiger and leopard. Camera trapping may not be possible in Namsai FD due to high rate of human disturbances.
4. Occupancy survey in identified forest areas under Anjaw Forest Division, community lands in Anjaw district in both community forests and reserve forest will be carried out. Questionnaire based occupancy surveys and socio economic surveys also will be carried out in Anjaw district.

PLATES

Image 1.1: Clouded leopard (*Neofelis nebulosa*)

Image 1.2: Asiatic golden cat (*Catopuma temminckii)*

Image 1.3: Himalayan black bear *(Ursus thibetanus laniger)*

Image 1.4: Malayan sun bear *(Helarctos malayanus)*

Image 1.5: Barking deer *(Muntiacus muntjak)*

Image 1.6: Mishmi Takin *(Budorcas taxicolor taxicolor)*

Image 1.7: Himalayan serow *(Capricornis s. thar)*

Image 1.8: Asiatic wild dog *(Cuon alpinus)*

Image 1.9: Asian palm civet *(Paradoxurus hermaphrodites)*

Image 1.10: Spotted linsang *(Prionodon pardicolor)*

Image 1.11: Capped langur *(Trachypithecus pileatus)*

Image 1.12: Stump tailed macaque *(Macaca arctoides)*

Images 1.13: Trophies recorded during questionnaire survey

References

Giman, B., Stuebing, R., Megum, N., Meshea, W.J. & Stewart, C. M. (2007) a camera trapping inventory for mammals in a mixed use planted forest in Sarawak, *The Raffles Bulletin of Zoology*. National university of Singapore. Pp 209-215.

CHAPTER 2
MEHAO WILDLIFE SANCTUARY, LOWER DIBANG VALLEY, ARUNACHAL PRADESH

Study Area

Current study was carried out in Mehao Wildlife Sanctuary (Mehao WLS) in the Lower Dibang Valley district of Arunachal Pradesh. It was declared as a sanctuary in 1980 and it harbours several species of wild animals and birds. The Mehao WLS which cover an area of 281.5 km² lies between 93˚ 30` and 95˚ 45` East longitudes and 28˚ 05` and 28˚ 15` North latitude (Fig 2.1). The terrain in Mehao WLS is flat in the southern part and hilly in the northern part with an altitude range between 400m to 3568m above mean sea level (asl). In Mehao WLS, the forest type changes with the altitude. The forest types in Mehao WLS are tropical evergreen forest (900m), sub-tropical and temperate forest (900m-1800m), temperate broad leaved forest (1800m-2800m) and temperate conifer forest (2800m-3500m). These forests are dominated by *Terminalia myriocarpa*, *Butea monosperma, Dipterocarpus retusus, Albizzia lucidor*, *Messua ferra*, *Dillenia indica, Bombax ceiba* and *Castanopsis indica*, while primary shrub and herb species include *Clerodendrum viscosum, Maesa indica, Tephrosia candida,* and *Solanum khaslanum.* Bamboos such as *Dendrocalamus giganteus*, *Dendrocalamus hamiltonii and Bambusa pallida occur here.*

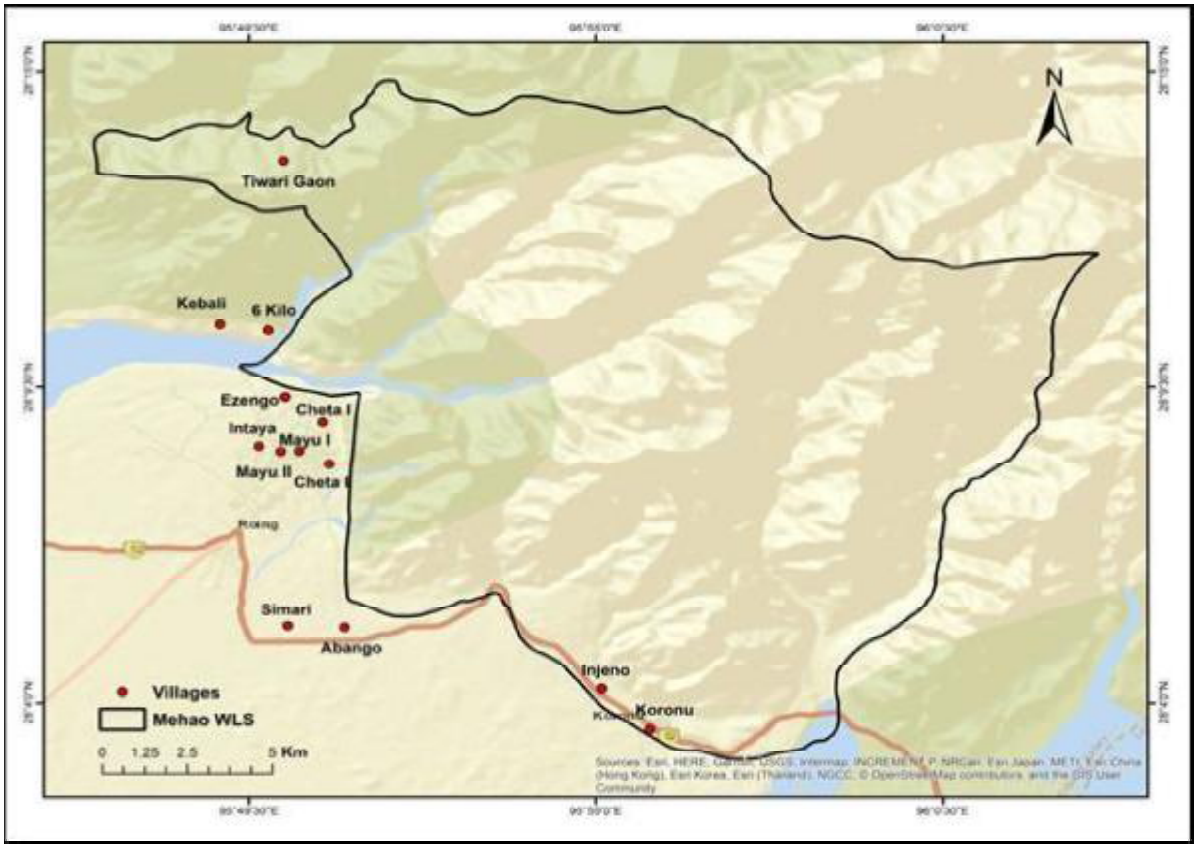


Figure 2.1: Study map of Mehao Wildlife Sanctuary, Lower Dibang valley, Arunachal Pradesh, India

Methodology

The field survey was conducted between the months of December 2019 to April 2020. Reconnaissance was carried out during the initial months of the study period to develop fair knowledge and understanding about the area, and baseline information for further intensive sampling. The effort was made to deploy the camera trap units along the stream beds, animal trails and locations, which have confirmation of animal presence as identified during the preliminary sign survey. 41 camera traps were deployed in a 3 km^2 grid covering an area of 123 km^2 (Figure 2.2). Cuddeback C1 and G models camera traps were utilized. The cuddeback C1 model is a white flash model and Cuddeback G model is an infrared (IR) model. The range of detection for both camera traps models is 100 ft, with a trigger speed of ¼ second. Both models were set as fast as possible (FAP) after being activated once. Relative abundance index (RAI) was calculated as total number of photographs for each species divided by total trap nights and then multiplied by 100 days (Carbone et al. 2001). Due to low capture rate of species, we recorded the multiple photographs of single individuals within a 20 min period as one effective photograph (O'Brien et al. 2003). To assess the activity pattern, we assumed that number of camera trap data taken at different times has interacted to the daily activity patterns of mammals. This analysis was performed for the species, which have at least ten records (Sanderson 2004). To analyse temporal patterns kernel density estimation was used to establish activity patterns in program **R** (Version 3.5.1) platform using overlap package (Ridout & Linkie 2009). Species accumulation curve of mammals in Mehao WLS was calculated using rarefaction. It gives the estimate of what the species richness or the assemblage would be if at the particular level of camera trapping effort were made (Maguran 2004). This is done by taking a mean of repeated re-sampling of all combined individual or samples (Gotelli & Colwell 2001). Thus, the sample-based rarefaction curves can be used to account for natural levels of sampling heterogeneity in data. Therefore, the rarefaction curve of the mammalian species found in Mehao WLS was calculated using vegan package of R software 3.5.1. A semi-structured questionnaire survey was conducted for collecting information related to socio-economic profile of local communities and their interactions with wildlife. Household survey was conducted in 7 villages and 37 respondents were interviewed, in addition to this focus group, discussion was also conducted in the study area. The interviews focused to understand the socio-economic status of Idu Mishmi communities and their predominant natural resource dependence. Household information pertaining to basic socio-demographics, source of income, mean annual income, land and livestock holding, agricultural practices, non-timber forest produce dependence, availability of fuel sources were collected. In to the above survey, on the spot inspection of depredation of crop and livestock was carried out whenever possible or when informed by villagers.

Results and Discussion

This preliminary survey records 24 mammalian species, which includes 12 carnivores (four felids, two viverrids, one mustelid, two canids and each from the ursidae, herpestidae, prionodontidae family); 6 ungulates (three bovidae, two cervidae, one suidae) species. In the carnivore guild, we photo captured clouded Leopard, Asiatic golden cat, leopard cat, marbled cat, spotted linsang, Masked palm civet, large Indian civet, crab-eating mongoose, Asiatic wild dog, golden jackal, Asiatic black bear, and Yellow-throated marten. In the herbivore guild, Mishmi Takin, Himalayan Serow, Mithun, Barking deer, Sambar, Indian Wild Pig. Seven other species of two hystricidae, three sicuridae and each from hylobatidae, cercopithecidae comprising of Himalayan crestless Porcupine, Asiatic Brush-tailed Porcupine, Black Giant Squirrel, Pallas's Squirrel, Himalayan striped Squirrel, Eastern Hoolock Gibbon, Assamese macaque were recorded. Of the 24 species recorded, 11 have high global conservation significance, categorized as, Endangered (2), Vulnerable (7), Near Threatened (3) and Least Concern (12) in the IUCN Red List (IUCN 2010) (Table 2.1). A sum of 24 species was recorded through sign survey, direct sighting, questionnaire survey and camera trapping.

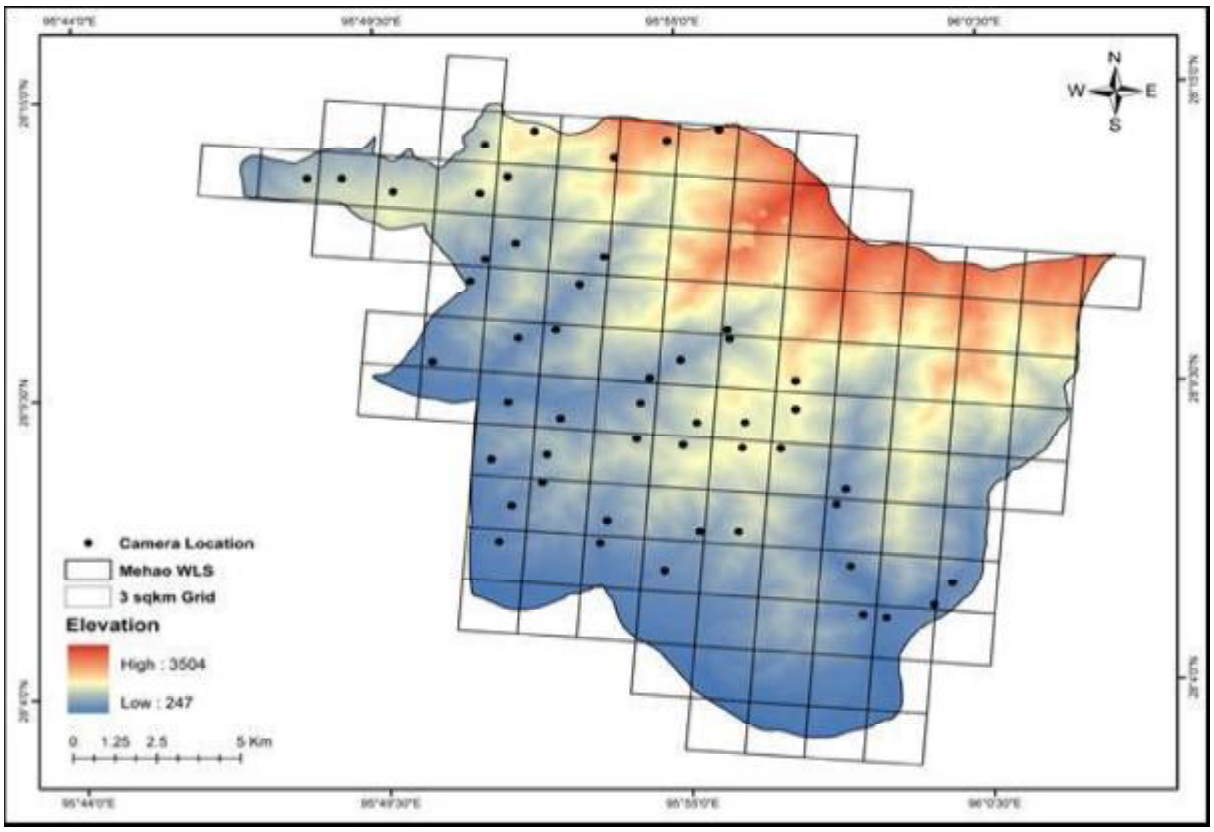


Figure 2.2: Map showing the location of camera trap and grids covered during the survey in Mehao Wildlife Sanctuary

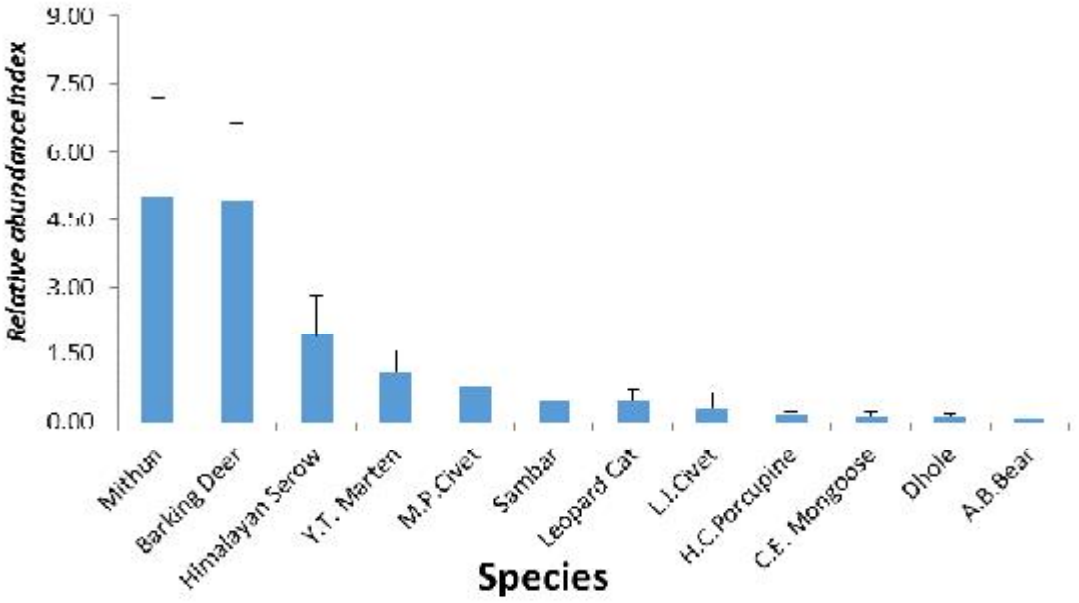


Figure 2.3: Relative Abundance Index (RAI) of photo captured mammals in Mehao Wildlife Sanctuary.

The maximum values of the relative abundance index were noted for Mithun (5.01±2.13), followed by barking deer (4.94±1.68), Himalayan serow (1.92±0.88), Yellow-throated marten (1.12±0.47), Masked palm civet (0.79±0.30), Sambar (0.49±0.48), Leopard cat (0.48 ±0.23) and Large Indian civet (0.33±0.32) (Table 2.1). As shown in RAI, the most abundant mammalian species were the Mithun (*Bos frontalis)* and Barking deer (*Muntiacus muntjac*), among carnivores, Leopard cat (*Prionailurus bengalensis*) and Asiatic wild dog (*Cuon alpinus*) were the most abundant carnivore recorded in Mehao WLS, respectively (Figure 2.3). Recent scientific work stated that due to habitat fragmentation and loss of habitat due to anthropogenic pressure (like, expansion of agriculture land, build-up area, construction of highways, presence of human inside the sanctuary and excessive cutting of cane and timber) which results in local extinction of species. Such anthropogenic pressures may affect the species distribution and abundance in the landscape.

Spatial distribution

Species distribution map through kernel density distribution in space using camera trap locations and direct and indirect sighting locations were created (Silverman 1986, Worton 1995, Kernohan et al. 2001). The activity map of Barking deer (*Muntiacus muntjac*), Mithun (*Bos frontalis)* and Himalayan Serow *(Capricornis s. thar*) shows the intensity of Barking deer activity is more in fringes of the forested areas which are near to human settlement. The activity centre map of Himalayan Serow *(Capricornis thar*) and Yellow-throated Marten *(Martes flavigula)* shows the intensity of usage of the area ranging from high (depicted in red colour) to low (green colour). The high-density areas (hotspots) of both species seem to be

clustered which may be due to the patchy distribution because of factors such as undulating terrain, ruggedness, human disturbance, dense forest and small streams. However, the causal reason behind this need further investigation (Figure 2.5).

Species accumulation curve

Species accumulation curve shows that the species richness in camera traps nights in the sanctuary increases during the initial 30 days of camera traps night and show asymptote after 60 trap nights (**Figure 2.4**).

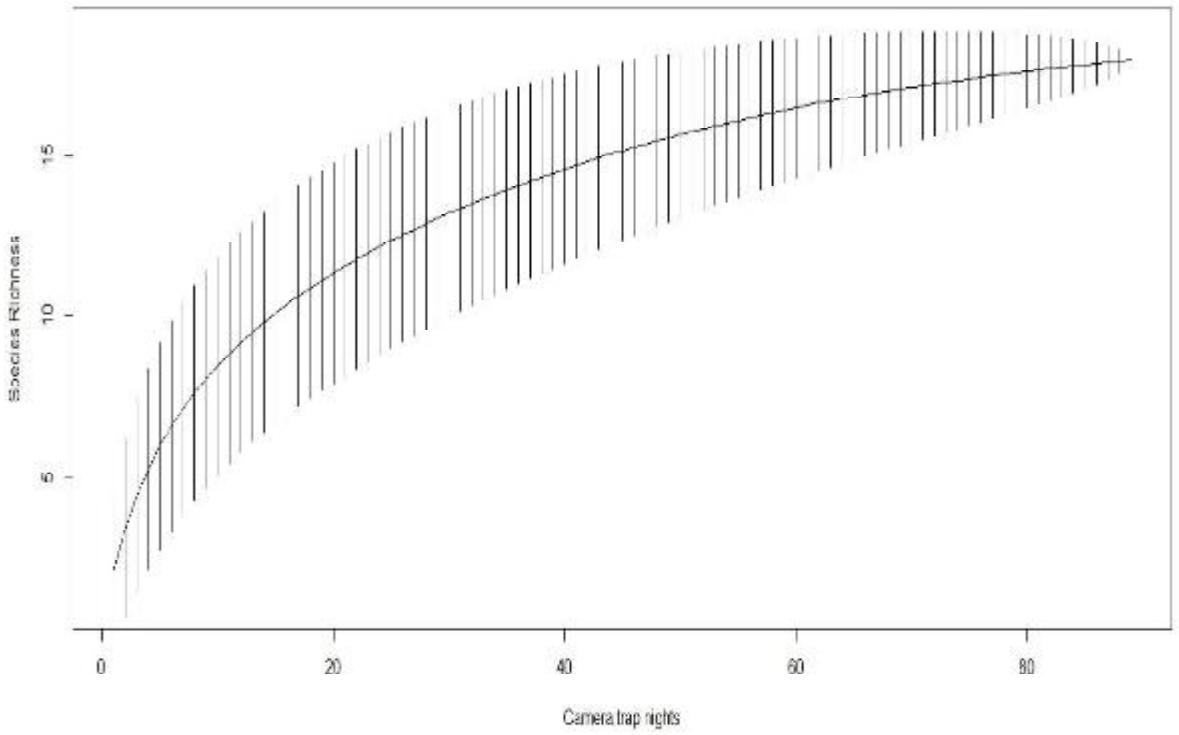


Figure 2.4: Species accumulation curve of mammalian carnivores and forest dwelling ungulates species in Mehao Wildlife Sanctuary

Table 2.1: Mammals recorded from Mehao Wildlife Sanctuary through different methods, CT (Camera Trap), Sign Survey (SS), Direct Sighting (DS), Questionnaire survey (QS) and their Relative abundance index (RAI), IUCN status (LC- Least concern, NT- Near Threatened, VU- Vulnerable, EN-Endangered)

Order	Family	Sl. No.	Common Name	*Scientific Name*	IUCN	RAI	Record Through			
							CT	SS	DS	QS
Primates	Hylobatidae	1	Eastern Hoolock Gibbon	*Hoolock leuconedys*	VU	-	-	*	*	*
	Cercopithecidae	2	Assamese macaque	*Macaca assamensis*	NT	-	-	-	*	*
Carnivora	Felidae	3	Clouded Leopard	*Neofelis nebulosa*	VU	-	*	*	-	*
		4	Marbled Cat	*Pardofelis marmorata*	VU	-	*	*	-	-
		5	Asian Golden Cat	*Catopuma temminckii*	NT	-	*	-	*	*
		6	Leopard Cat	*Prionailurus bengalensis*	LC	0.48±0.23	*	*	*	*
	Canidae	7	Asiatic wild dog	*Cuon alpinus*	EN	0.13±0.07	*	*	*	*
		8	Golden Jackal	*Canis aureus*	LC	-	*	*	*	*
	Ursidae	9	Asiatic Black Bear	*Ursus thibetanus*	VU	0.09±0.06	*	*	-	*
	Mustelids	10	Yellow throated marten	*Martes flavigula*	LC	1.12±0.47	*	*	*	*
	Herpestidae	11	Crab-eating Mongoose	*Herpestes urva*	LC	0.13±0.09	*	-	-	-
	Viverrids	12	Masked Palm Civet	*Paguma larvata*	LC	0.79±0.30	*	*	*	-
		13	Large Indian Civet	*Viverra zibetha*	LC	0.33±0.32	*	-	-	*
	Prionodontidae	14	Spotted Linsang	*Prionodon pardicolor*	LC	-	*	-	-	-
Artiodactyla	Bovidae	15	Himalayan Serow	*Capricornis s.thar*	VU	1.92±0.88	*	*	*	*
		16	Mithun	*Bos frontalis*	-	5.01±2.13	*	*	*	*
		17	Mishmi Takin	*Budorcas t. taxicolor*	VU	-	-	*	-	*
	Cervidae	18	Barking deer	*Muntiacus muntjak*	LC	4.94±1.68	*	*	*	*
		19	Sambar	*Rusa unicolor*	VU	0.49±0.48	*	*	-	*
Rodentia	Suidae	20	Wild pig	*Sus scrofa*	LC	-	*	*	-	*
	Sciuridae	21	Pallas's Squirrel	*Callosciurus erythraeus*	LC	-	-	-	*	*
		22	Black Giant Squirrel	*Ratufa bicolor*	NT	-	-	-	*	*

		23	Himalayan Striped Squirrel	*Tamiops macclellandi*	LC	-	-	-	*	*
	Hystricidae	24	Himalayan crestless Porcupine	*Hystrix brachyura*	LC	0.14±0.07	*	*	-	*

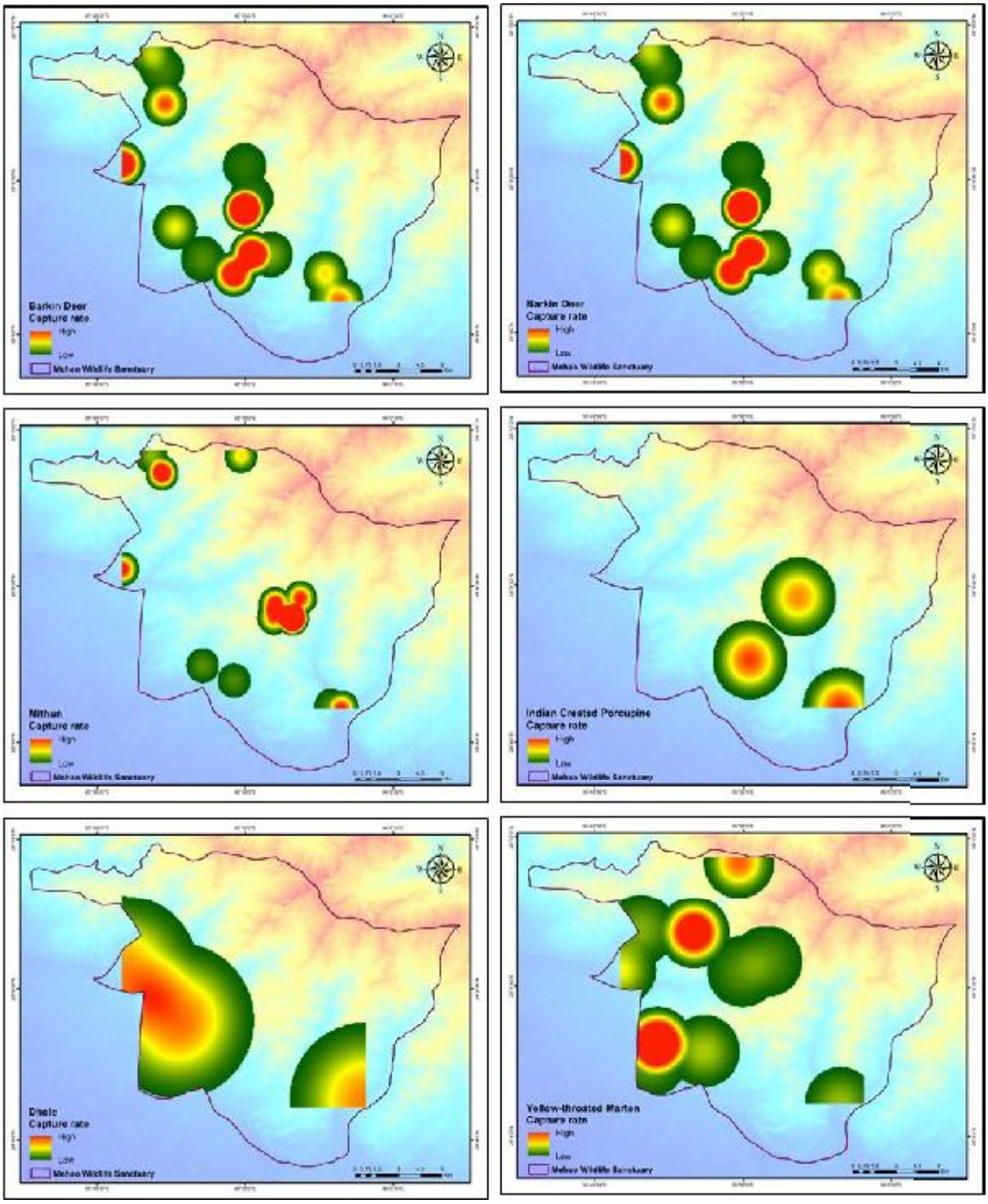
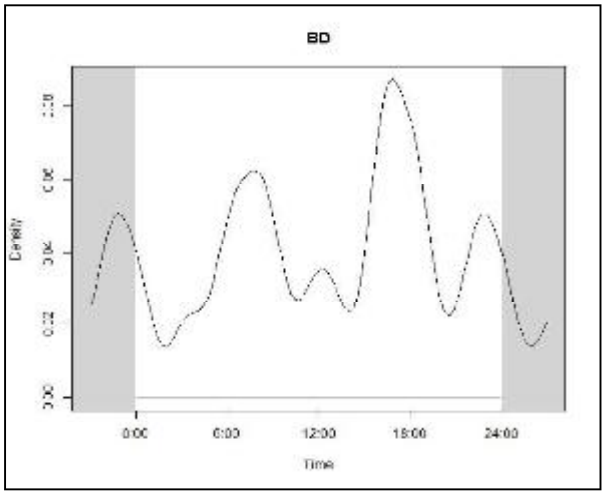


Figure 2.5: Distribution map of barking deer, Himalayan serow, mithun, Himalayan crestless porcupine, Asiatic wild dog and yellow-throated marten in Mehao wildlife sanctuary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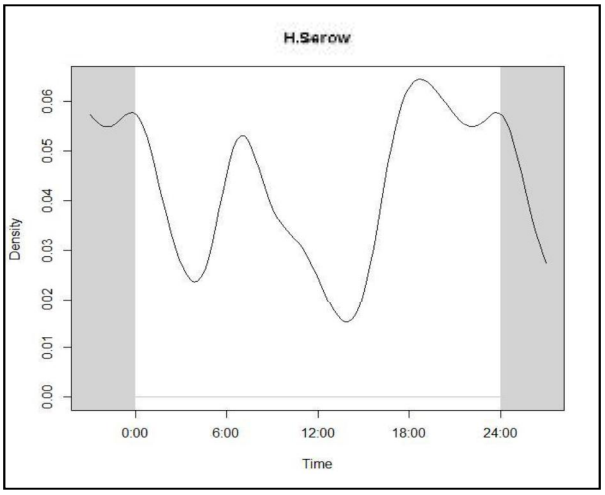
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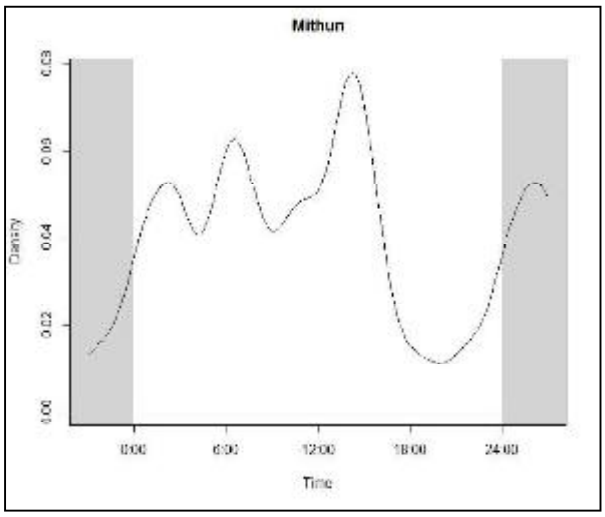
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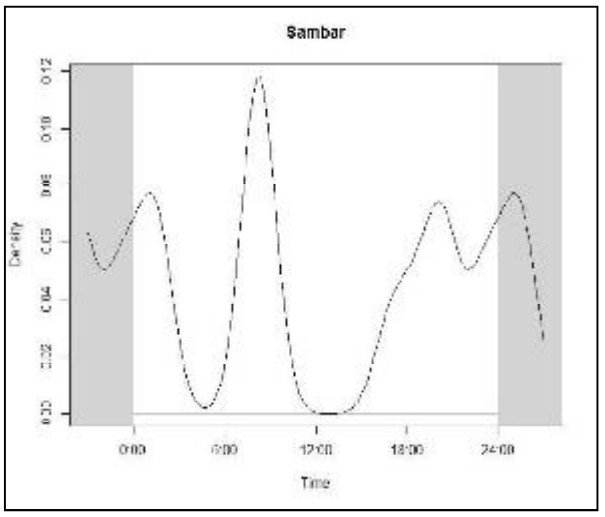
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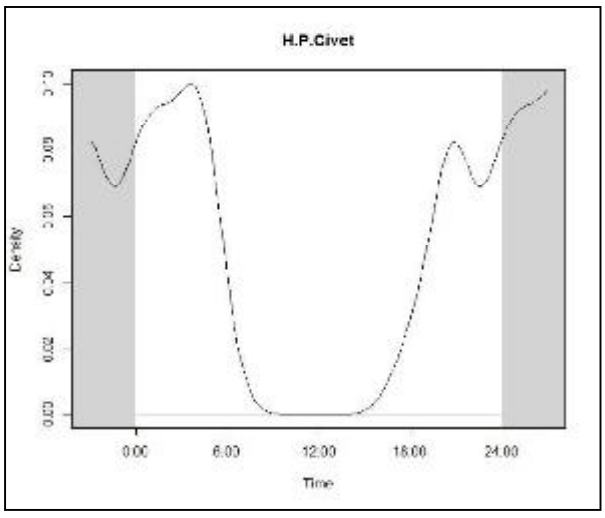
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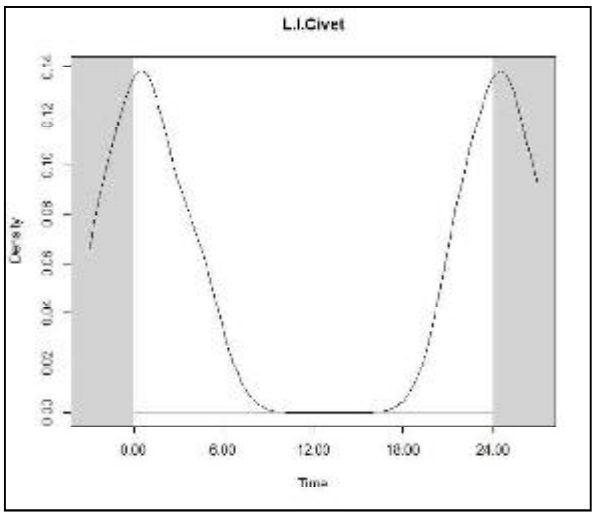
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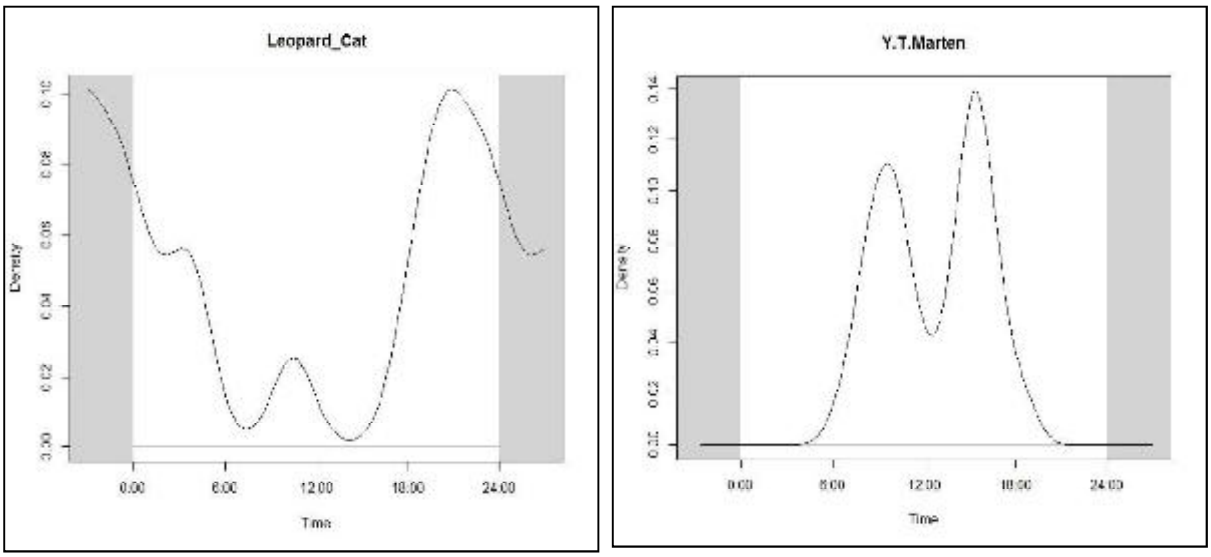

Figure 2.6: Activity patterns of carnivores, ungulate species species and semi-domesticated Mithun in Mehao WLS

Daily activity patterns

Activity patterns of mammals in the wild reveal interesting patterns of resource used by them. Recently, the use of camera-trap has widely contributed to study animal activity around the world (Stephanny**.** et. al*.* 2016; Leuchtenberger. et. al., 2017; Noor. et. al., 2017; Sergey *et. al., 2018*). Most of the species had a high selection of dawn and dusk time for daily activities and can be considered as crepuscular. For carnivores, we found nocturnal pattern (Time: 1500 hrs to 2400 hrs) in Leopard cat. In herbivores, Barking deer and Himalayan Serow showed nocturnal pattern but Mithun are active during daytime. The sharp incline in the activity of Sambar showed crepuscular activity (Tan. *et. al.,* 2018) which is active between 0600 hrs to 1100 hrs and 1500 hrs to 2200 hrs. Himalayan palm civet and Large Indian Civet showed nocturnal activity pattern. Yellow-throated Marten showed diurnal activity pattern between 0600 hrs to 1800 hrs (Figure 2.6). Most of the species have examined shows high activity peak during dusk and dawn to avoid the human presence.

Questionnaire survey

As per Census of India 2011, Roing had a populace of 11,389. Both Adi and Idu Mishmi tribes are the main indigenous dwellers of Roing. The Idu Mishmi community is mainly dependent on the forest for their livelihood and daily needs. The significant source of dietary protein is meat and is obtained from wild meat and they observe cultural / customary *(Aena)* for 5 days when they hunt wild animals. We collected data about wild animal reported near or in and around the villages of the protected area. According to the study, 60% responded that they encountered Barking deer near their village, which was followed by Himalayan serow (45%) (Fig 2.7).

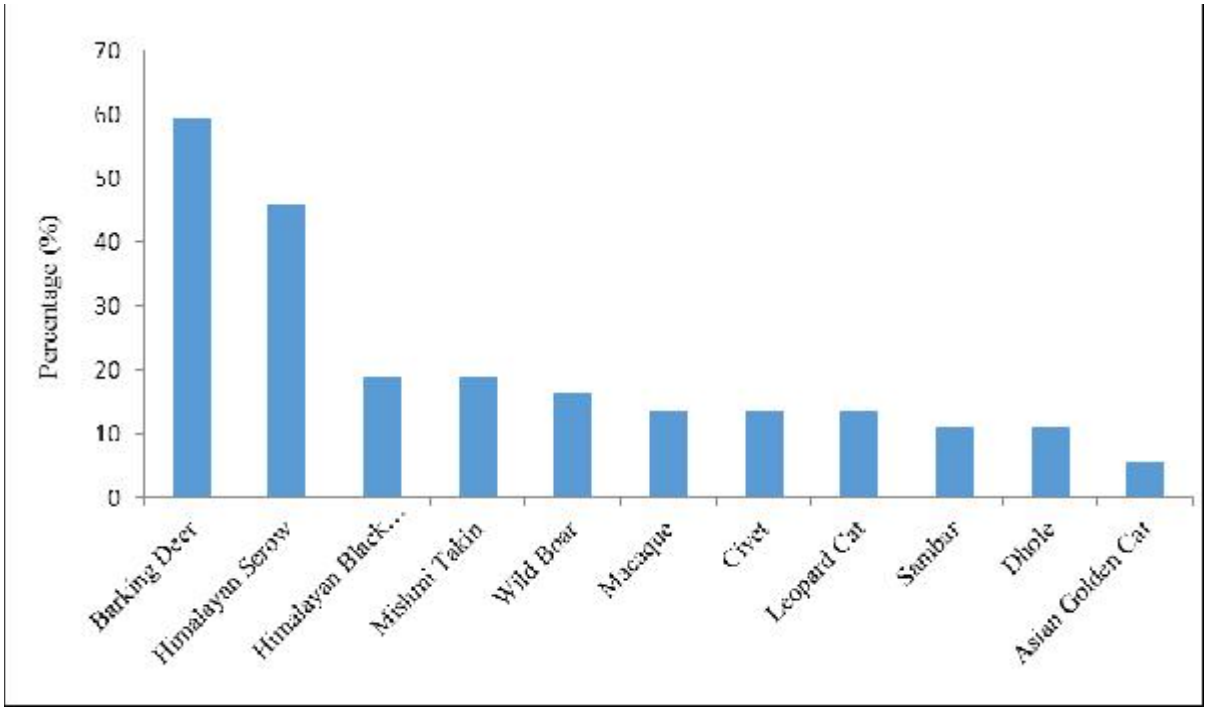

Figure 2.7: Percentage of wild animals reported nearby villages around Mehao WLS

Around 30% of respondents informed that they were involved in hunting in and around the sanctuary. Hunting is mainly done for meat consumption (Gopi et al. 2010*)*. Both guns and locally hand-made traps are often used for hunting. Of which 20% responded that they used guns and 15% responded that they use both guns and traps for hunting wild mammals (Fig 2.8). Hunting is an essential part of the community's tradition and is one of the prime threats to wildlife in Mehao WLS. Many evidences of hunting were observed in the local houses as trophies such as horns, antlers, skulls and skins of various species were encountered during the survey. Hunting is mainly carried out during winter seasons.

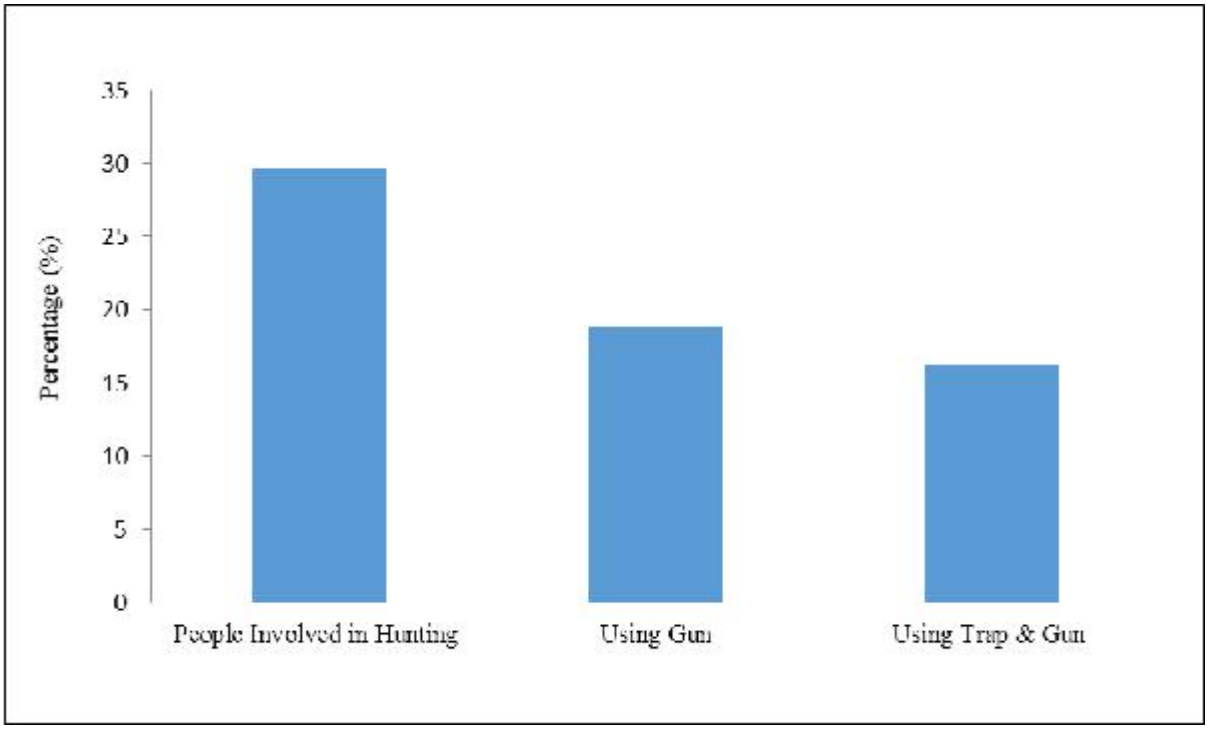

Figure 2.8: Percentage of people involved in hunting and using Gun and Trap

Buckwheat, rice and maize were major crops grown by people in peripheral villages of sanctuary (Figure 2.9). The percentage of pineapple and broom grass was relatively less along the periphery of Mehao WLS. Buckwheat, orange, ginger, mustard and pineapple are the major cash crops.

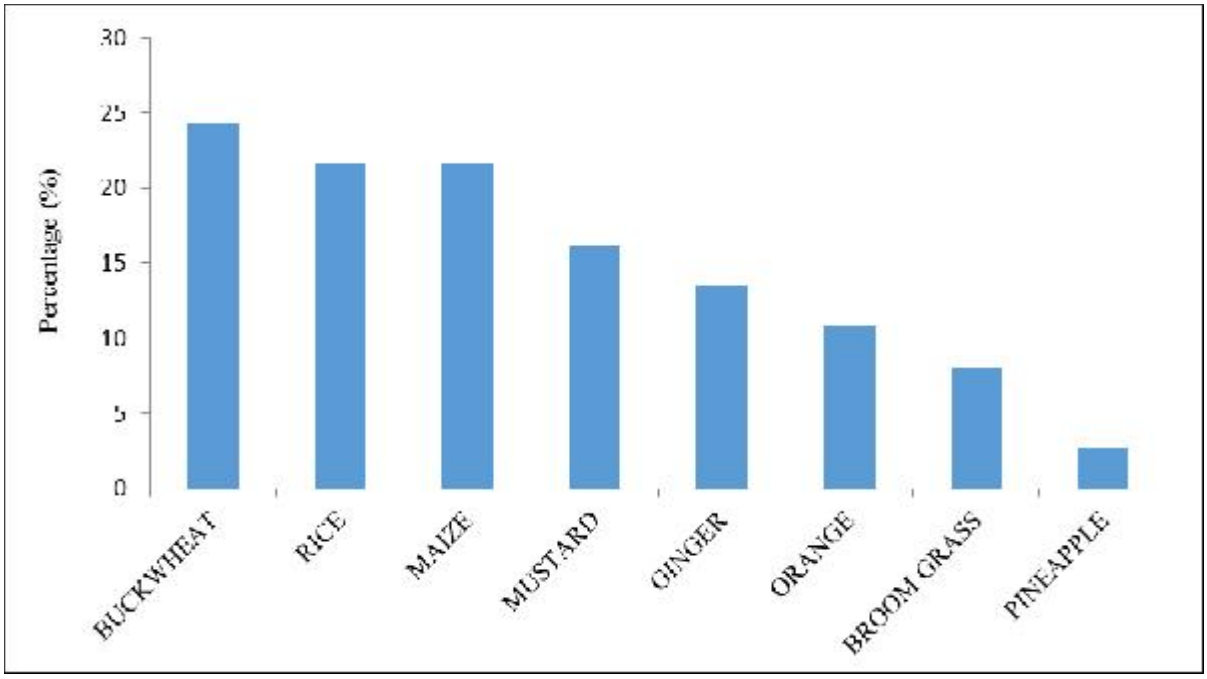

Figure 2.9: Major crop cultivated around Mehao Wildlife Sanctuary

One of the most common natural resource dependence for rural or forest proximate communities is of fuel-wood. It was found that every household had access to liquid

petroleum gas (LPG) (Figure 2.10) Study suggests that around 84% of households uses both LPG and fuelwood for cooking food. Rest of the 16% of households used only LPG exclusively.

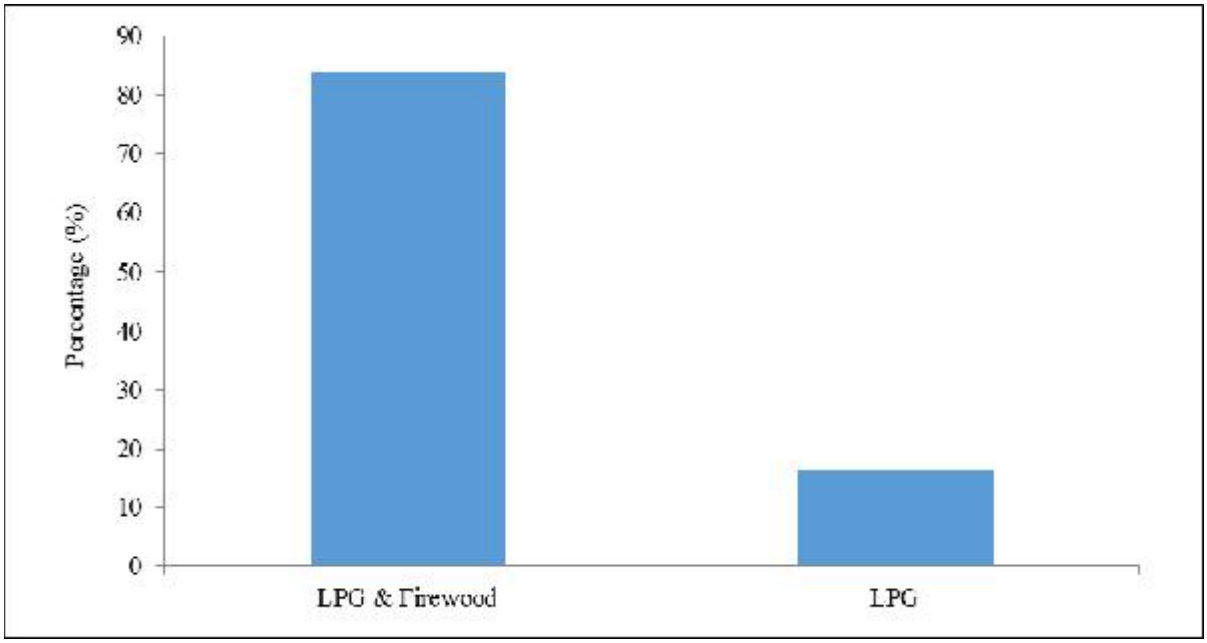

Figure 2.10: Percentage of the fuel type used in a household

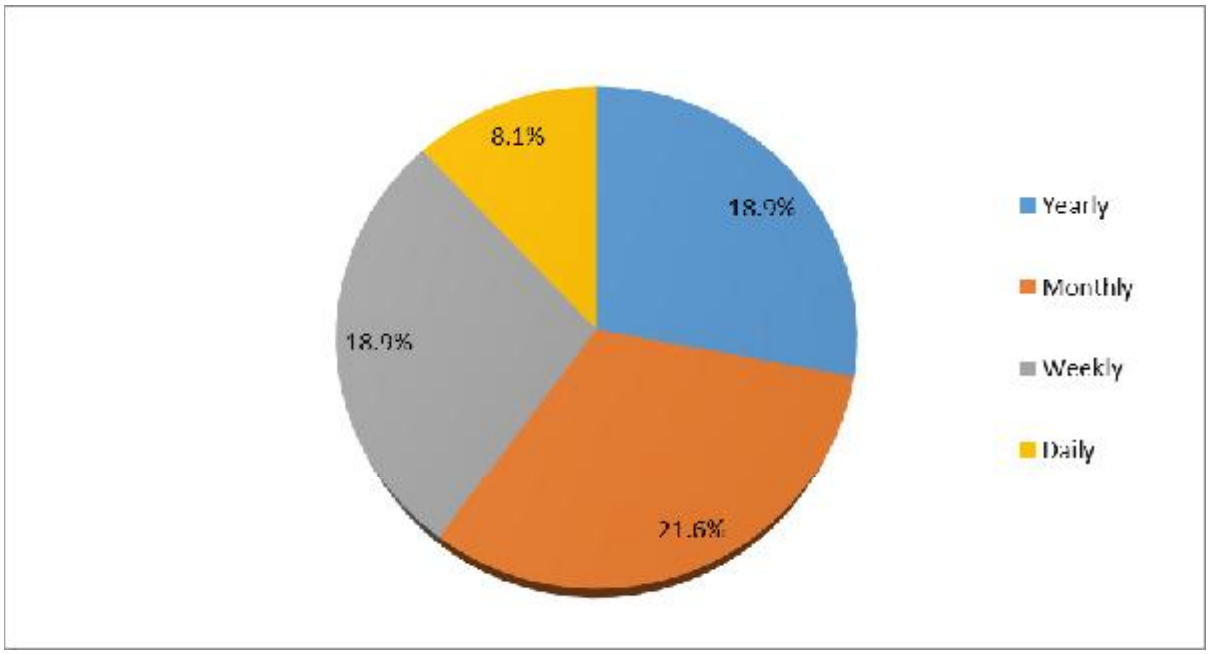

Figure 2.11: Frequency of fuelwood collection

This study revealed that around 21.6% of households collect fuelwood monthly, 18.9% household collect fuelwood weekly, yearly and 8.1% collect fuelwood daily (Figure 2.11).

Duabanga grandiflora, Neolamarckia cadamba, Terminalia myriocarpa, and bamboo are the major woods used for household purposes by Idu Mishmis. *Bahunia variegata* is the major fuelwood followed by bamboo and khokon (Figure 2.12).

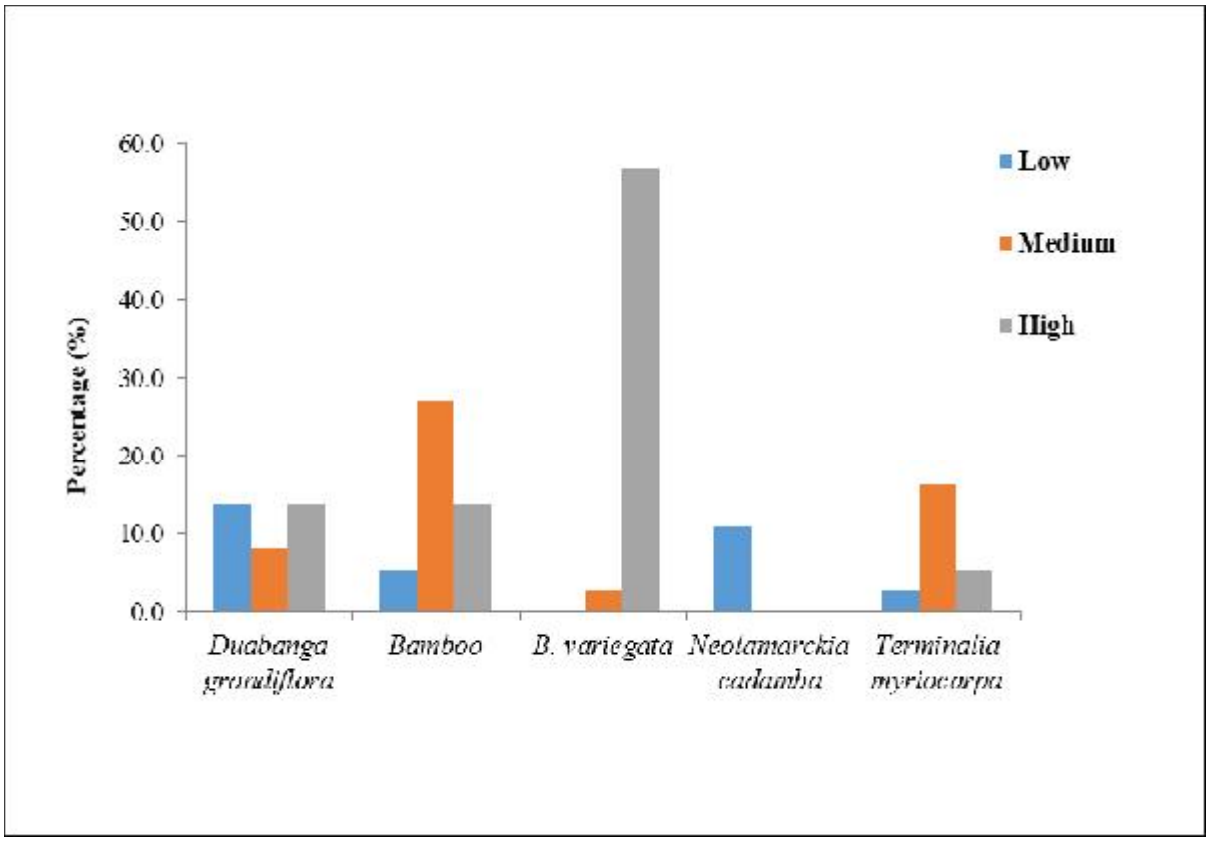

Figure 2.12: Percentage of Fuelwood types collection at Lower Dibang Valley

The Idu Mishmi community practice *jhum* cultivation and broom grass cultivation and the study reveals that 40% practiced *jhum* cultivation is mainly done mostly towards the western part of the sanctuary periphery (Figure 2.13). The Idu Mishmis are aware and believe in the conservation of forest and wildlife. During the discussion and interview, 30% respondent's showed positive nature towards conservation and 48% of the community is aware of a protected area and the laws for the protection of wildlife (Figure 2.14).

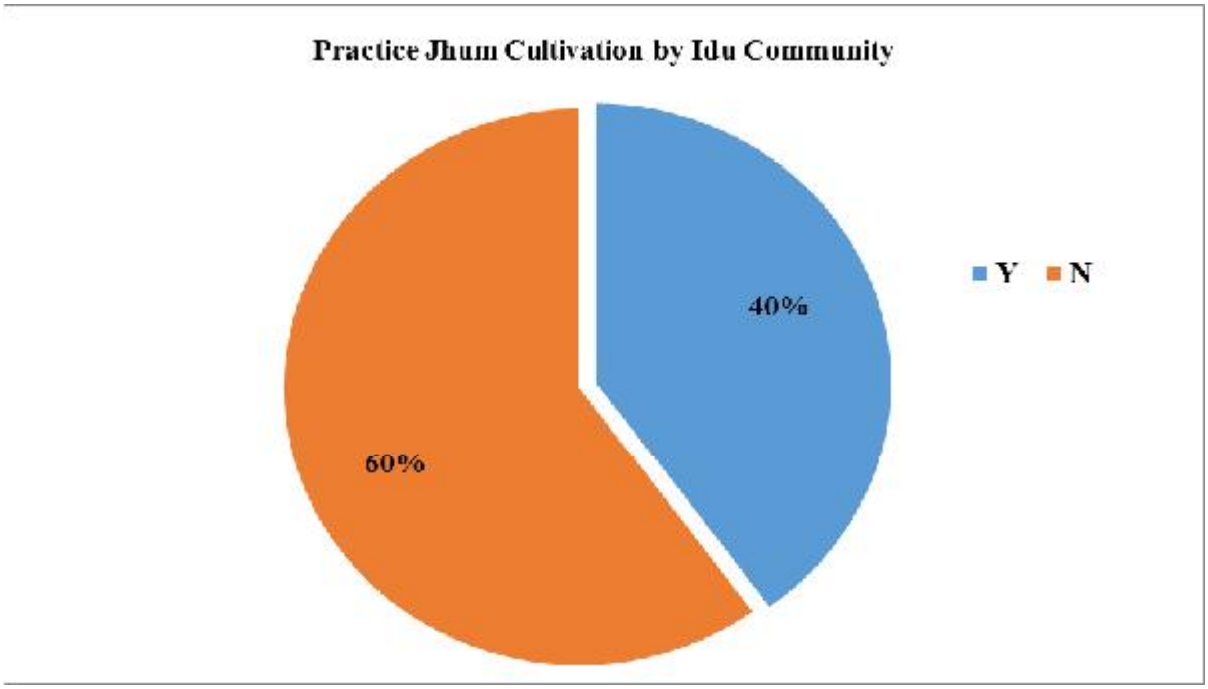

Figure 2.13: Percentage of *jhum* cultivation practiced in and around Mehao WLS

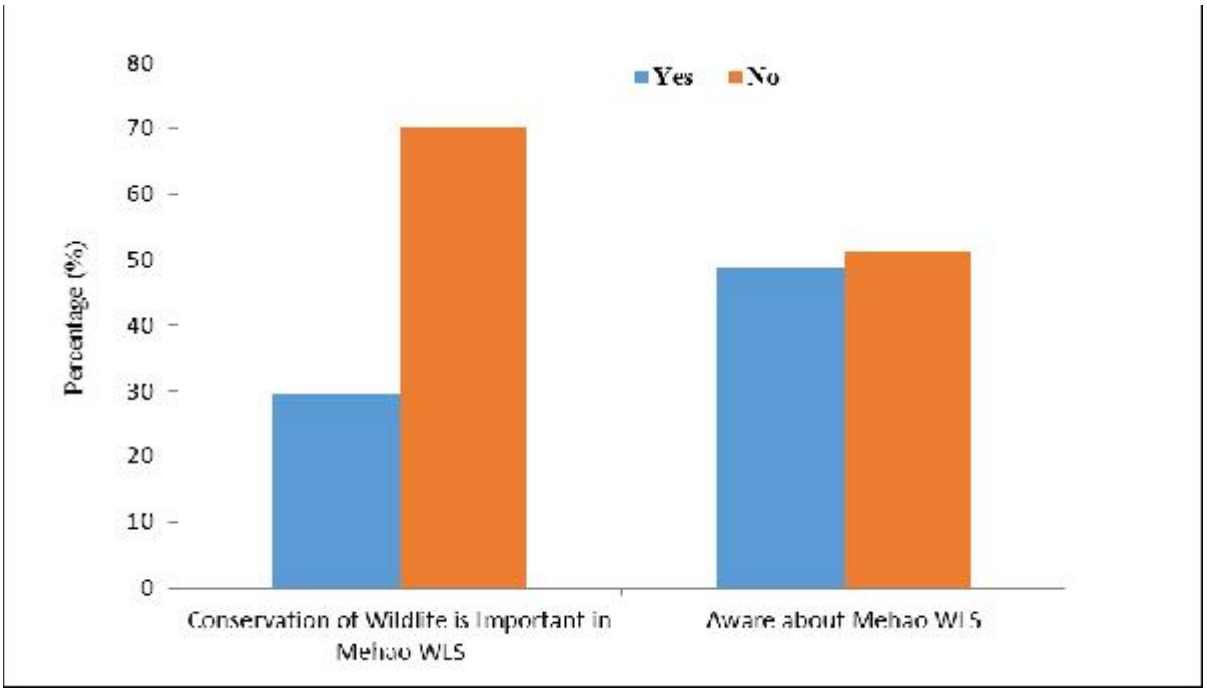

Figure 2.14: Percentage of perception of people for conservation of wildlife and awareness about Mehao WLS

Way forward:

The camera trap based occupancy surveys, socioeconomic surveys will be carried out, and survey areas will be expanded.

PLATES

Image 2.1: Large Indian civet (*Viverra zibetha*)

Image 2.2: Asiatic wild dog *(Cuon alpinus)*

Image 2.3: Golden jackal *(Canis aureus)*

Image 2.4: Yellow-throated marten *(Martes flavigula)*

Image 2.5: Clouded leopard *(Neofelis nebulosa)*

Image 2.6: Crab-eating mongoose *(Herpestes urva)*

Image 2.7: Barking deer *(Muntiacus muntjac)*

Image 2.8: Himalayan serow ***(****Capricornis s.thar****)***

Image 2.9: Asiatic golden cat *(Catopuma temminckii)*

Image 2.10: Leopard cat (*Prionailurus benghalensis*)

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CHAPTER 3
DIBANG WILDLIFE SANCTUARY, DIBANG VALLEY, ARUNACHAL PRADESH

Study Area

Dibang Valley district is one of the largest district of Arunachal Pradesh, which is situated at the northeastern corner of the state (Fig 3.1). With an area of 9129 km^2, it is one of the least populated districts in India. The various valleys in the district are drained by various streams, rivulets, and rivers such as Talo(n), Mathu(n), Dri, Ahi, Emra, which joins to form the river Dibang - the major tributary of the mighty Brahmaputra river. Dibang Valley is bounded by the international border with Tibet in the north and east, to the south by Lower Dibang Valley and the west by Upper Siang districts. Dibang Valley is considered as one of the most formidable terrain where precipitous mountain ridges, gurgling rivers, landslides, deep and narrow gorges inspire awe in the minds of the nature enthusiasts.

The district encompasses the Dibang Wildlife Sanctuary, which covers an area of 4149 km^2. Anini is the district headquarter and is located at 1675 m which is situated on a mini plateau flanked by two rivers: Dri and Mathu(n). The district has a mosaic of vegetation, which varies

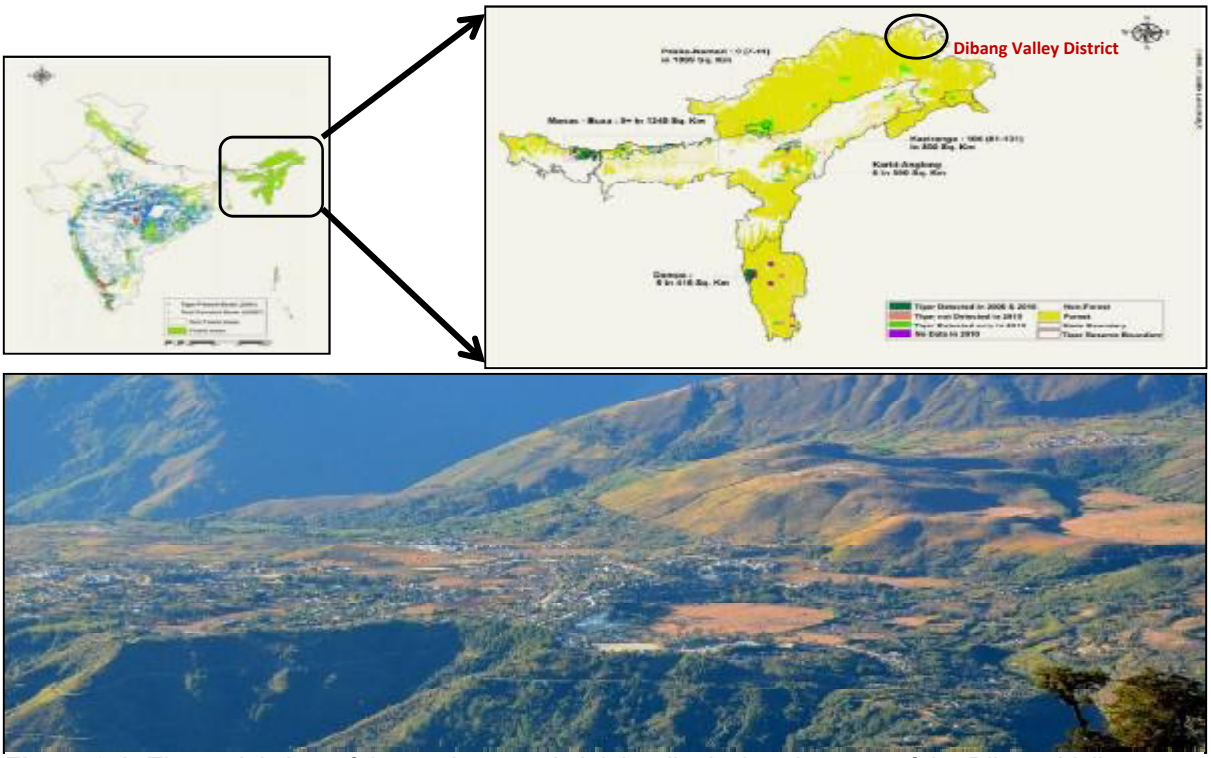

Figure 3.1: The aerial view of the study area: Anini the district headquarter of the Dibang Valley

with altitude (Champion & Seth 1968, Kaul & Haridasan 1987). The low elevation valleys support dense subtropical evergreen forests, as the altitude rises the vegetation transits from subtropical evergreen to temperate forest composed of conifers and broad-leaved trees such as pine, birch, fir, and maple to sub-alpine scrubs to alpine pastures. The region is rich in varied species of bamboo that grow at different elevations and forms an integral component

of the local culture and economy. These diverse habitat harbors some of the rare, endemic and threatened faunal species like tiger *Panthera tigris*, clouded leopard *Neofelis nebulosa*, snow leopard *Panthera uncia*, Asiatic golden cat *Catopuma temminckii*, marbled cat *Pardofelis marmorata*, leopard cat *Prionailurus bengalensis*, fishing cat *Prionailurus viverrinus*, jungle cat *Felis chaus*, Asiatic wild dog *Cuon alpinus*, Mishmi takin *Budorcos taxicolor*, goral *Naemorhedus goral*, musk deer *Moschus fuscus*, barking deer *Muntiacus muntjac*, Himalayan serow *Capricornis sumatraensis thar* (Gopi et al. 2014).

Hindrance in camera trapping and sign survey

There is an ongoing dispute between the locals and district administration regarding the boundary rationalization of Dibang Wildlife Sanctuary. A consultative meeting was held with National Tiger Conservation Authority (NTCA) and various stakeholders of Idu Mishmi society regarding boundary dispute on 16.10.2019. They reiterated that no research work would be carried out inside the sanctuary until the issue of rationalization is solved by the district administration. Therefore, in purview of this meeting, the locals and their representative bodies did not grant permission for deploying camera traps and carrying out sign survey. However, with much deliberation with Idu Mishmi Elite Society, local MLA from researchers and forest department officials, permission for the socio-cultural survey was granted.

Methodology: **Socio-cultural survey**

To document which wild animals are considered by the indigenous people to be culturally and economically significant, household surveys, semi-structured interviews, and informal discussions were carried out. As a participant observation methodology, the researcher(s) stayed with a local family, participated in official meetings, social gatherings (healing rituals, funeral ceremony and other shamanic rituals), observed all taboos with local family. A semi-structured questionnaire with both open and close-ended questions was used for household survey (Bernard 2017, Nash et al. 2016, Nyariki 2009). The primary strategy for identifying respondents for conducting household surveys, involved selecting households randomly to interview by walking through each village. As each village was relatively small, this approach led to traversing the entire village.

The survey was carried out with the household head. Men and women of different age groups were interviewed. Field assistant would usually introduce us and objective of the survey was relayed to the household head, they also acted as a bridge for overcoming language barrier. Following this, verbal consent was sought before continuing with the survey. This survey gathered some demographic information on gender, age, religion, tribe, number of members, marital status, educational qualification, source of income, religious affiliation, length of residency, type of house, crop cultivation, beneficiary of any government

schemes (if any), nearest medical facility, educational facilities, livestock, Non-Timber Forest Product (NTFP) collection, cultural values associated with flora and fauna (totems and taboos), perception towards wildlife conservation and knowledge about the presence of wildlife in and around the villages was ascertained using pictorial field guide books. As the villagers were wary of questionnaire forms used for conducting interviews, hence information was noted down in field notebook and transcribed later into datasheets.

Preliminary Results and Discussions

In the preliminary survey on documenting the traditional ecological knowledge of Idu Mishmi community, a pilot survey was focused primarily in Anini and few far-flung villages. 110 household surveys were conducted in Kongo 1, Kongo 2, Boo basti, Pukhri line, Angocha line, Medical line, Old bazaar line, Prabhaya line, Kazi line, Angui line and New Anini area. At Dri valley (locally called *Dri-mro*), villages such as Etabe, Larango, Gipulin, Mihundo, Akunli and Angrim valley have been covered. Opportunistic surveys have also been done during social gatherings and during *Reh* festival celebrated on 2nd and 4th February, 2020.

Demographic Profile

Demographically, the total population of Dibang Valley district is 8004 people (National Census, Govt. of India, 2011), of which 4414 are males and 3590 are females. About 70% of the population is rural and 30% is urban, restricted mainly to Anini, the district headquarters. Idu Mishmi is the lone tribe inhabiting the Dibang Valley district. Mishmi is one of the 26 major tribal groups of Arunachal Pradesh. There are four sub-groups recognized within the Mishmi (Idu, Digaru, Miju, and Deng). Idu, Digaru and Miju inhabits in Indian Territory and Deng are found in South Tibet (Aiyadurai 2007). Idu Mishmi practice shifting cultivation because of the rugged terrain in Dibang Valley district, this is the only feasible way of cultivation along with kitchen gardens.

As per the household survey, 84.91% Idu Mishmi's follow indigenous faith system which is animistic in nature i.e., attribution of living soul to plants, inanimate objects and natural phenomenon. Spirits or *khinyu* are said to abound in forests, hills, shadowy recesses, rivers, gorges, cliffs and are feared by the *Idus* (Bhattacharjee 1983). Their supreme God *Inni*, embodies the highest ethical conception (Baruah 1960). Traditionally, an *Igu* (Shaman) is a key figure of religious beliefs and practices in the Idu Society (Chaudhary 2008), who utilizes many natural resources to carry out his rituals. Of late, Christianity has made a slow inroad in the district. Besides, there are ethnic metamorphoses where mythological tales and beliefs are being used to establish a link between Hinduism and indigenous faith (Figure 3.2).

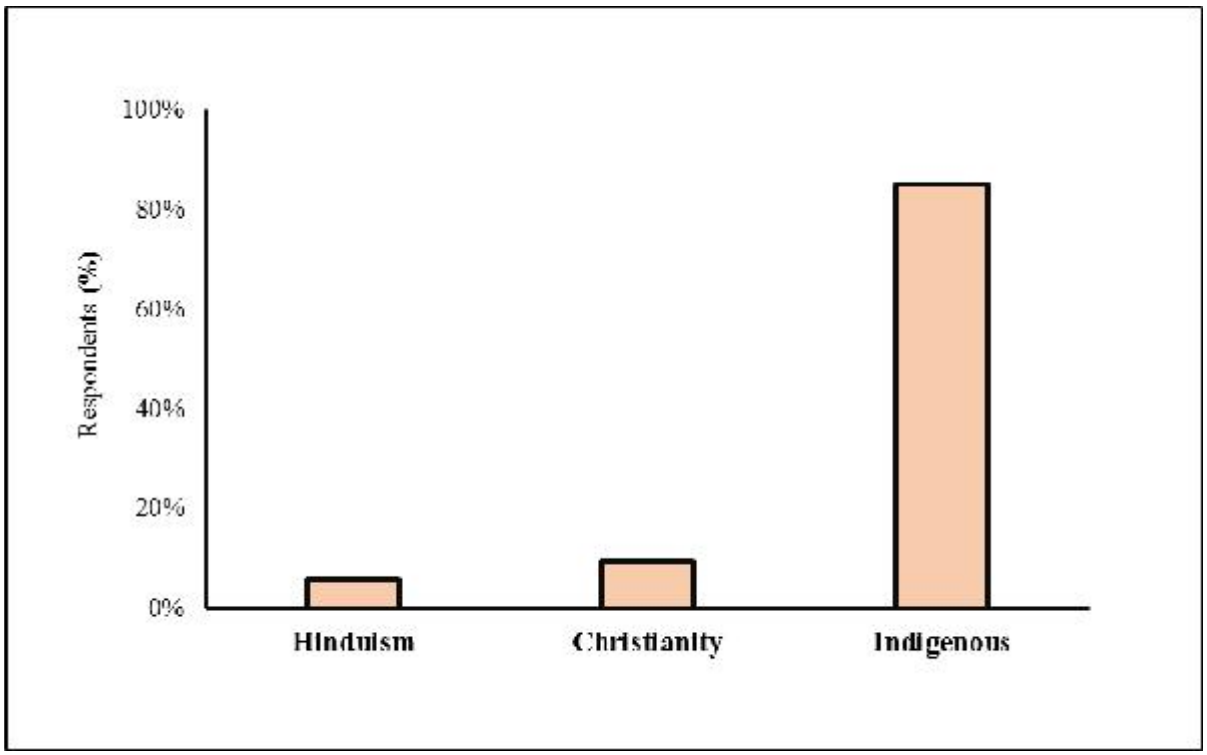

Figure 3.2: Religious affiliation of Idu Mishmi at the surveyed villages

About 84.62 % of the respondents during the survey were male and 15.38 % comprised of female respondents (Figure 3.3). One respondent per household was surveyed that was generally head of the family. Most of the time it was a male-headed family but there were many female-headed families also.

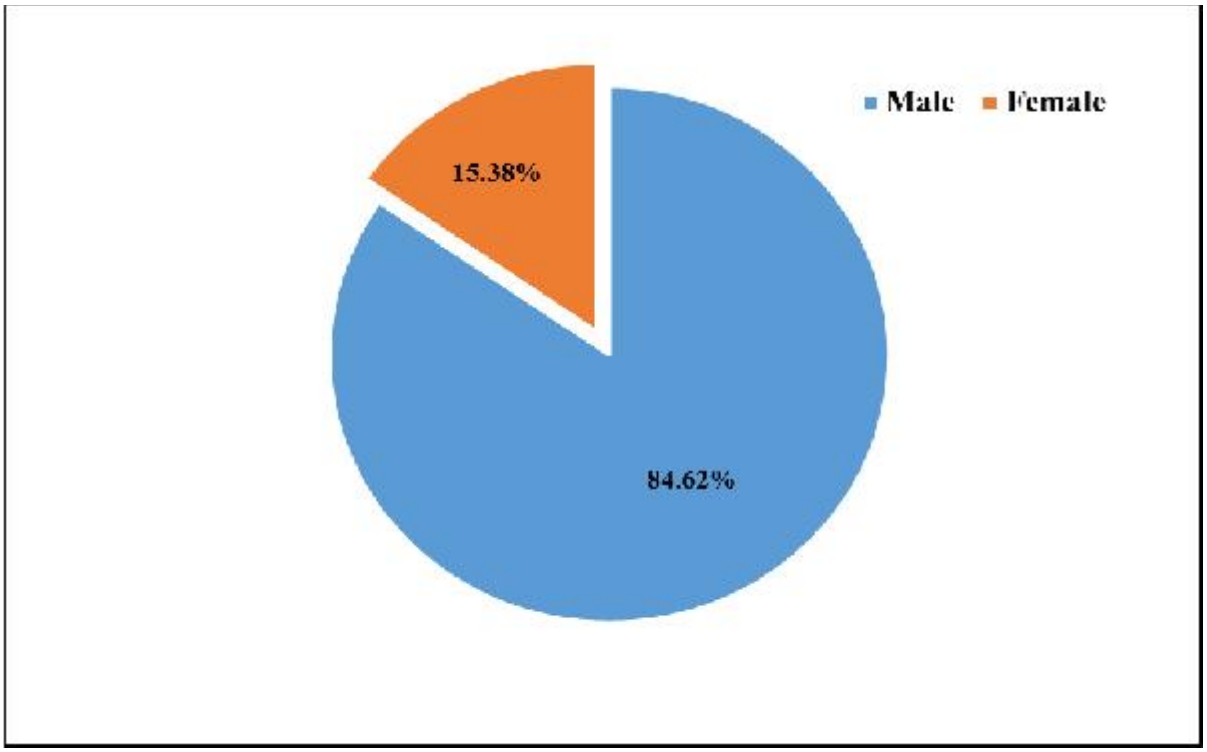

Figure 3.3: Gender composition of respondents in the sampled villages

About 26.01 % of the respondent were in the age class of 31 to 40 followed by 22.1 % in the age class of 21 to 30. Only 1.9 % of respondent constituted of age class 81 & above (Figure 3.4). The population pyramid shows the visualizing of age structure and gender of the households surveyed. The width represents the size of the population of a given age with female on the right and male on the left. The bottom layers represent the number of new born and above it is older cohorts. Approximately 16.5% of women fall in the 20 to 24 age class (Figure 3.5). Looking at the age structure it is very evident that the majority of the population of surveyed household falls in two age groups i.e. (0 to 14 – young and adolescent, 15 to 34 age class).

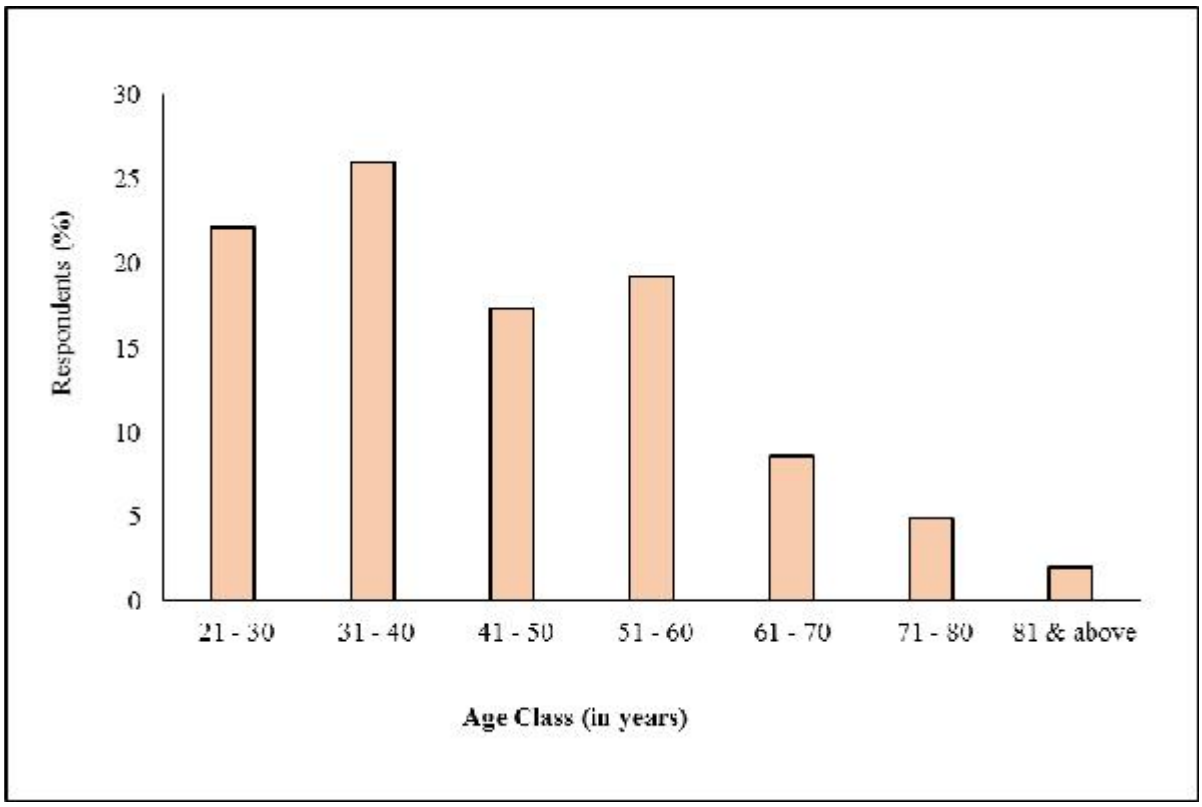

Figure 3.4: Age class of respondents during the survey at Anini circle, Dibang Valley district

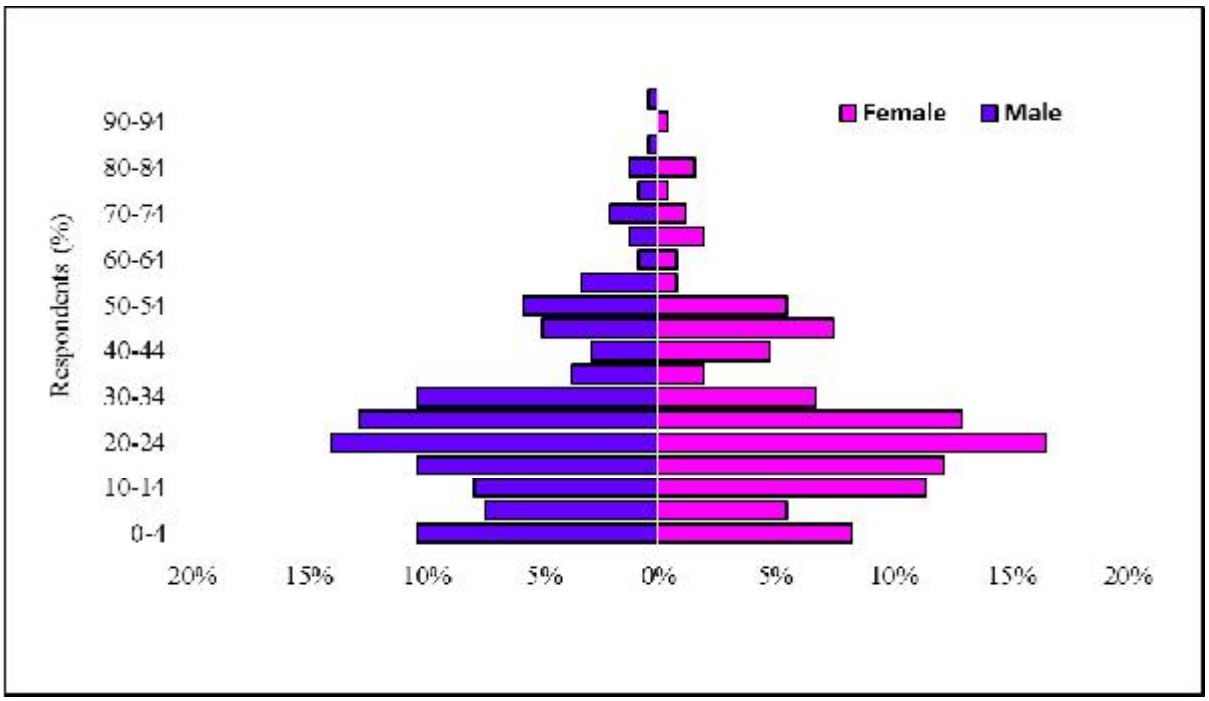

Figure 3.5: The population pyramid visualizing the age structure and gender of the households

Education profile and occupation

The education profile of the surveyed villages revealed that 20% of the respondents were illiterate. Most Idus above the age of 40 were poorly educated. Usually senior citizens when interviewed claimed themselves as either never attended school or pre-primary drop out. 12 % of the respondents were undergraduate and 5 % as postgraduate (Figure 3.6). Western education is still a relatively recent phenomenon and there is a distinct generational shift in the prevalence of higher education. Currently, almost all children go to school.

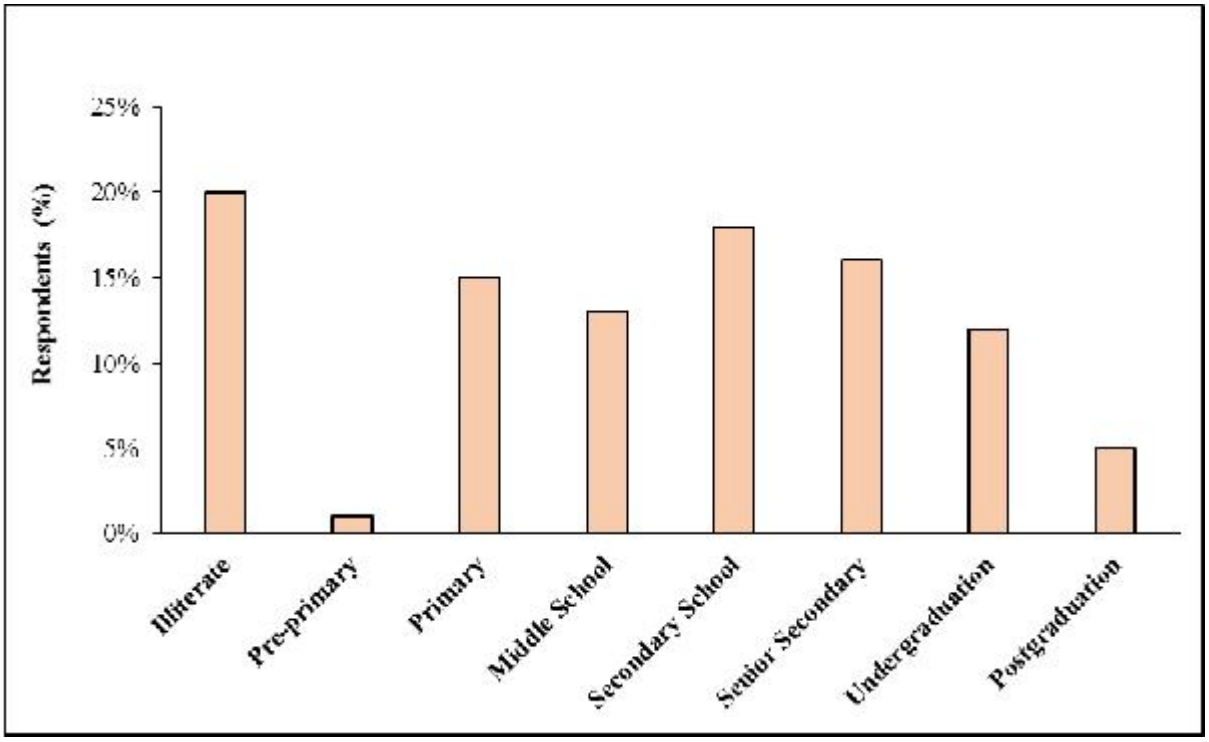

Figure 3.6: Education profile of the respondents at sampled villages

Nearly 38% of the respondents have government job in Anini (Figure 3.7). Most surveyed houses have at least one member employed by the state government, sometimes as contractual staff or contingency staff. Contractors undertake contractual work from the government and own businesses. Respondents falling in the public category have no permanent source of employment. They usually make their living by doing a variety of work such as occasional contract work, musk deer hunting for musk pod, porters, selling fuelwood, timber, daily wagers *"hajra"*, etc. Skilled trade comprises people who are skilled in carpentry, masonry, plumbing, etc. It is important to note that people have multiple sources of livelihood. Their primary source can be contract work, which can be supplemented with other sources such as forest-based business etc. The mode of livelihood earning is indeed complex in Idu society, where people consider earning from the forest as their traditional right and an easy source of income.

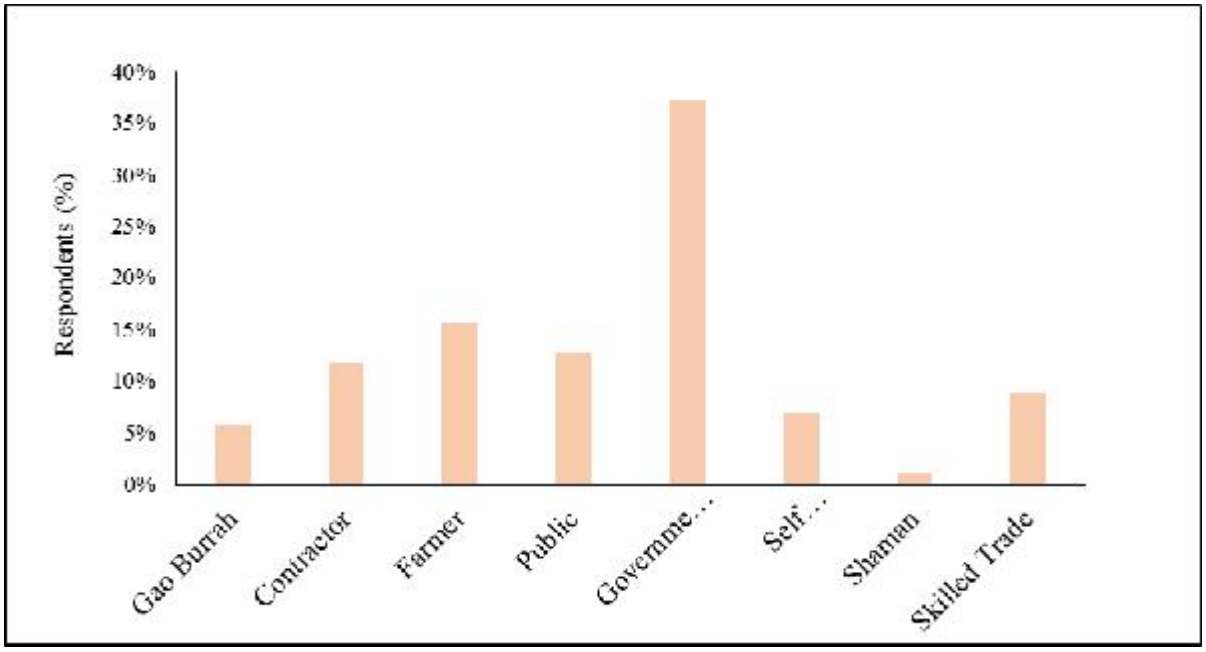

Figure 3.7: Occupation of respondents in the sampled villages at Anini circle, Dibang Valley district

Fuel consumption

In most households, they utilize fuelwood along with liquefied petroleum gas (LPG). The utilization of fuelwood at *Engokkhe* (fireplace) is more during winter and for preparation of fodder for domestic pig (Figure 3.8). For fuelwood, people use mostly Bamboo (bifurcated bamboo, locally called *Abradica*), *Ekambo, Kanimbo, Mashumbo, Tathembo* and *Ambombo*. Among them, *Kanimbo* (*Alnus nepalensis*) is the most utilized and easily available fuelwood in and around the valley. *Ekambo, Ambombo* and *Tathembo* are better for firewood than *Kanimbo*, but availability is less as compared. People in general use head load that is *tukri* (bamboo basket) for collection. However, sometime fuelwood is carried in Tata mobile van (carrying capacity of 1-2 ton) as well. *Tukri* is used when collecting fuelwood daily or weekly whereas for monthly consumption and storing fuelwood in bulk quantity, automobiles are used. People normally fetch firewood from their area of native village where they have their own land. People residing in Anini from middle belt generally purchase fuelwood from local people. Even though people have LPG, they prefer cooking using fuelwood. It is also important to note that Anini being a hilly district where it rains incessantly for days, fuelwood is used for keeping the house warm.

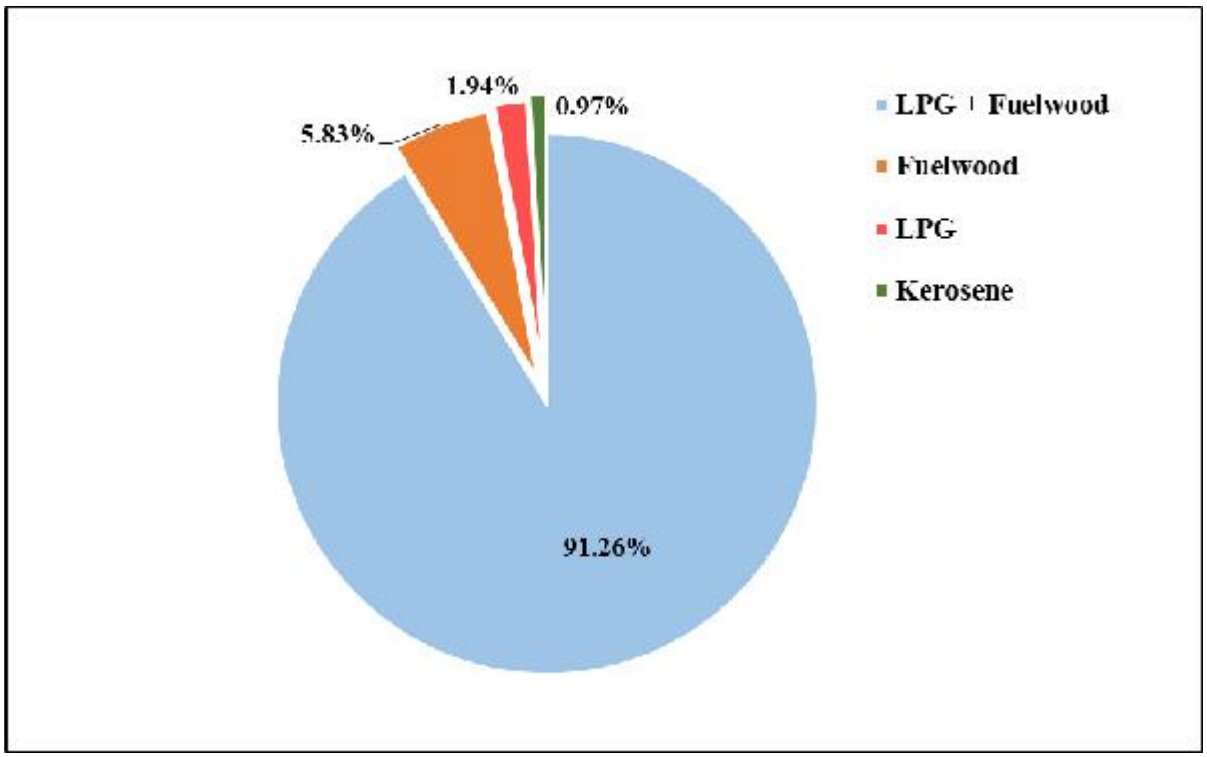

Figure 3.8: The percentage of fuel wood consumption of the respondents at sampled village

Crop Cultivation

Idu Mishmi practice Jhum cultivation because of less availability of cultivable land due to rugged terrain making it the only feasible way of cultivation along with the kitchen gardens. This conversion of forested land into agricultural land has aggravated human wildlife interaction i.e. negative interaction due to raiding of crops by black bear, wild pig, barking deer, monkey etc. Crop raiding usually occurs just before harvesting, especially during August and September. Crop raiding of maize is mostly done by black bear and wild pig, that of rice by wild pig and scaly-breasted munia. Barking deer raids more on rice and potato. The procedure of harvesting crops is following:

Cutting the bamboo patch and then burn the soil
(November-December)

↓

Keeping it abandoned until Bamboo shoots will come out from the land
(December-March)

↓

Sowing different crops during the *jhum* cultivation
1st Year: Idu dal, soybean, maize, buckwheat, millet, potato and other vegetables
2nd Year: Maize, rice, potato and vegetables
3rd Year: Rice, buckwheat and vegetables

↓

Harvesting crops mostly by August-September

Collection of Non-Timber Forest Products

People in rural and remote areas depend on forest products i.e., fruits, fibres and fuelwood to meet their basic needs (FAO 2011, World Bank 2016). Most people collect these products for sustenance and as fodder for livestock particularly for domestic pig. During the collection of fuelwood, they also collect '*Kamba pachi anapra'* (wild edible plants). Some of these are listed below in their local names:

1. Leaves: *Ahona (*from middle valley only), *Etona, Pushuna, A(r)ubraduna, Anjena, Tupurna* (*Tupurna* is collected during summer), etc.

2. Mushrooms: *Akolo, Akunu, Akupri, Akumaja, Akudi , Akruku,* etc. (mostly collected during February-April).

3. Fruits: *Akushi, Enashi, Kanashi, Nanjushi, Apimbo, Apumu, Ishumbo, etc* (mostly collected during winter season).

4. Plant parts: Stem and flower of wild banana, stem of *Atombo* to make *Alukhi*, *Apago* (tuber).

Collection of medicinal plants

Among medicinal plants, collection of *Paris polyphylla* is highest due to increased demand in the international market. For collection of the root, people trek (usually 6 to 7 days) inside the forest and thereafter sell it to the local businessman. For the past two years, there has been a sharp decline in *Paris polyphylla* collection by the locals due to unavailability of the herb. Locals reported as saying that *"aajkal to sona milta hi nhi hai, chahe aap kitni dur chale jao, aur agar milta bhi hai to bhut hi thoda" - these days you don't find sona (Paris polyphylla in local name) easily, even after traveling to long distances. In case even if you find it, its very less in quantity.* Few people collect ginseng (both *Panax pseudo* and *Panax sikkimensis*) and *Coptis teeta* and utilize it in various medicinal purposes for their own use. Except that *Tupurna, Illimu, Aa(r)eyy sapana* etc. are frequently used in day-to-day life for various purposes (Table 3.1).

Table 3.1: Name of few medicinal plants/herbs used and extracted by Idu Mishmi

Sl. No.	Name of the plant (Local name)	Uses
1	*Paris polyphylla (Riteshi/ Nushiga tamba)*	Utilized as lip balm, on cuts and wounds, selling purpose
2	*Paris quadrifolia (Riteshi/ Nushiga tamba)*	On cuts and wounds, dysentery, gastritis
3	*Panax pseudo and Panax sikkimensis (Imumbo)*	Anti-aging, stimulant, tonic
4	*Coptis teetha (Aaron)*	On dysentery and other abdominal pain related issues, gastritis
5	*Artemisia nilagirica (Illimu)*	Bronchitis and other respiratory issues, dysentery
6	*Tupurna (local name)*	To reduce high blood pressure

7	*Aa(r)ey sapana (local name)*	To put on cuts and bleeding, on twisted and broken limbs
8	*Aarutha(w)a (local name)*	To put latex on deep cut and wounds
9	*Amashi (local name)*	act as anti-poison (food poisoning), abdominal pain, cuts
10	*Cordyceps sinensis (Yarshagumba)*	anti-aging, gives energy, fights with malaria

Importance of Wildlife

Although hunting is an integral part of the community's tradition, it is in general and one of the major threats to wildlife in Arunachal Pradesh. However, wild animals are primarily hunted for meat, but at the same time, there is a local demand for skin, teeth, feather, beaks and other animal parts, for making traditional dresses and medicines. Wildlife is also hunted because of livestock/human-wildlife conflict. Consumption of wild meat in the study area is attributed more as a cultural attribute then socio-economic attribute. Idus roughly and locally classify wild animals in two broad categories based on their habitat preference: one is wild animals that are found throughout the year residents of lower elevation, closer to the villages like barking deer, wild pig, civet, etc. and another are species that are found permanently or temporarily in higher altitudes such as goral, takin, musk deer, etc. Wild meat is an important source of protein and recreation while some of the species are harvested for financial gains such as musk deer and Himalayan black bear.

Idu Mishmi's as discussed earlier are animistic in nature and believe in presence of various spirits *khinu*, their relationship to the forest is strongly linked to the presence of spirits, which take care of the resources and hunters, also supply them to people. The spirits are both revered and feared; a ritual price for the animal is also paid to the spirits. Wild animal skulls/antler/horn and skins are a common sight amongst the Idu Mishmi house. Wild pig, takin, serow, barking deer, goral and Himalayan black bear are some of the animals whose skulls/antlers/horns/jaws are mounted as trophies in most of the rural houses. Idu Mishmi follow customary restrictions or taboos known as *Aena* and the ritual period for observing restrictions is known as *Angi*. In a post hunting ritual called *Aphu*, an offering is made to the mountain forest spirit "*Golo(n)"* using a metallic object (brass) as a payment for killing animal. After *Aphu*, the hunter observe *Aena* for a period of five days and follow restrictions such as not consuming onion and garlic, do not have sexual contact with a woman, do not visit a place of celebration or mourning, do not wash clothes, woman stop weaving as soon as the news of successful kill reaches to the village. One day *Aena* is observed by anyone who consumes wild meat. Some species are not hunted such as tiger, hoolock gibbon, etc., as it is taboo to kill them. Idus consider tigers as next to human kin i.e. their elder brother (Aiyadurai 2016). Tigers can only be killed in self-defense, or if it is a man-eater. If a tiger is killed otherwise, the entire village has to observe *Aena,* making tiger protection a collective

responsibility. *Aena* ensures that the Idu Mishmi continue to respect the ecosystem they inhabit. Violation of such taboos is believed to bring misfortune. Violation could be in the form of any auspicious and profit making works like hunting wild animals, agricultural work, weaving, handicraft, etc. during days of restrictions (Chakravarty and Bezbaruah 2018). Distribution of hunted wild meat among close relatives during their festivals, such as during *Reh* (specially during Individual *Reh*) or *Keh-me-haa* is also a major driving force for seasonal hunting. For ritualistic purpose they hunt more on pheasants, such as Sclater's monal, Himalayan monal, Temminck's tragopan, Kalij, Hill partridge and Snow partridge; House shrew, Elegant water shrew, White tailed mole; rodents such as Mishmi giant flying squirrel, Particolored flying squirrel, Orange bellied squirrel, Himalayan striped squirrel, Pallas's squirrel and other wild mouse species (Table 3.2).

There is negative interaction with wild animals when they raid crop or there is mithun depredation, which leads to retaliatory killing of the wildlife. Mithun (*Bos frontalis*) is a semi-domesticated cattle; they are never tethered, herded or stall-fed. Mithun has a profound significance in Idu culture and is the ultimate indicator of one's prosperity. 38% of the responded reported problem of crop raiding by Himalayan black bear, wild pig, macaque and barking deer. This negative interaction often leads to retaliatory killing. 76.9% of the respondents own livestock and out of this 45% have reported Mithun depredation mainly by wild dog and tigers. This has resulted in a negative perception towards wild dog and it is considered as the enemy of Mithuns.

Box: Idus and the Tiger

As per Idu mythology, the story of tiger and man goes like this – tiger and man were both born to the same mother and therefore tiger is regarded as their elder brother. As per the folklore, the origin of other feline species began in this fashion when one-day man and tiger decided to go and hunt together in jungle. The man hunted down an animal called *Marye* (Himalayan serow). So the man went in search of firewood to cook the meat but when he came back, he was shocked to see tiger tearing apart the meat like a piece of cloth and eating it raw. He stood their trembling with fear looking at his elder brother (tiger). He came back home and narrated the whole story to his parents. The mother came up with a trick so that the tiger is gone away from human life forever. She called tiger and asked him to challenge his human brother. Human tricked the tiger and shot the tiger with his bow and arrow. The body of the tiger flowed down into the river. The people saw shining bones of the tiger half buried in the sand. They dug out the bones and were curious to know to whom these bones belonged. They then made a pile of the bones and asked a bird to sit on it and try if it could give life to it. The pelican agreed to do so and after ten months of nestling, they were astonished to see many different species of cat were born as tiger clan.

However, various factors are changing in the present scenario of hunting from sustenance and ritualistic killing to commercial purpose. Many people posted in higher authority of

government institution or in business; sometimes demand wild meat to complete their ritualistic demand during festivals or special occasions. Thus, hunters from remote areas are hunting down more wild animals than their capacity, turning the trend of hunting from sustenance to commercialization.

Table 3.2: Species that are frequently hunted by Idu hunters in and around the Dibang WLS

Sl. no.	Idu Name	Common Name	Purpose of Hunting
1	*Ala*	Musk deer	Commercial purpose, meat consumption, trophy
2	*Ameh*	Assamese macaque	Meat consumption, trophy
3	*Manjo*	Barking deer	Meat consumption, trophy, retaliatory killing
4	*Manjoimbu*	Gongshan muntjac	Meat consumption, trophy
5	*Awkru*	Mishmi takin	Meat consumption, trophy
6	*Ami*	Red goral	Meat consumption, trophy
7	*Aamwe*	Wild pig	Meat consumption, trophy, retaliatory killing
8	*Aprup(r)u*	Wild dog	Retaliatory killing
9	*Achango*	Leopard cat	Retaliatory killing
10	*Ingurrambo*	Marbled cat	Retaliatory killing
11	*Kaatoh*	Spotted linsang	Retaliatory killing
12	*Aapi*	Himalayan palm civet	Meat consumption
13	*Aahu(n)*	Asiatic black bear	Meat consumption, trophy, retaliatory killing, commercial purpose (bear bile/ *ahuimu*)
14	*Eaa(n)-oh*	Yellow bellied weasel	Retaliatory killing
15	*Aaro(n)*	Smooth coated otter	Meat consumption
16	*Aawrogaa*	Eurasian Otter	Meat consumption
17	*Ibizu*	Pika	Meat consumption (opportunistic, during musk deer hunting)
18	*Kapichi*	Hill Shrew	Meat consumption (especially during cultural festival)
19	*Aapibu*	Elegant water shrew	Meat consumption (especially during cultural festival)
20	*Aapichi*	White tailed shrew	Meat consumption (especially during cultural festival)
21	*Kaamey*	Mishmi giant flying squirrel	Meat consumption, trophy
22	*Aagh(r)i*	Parti-colored flying squirrel	Meat consumption (especially during cultural festival)
23	*Anache*	Hoary bellied squirrel and Orange-bellied Himalayan squirrel	Meat consumption (especially during cultural festival)
24	*Ada*	Pallas's squirrel	Meat consumption (especially during cultural festival)
25	*Adaka*	Himalayan striped squirrel	Meat consumption (especially

			during cultural festival)
26	*Asha(n)*	House mouse	Meat consumption (especially during cultural festival)
27	*Puhuu(n)*	Great barbet	Meat consumption (especially during cultural festival)
28	*Pr(w)iggi*	Golden throated barbet	Meat consumption (especially during cultural festival)
29	*Chhenda*	Himalayan monal	Meat consumption (especially during cultural festival)
30	*Pidi*	Sclater's monal	Meat consumption (especially during cultural festival)
31	*Peba*	Temminck's tragopan	Meat consumption (especially during cultural festival)
32	*Iduku*	Black faced laughing thrush	Meat consumption (especially during cultural festival)
33	*Pucu*	White crested laughingthrush	Meat consumption (especially during cultural festival)
34	*Pyecaa*	Beautiful sibia	Meat consumption (especially during cultural festival)
36	*Poco*	Hill partridge	Meat consumption (especially during cultural festival)

Long-distance hunting trips especially ones that are undertaken for musk deer, takin, and other ungulates are often carried out in the higher elevations of the district. Hunters cross mountains and move uphill towards the Sino-Indian border for musk deer hunting. Animals such as barking deer and wild pigs, monkeys and bears are some of the animals commonly hunted closer to the villages or when they raid the crops, especially during harvesting season (Figure 3.9). According to hunters, winter (November to February) is the preferred season to hunt, as the high-altitude animals come down the mountains in search of food. The vegetation on the mountain tops are covered by the snow and wild animals are forced to move to lower altitudes or near the foothills. Hunters prefer this season also because they need not travel very far to look for wild animals. Hunting in the winter season is not only less tiring but there is also more time for trekking and camping as there is no substantial farm-related work during this season.

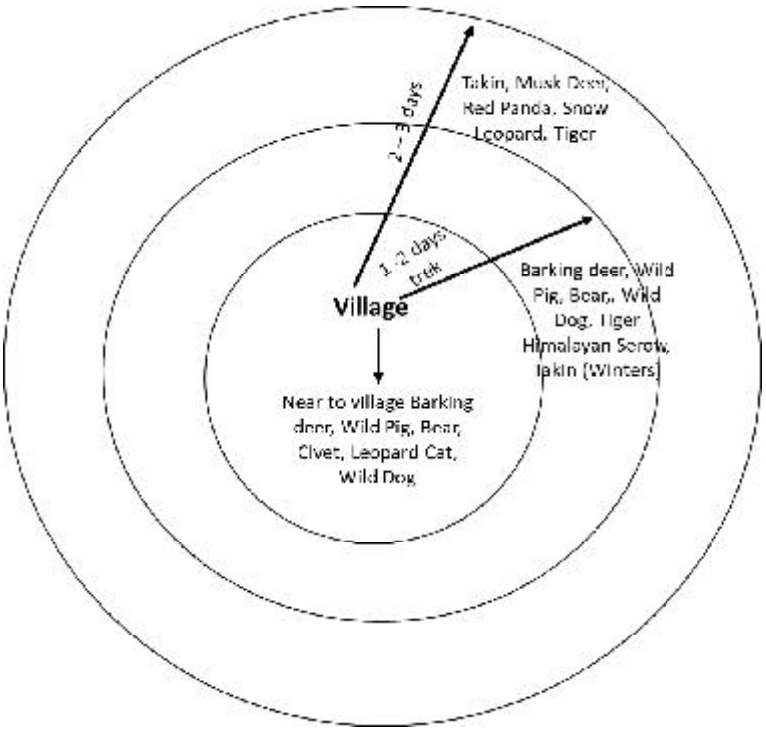

Figure 3.9: Presence of wild animals as per locals at Dibang Valley landscape

Perception on Wildlife Conservation, Wildlife Sanctuary and protected areas

People of Dibang Valley have a mixed reaction towards protected areas, its laws and policies and plans of potential "**Tiger Reserve"** formation. Those who are active hunters are concerned about their future hunting opportunities. Few of them have taken hunting as a source of income as due to lack of any other alternative. Besides, hunting is part of their tradition since time immemorial. According to some people, they are always into sustainable hunting, as they have to follow *"aena"* or taboos. Therefore, discrepancies between their traditional taboo system and modern conservation system always draws a line between them.

Positive perceptions allow the thought of opportunity for young educated group to indulge themselves in eco-tourism. Formation of tiger reserve will welcome more employment through forest department. Tourism indirectly will help them to access better developmental processes, especially linear developments that are lacking in that difficult terrain. Formation of alternative livelihoods will not only help the local people but also will help in conservation of floral and faunal diversity of Dibang valley, hence conservation of unique Idu Mishmi and their tradition will also be conserved indirectly through tourism promotion.

However, various conflicts also are in the mind of young educated people, those who think that they did not get the privilege of knowing what is happening around them. Dibang Wildlife Sanctuary has been formed in 1998, approximately 22 years ago from today. However, while demarcation process was carried out, forest department did not think it was necessary to

discuss with indigenous Idu community for converting their personal land to protected one. As light of education reached there, concerns about losing their land and opportunity to collect their basic necessities for livelihood has also occurred in the mind. They started raising their voice against all mishaps that have been done without their knowledge. Being a part of Biosphere Reserve and enjoying the status of wildlife sanctuary, Dibang Valley have rarely seen any improvement or involvement of forest related tasks in last two decades. Also improper compensation procedure in both crop raiding and Mithun lifting has created agitation among the inhabitants living on forest edges. They are also suspicious about the freedom of collection by means of traditional hunting, collection of firewood as well as non-timber forest products, if it is declared as tiger reserve. Thus, their food source and livelihood will be hampered by rules and regulations. Some older people have a belief that due to their "*Aena*" system, population of wild animals are sustainably surviving and there is no need for Tiger Reserve or Wildlife Sanctuary to protect those animals.

Possible Outcome of the study

Idu community have a very profound connection with forest and its surrounding ecosystem. Elderly people know surroundings of their villages like the palm of their hand. They utilize the forest product efficiently and in a sustainable manner too. The probable outcome of this study will highlight the present status of Idu Mishmi society, scenario of their accelerated economic condition, demographic profile of the landscape, rich traditional knowledge and of medicinal plants, preserving the knowledge of taboos by passing from one generation to the next, livelihood and socio-cultural dependence on forest products, human-wildlife conflict and major drivers behind these issues and pressure on wildlife as well as on natural resources due to over-extraction.

This study will also cover the perception and attitude towards protected areas, wildlife, conservation measures, laws and policies to maintain the integrity of floral and faunal diversity in the sanctuary. Compensation and mitigation procedures in case of human-wildlife conflict, possible alternative livelihood for inhabitants of remote villages, eco-development and involvement of people in possible conservation measures. Ultimately, this study will aid policy makers to formulate policies that will benefit both local people and wildlife in and around the protected area.

Future plans

1 To cover more places, especially remote villages nearby the periphery of Dibang WLS for better understanding of their forest dependence through questionnaire survey. Modification of questionnaire survey pertinent to Idu Mishmi lifestyle at Dibang Valley district.

2. Accumulating more knowledge on their traditional medicinal plants as well as NTFP products. Also, to document variation in extraction and usage that have been transfigured presently.

3. To create more awareness among Idu Mishmi about the natural resources they are surrounded by and connecting the gaps between their traditional knowledge and conservation plans.

4. Camera trapping based occupancy surveys in unexplored areas of the DWLS

PLATES

Image 3.1: Displaying of various wild animals skulls on trophy board

Image 3.2: Documenting knowledge about trophies and their arrangements

Image 3.3: An informal discussion with an experienced hunter of Idu Mishmi tribe

Image 3.4: Interviewing the local people at Anini, Dibang Valley district

Image 3.5: Interactions with older people of Dibang Valley district

Image 3.6: A freshly killed tragopan species hunted by an experienced hunter

Image 3.7: Trophy of Mishmi hill giant flying squirrel captured from an Idu village

Image 3.8: Fruit of *Paris polyphylla*, a medicinal plant found in Dibang Valley district

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CHAPTER 4
MANIPUR & NAGALAND

Study Area

The study area includes forest patches of Tamenglong and Senapati districts in Manipur. For Nagaland, it included Intanki National park and Peren district (Fig 4.1). These areas are connected to the Karbi-Anglong forest and further act as a wildlife corridor across state borders through the Barail range and Mikir hills. The study area is part of the Indo-Burma global biodiversity hotspots (Myers et al. 2000) and harbors a rich diversity of flora and fauna of conservation importance. The vegetation is tropical wet evergreen and semi-evergreen in the lower- and middle-elevation areas.

Tamenglong district is bounded by Senapati district to the east, North Cachar hills district of Assam to the west, Peren district of Nagaland to the north and Churachandpur district of Manipur to the south. The district covers a total area of 4395 km^2 and has 215 villages. (Census of India 2011) The district is drained by following major rivers: Barak (Ahu), Irang, Makhru (Makhu), Iring, Ijei (Aga) and Apah rivers, etc. The district has a total forest cover of 3,844.44 km^2 covering 87% of the district area. (FSI 2019). It has three protected areas *viz.,* Buning Wildlife Sanctuary (BWLS), Zeilad Wildlife Sanctuary (ZWLS), and Jiri-Makru Wildlife Sanctuary (JMWLS). The Jiri River separates the western border of Manipur from Assam. The district is inhabited predominantly by the Zeliangrong community, which includes Rongmei, Zeme, and Langmei Naga tribes. Senapati district covers a total area of 3271 km^2 and is located in the northern part of Manipur with Ukhrul district to its east, Kangpokpi district to its south, and Tamenglong district on the west. The district is endowed with a kaleidoscopic landscape of blue hills, green valleys, streams and rivers flowing through mountains and deep gorges. Rich varieties of flora and fauna are known to occur in few hilly forest tracts. Agriculture is the main occupation of the people and the people generally practice terrace cultivation. The literacy rate is 63.60% and has 686 villages. (Census of India, 2011). According to Champion and Seth classification of forest types(1968), the forest areas in these districts are dominated by following forest types: 8B/C1 East Himalayan Sub-Tropical Wet Hill Forest, 2B/C2 Cachar Semi-Evergreen Forest, 3C/C3b East Himalayan Moist Mixed Deciduous Forest, and 2/2S1 Secondary Moist Bamboo Brakes.

Peren district is the newly formed district of Nagaland with an area of 1799 km^2. With 86 recognized villages, the district is bounded by Dimapur in the North, Kohima in the East, Manipur in the south and Assam in the West. Peren, Jalukie and Tening are the major towns of the district. Most of the inhabitants belong to the Zeliang and Kuki tribes.

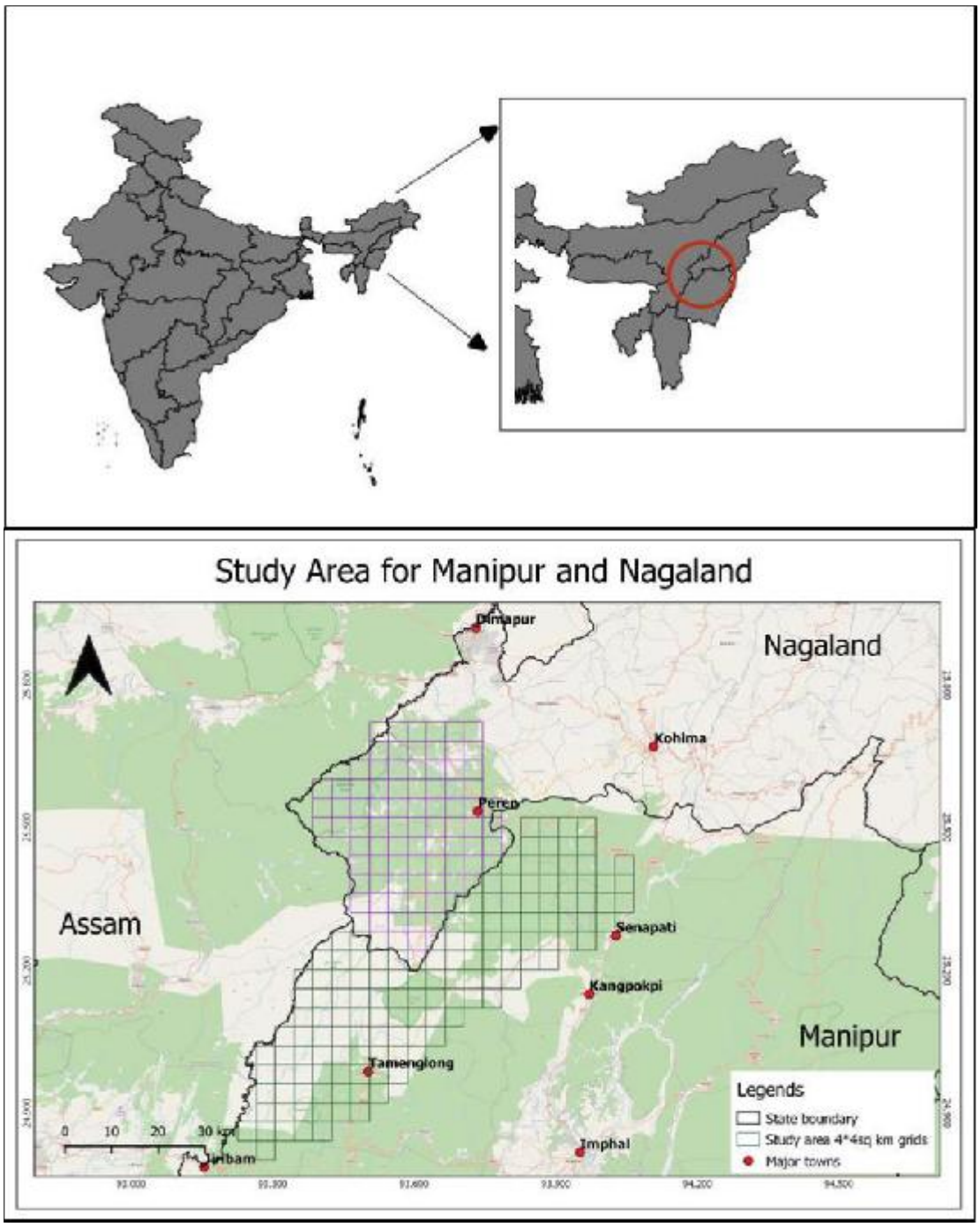

Figure 4.1: Map showing the study areas of Manipur and Nagaland, India

Methodology

The study area was selected considering forest areas and it's connectivity to Karbi-Anglong forest and Intanki National Park. The area was divided into 4 x 4 km^2 first and then accessibility to each grid was discussed with the field experts from the local non-governmental organization (NGO) or forest department staff. After which villages present in the accessible grids were visited to assess the forest type and to prioritize survey efforts later. Global Positioning System (GPS) coordinates collected for forest patches and villages having good tree cover and diverse fauna as reported during the questionnaire survey. Based on these coordinates, the selected area was further mapped and divided into 2 x 2 km^2 grids to prioritize for intensive study. Since most of the forests in Manipur are broadly under the community and private ownership, selecting priority areas by first visiting villages and interacting with the locals was therefore considered. The larger grid size was found to be the approximate area owned by many villages present in Tamenglong district. Further village chiefs were informed about the possibility of camera trapping efforts to be carried out in a 2 x 2 km^2 grid in high priority areas for tigers and associated species in next season.

Questionnaire survey

For the questionnaire survey, the village chief was approached and requested to inform the local hunters, traditional healers, elders, and people with good forest knowledge to assemble at the community hall. The semi-structured questionnaire survey was conducted by asking open-ended and closed-ended questions in the community hall or village chairman's house. In some villages, people went to the fields for clearing *jhum* fields or firewood collection, and all informed individuals were unable to participate. In such cases, village headman or elders present were interviewed. Before the survey started, the field assistant in the local language explicitly informed the respondents about the project and its objectives. A field guide to Indian mammals (Menon 2003) was used for the identification of species to avoid confusion with vernacular names. The survey included information on socio-economic status, educational and health-care facilities, dependency on forest products, rotation period for shifting cultivation, medicinal plants, wildlife knowledge and cultural beliefs, etc.

Preliminary Results and Discussion

The initial phase of the study was focused mainly in Tamenglong and Senapati districts, of which a total of 26 villages surveyed (Fig 4.2). With the assistance from the state forest department in Chiuluan and Azuram villages, awareness campaigns about the importance of protecting biodiversity and community reserves were conducted. Opportunistic surveys and informal discussions were conducted during the "Hornbill festival" from 6th to 8th December in

Kigwema village of Nagaland and 'Orange festival' in Tamenglong district on 16th December 2019. For Nagaland, Beisempuikam and Jalukie villages, adjoining the Intaki national Park were surveyed. A total of eighty-two respondents participated in the questionnaire survey throughout the study area. Most of the respondents were male and married.

Socioeconomic profile

The majority of respondents (about 56%) were from the 50-70 year age-group category (Fig 4.3), which can be explained by the recent trend of younger generation moving out of the district

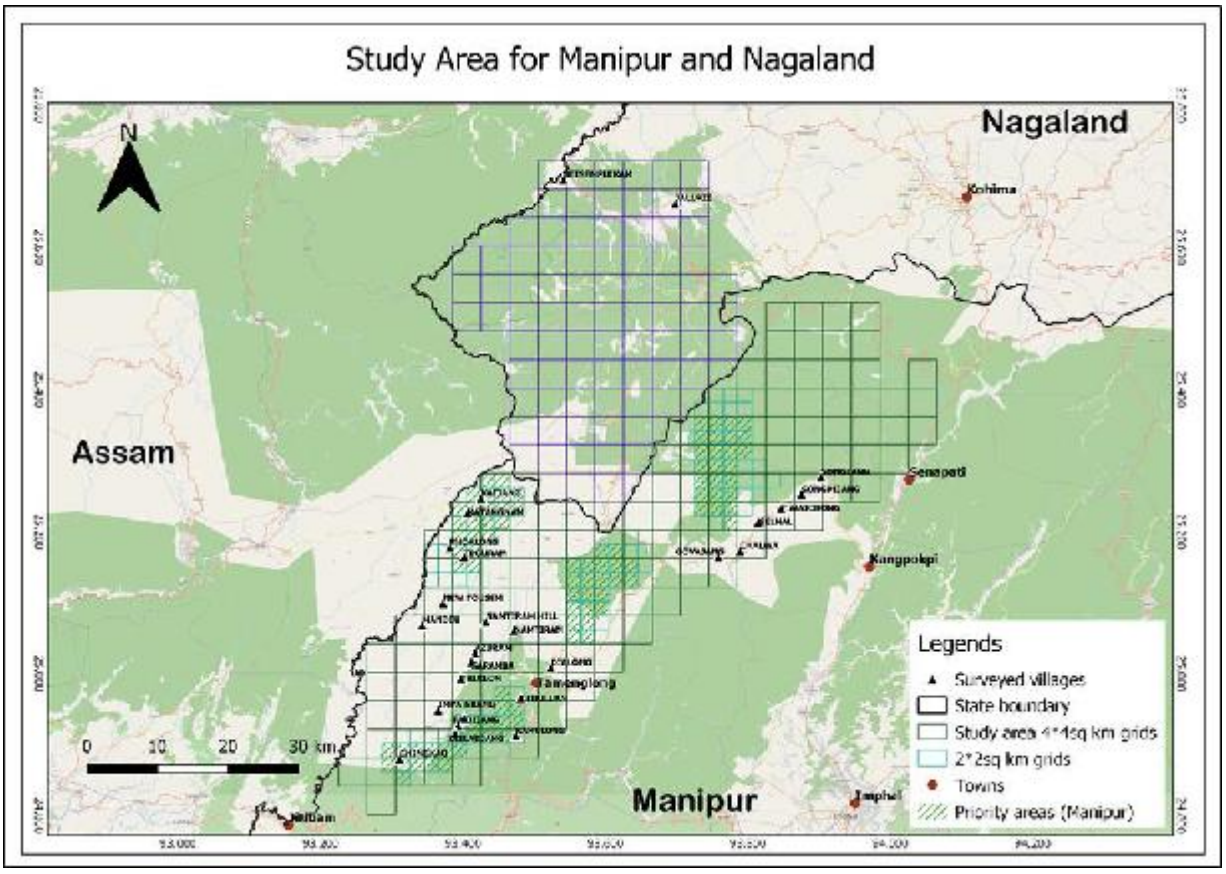

Figure 4.2: The surveyed villages in state of Manipur and Nagaland

for higher education and better job opportunities. They visit their hometown during the Christmas season annually. The most common occupation (about 90%) among the respondents was farming with an agriculture-based income, with some being part of the village authority committee to make crucial decisions concerning the village. They occasionally go and find temporary jobs at the Tamenglong town or sell forest produce at the Tamenglong market to earn a secondary income. The family size is generally between 6-8 members.

All the surveyed villages have adopted Christianity, and some are even following their traditional festivals alongside church services. When asked about taboos considering forest and animals, one respondent mentioned that during our ancestor time, we had many beliefs about hunting practices and animals. Since conversion to christianity during last two to three decades, people following the old traditional beliefs and rituals are minimal. Predominantly, the house type is katcha, usually made of bamboo and wood with tin or thatch roof. Village chairman and very few individuals in the villages have cemented house. The majority of the village areas in Tamenglong district are situated on hilltops at an elevation 650m to 1400m. The remoteness and poor road conditions make electricity connection last only during the dry season for 3-4 months in more than 80% of the villages. Three villages got the electricity connection only last year.

Medical facilities and Education

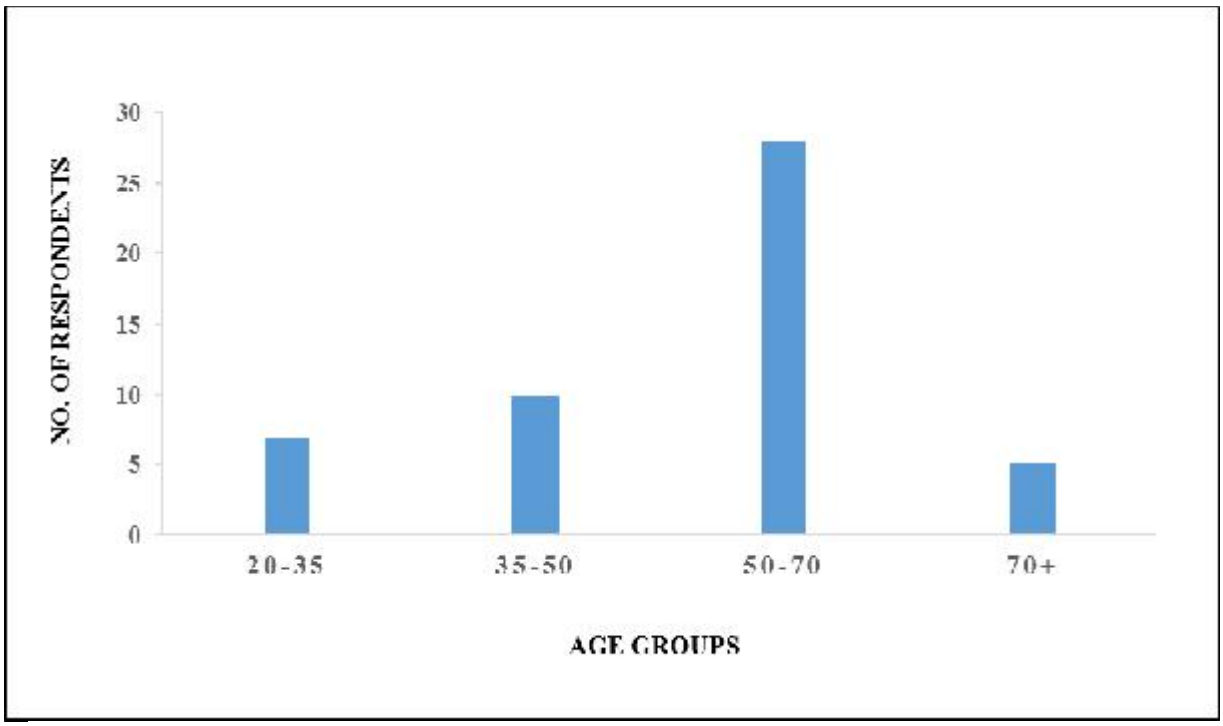

Figure 4.3: Age respondents group during the questionnaire survey

Villages have one partly functional primary health-care center with 1-2 local nurse- 'Asha' for dealing with pregnancy issues. Locals rely on their knowledge of medicinal plants and animal parts, sometimes suggested by local healers- '*Kubera*' for effective treatment of common illnesses. For emergency cases, villagers have to travel more than 2-3 hours to reach district

hospital in Tamenglong HQs. Similarly, primary government schools till 5th standard with substitute teachers are present in all the villages. Only few have higher education opportunities in the village.

Crops grown and shifting cultivation

The major crops grown in the study area includes rice, chilly, and mustard. Other vegetables grown for consumption include brinjal, colocasia, peas, tapioca, yam, potato, and different types of beans. As *jhum* is the dominant and only way of cultivation for a lot of villages, most of the locals could not produce enough food grains to meet yearly food requirements. At the same time, food supplies are not readily available due to hostile terrain and transportation. The rotation period of the *jhum* cycle varies from a minimum of 5 years to a maximum of 13 years in different villages, considering the soil fertility and the forest area under the ownership of the village chairman (Fig 4.4). There are orange and betel-nut plantations on a smaller scale in villages in Tamenglong district. Beisempuikam village in Nagaland has privately-owned rubber and teak plantations. The areas neighboring Barak River (Kahulong and Chiuluan) are the leading producers of crops and vegetables for the Tamenglong town area.

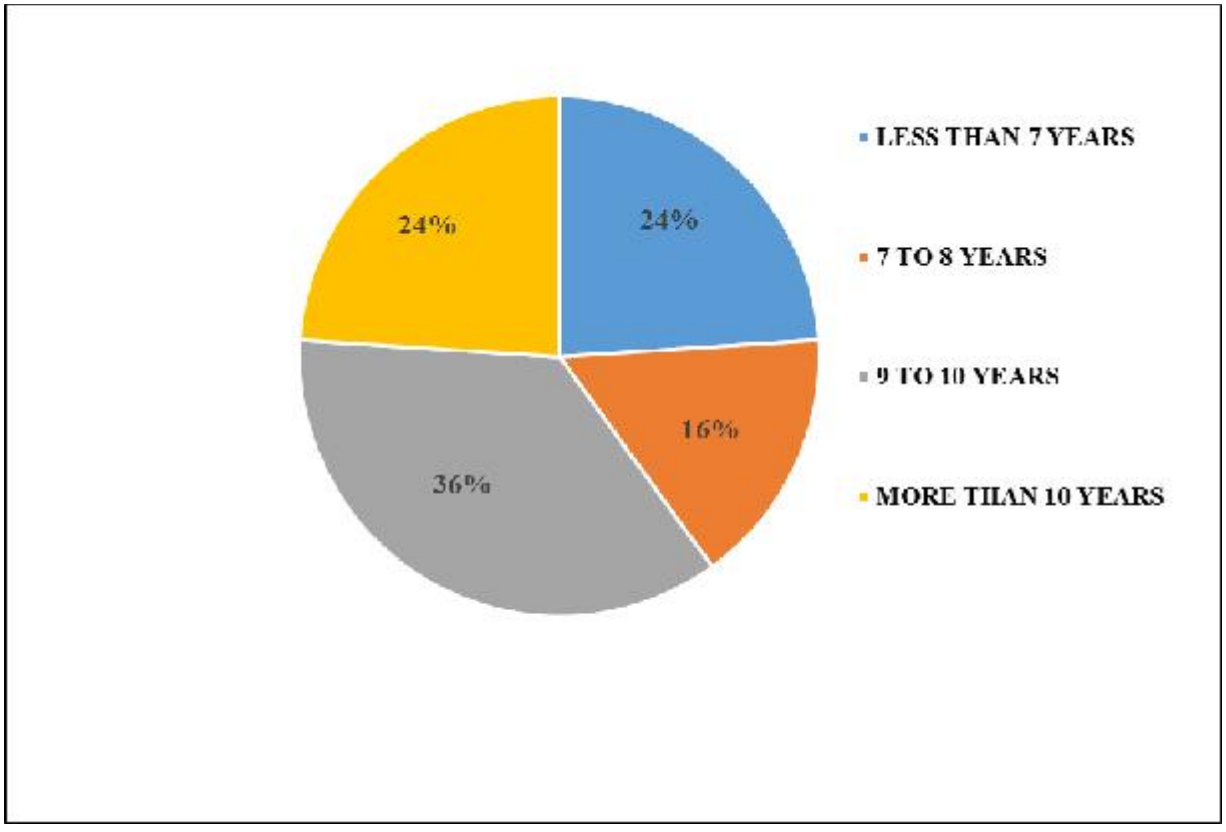

Figure 4.4: Rotation period for *jhum* cultivation in surveyed villages

Forest dependency and Traditional Ecological Knowledge

Most of the villages are self-sustained with known boundaries for sustenance activities like agriculture, hunting, collection of firewood and wild edible plants, etc.

a) Firewood and Timber collection

Firewood is the preferred option (more than 65%) for cooking than liquefied petroleum gas (LPG). Both LPG and firewood options used by only a few individuals in the village, which include chairman and secretary, but they also find it difficult to renew LPG connection considering the cost and remoteness of their village. The commonly used firewood species include *Siang*, *Nthou*, *Gelthing*, and *Gangpi* (in local names). It is collected all at once in the dry season to last throughout the year. Usually, the firewood is available from the forest cleared for *jhum* cultivation. Timber collection is carried out for the construction purposes of local households and by saw-mill owners. During our visit to forest adjoining Katangnam (part of Jiri-Makru WLS), huge felled trees (diameter more than 1 m) were waiting for transportation to Assam-Nagaland. These activities takes place near Nagaland- Manipur border, which are unregulated and not managed properly by the village chairman, which will result in a tremendous loss of secondary forest in the future.

b) NTFP Collection, Medicinal Plants and Animal parts

Many different plant species extracted from the wild are used in various ways to make curry and chutney for consumption. (**Table 4.1**) Mushroom, canes, beehives, bamboo shoots collected are either used for self-consumption or sold in the local market. These forest-based products provide required valuable nutrients for good health and longevity.

Table 4.1: List of wild edible plants consumed in Tamenglong district of Manipur

Sl. No	Species Name (local name)	Description	Mode of use	Medicinal value if any
1	Bungup Thai	Small bunch of fruits, sour in taste	Fruits used in making chutney and consumed raw after meals	NA
2	Thingmanrou	Like sweet potato	Tuber eaten boiled or used in curry	NA
3	Gankariak	Small plant	Leaves used for making gravy, also boiled and eaten	Good for blood circulation
4	Riiang	Leaves serrated, smells like iodex	Buds and bark eaten	Known to have medicinal value
5	Nagapulaya	Triangular leaves	Crushed and applied	Used for treating scars and wounds
6	Rukai	Climber	Tuber and roots consumed and	NA

Sl. No	Species Name (local name)	Description	Mode of use	Medicinal value if any
			sold for 50-60Rs per Kg	
7	Kankrew	Long pointed leaves, spicier than ginger	Used in curry and chutney	Has some medicinal value, mixed with other herbs
8	Lyangsi thai	Elliptical small greenish fruit	Served with amla as mouth freshner and also used in chutney	NA
9	Guipuang	Elephant apple	Used in curry	Deworming and fixing broken bones
10	Savri	Curled papery leaf, spicy taste	Used in chutney and making sinjung	NA
11	Talang	Five to Six leaves from one node	Leaves consumed	For stomach/gastritis problems, leaves used for sprain
12	Banamloi	Small leafs, creeper	Leaves consumed	For wounds and fracture
13	Koiplon	Climber	Leaves crushed with rice and consumed	For deworming
14	Naptalanga	Thumb sized root	Root consumed	For stomach ache
15	Thinmani	-	Eaten with rice, local delicacy in Churchandpur district	NA
16	Inta		Bark consumed	For treating diarrhoe
17	Khebnoi	Long glossy elongated leaves	Leaves consumed	For stomach problems, also used to get rid of evil spirits
18	Tamjenthai	Yellowish green fruit, large leaves	Fruits used in making pickles	NA
19	Pongthai	Sour taste	Soak for 2-3 days and drink	Used for kidney stone cases
20	Vaibolai (*Sarcochlamys pulcherrima*)	Lanceolate leaf with serrated edges	Leaves consumed as medicine	Used for treating diabetes

The locally-based traditional healers called '*Kubera*' uses many different types of herbs to treat illnesses. Sometimes, leaves of more than 40 different species of plants are crushed and mixed

for dealing with long-term illnesses. Animal parts are also known to harbor medicinal properties; gall bladder of Asiatic Black Bear and Python are known to have medicinal properties. The urine of serow and flying squirrels have medicinal properties and are collected before the animal dies after getting shot. Other animal parts include lungs of macaque species collected for treating respiratory illnesses, Asiatic brush-tailed Porcupine quills as a treatment for thyroid and yellow-throated marten's male reproductive part used for treating specific wounds.

c) Traditional practices and Folktales associated with wildlife

Many different plant and animal parts are used for cultural practices apart from consumption. There are folktales about humans turning into Hornbills and monkeys, hunting stories, friendship and rivalry between humans and animals. Most of the respondents don't remember folktales, and such stories remain known to a few older individuals and books in the local libraries. There are few similar traditional practices between Naga and Kuki tribes like teeth of wild pigs that may be used as local ornaments necklaces by members of both tribes. Porcupine quills are the females' hair accessories in both the tribes during traditional festival and also used in weaving of dresses. In some of the Kuki-inhabited villages, Clouded leopard is believed to switch forms between human and animals. A respondent mentioned that in earlier days hunting of red serow was considered as taboo and was prohibited as it was deemed unlucky having bad spirits. The ancestors worshiped pythons and frogs as a God. Animal parts used in anti-sorcery ritual purpose include snakeskin, muntjac intestine, etc.

Hornbill feathers are attached to headbands of both males and females during the cultural dance event. Other birds of cultural importance include '*Nzaipui*' - a small blue color bird whose feathers are used as earrings during the traditional dance for Zeliangrong tribes. Racket-tailed drongo tail feathers are used to decorate the headgear by tribes from the Peren district. In both tribes, houses of expert hunters were decorated to indicate the latter's prowess and superiority use skulls and jaws of animals like barking deer, wild pig, serow etc., and the beaks of hornbill.

Wildlife occurrence and Hunting pressure

The questionnaire survey resulted in the documenting of 28 mammalian species hunted in the study area (**Table 4.2**). The species present includes several globally threatened species like Chinese pangolin, Hoolock gibbon, otters, Bengal slow loris and marbled cat. Three different species of hornbills (*Rengdai*) were also mentioned that include great hornbill, Austen's brown hornbill and wreathed hornbill. Other rarer bird species include koklass pheasant, Western tragopan observed during June-July and many other yet to be confirmed species. Birds and animals are hunted using traditional traps, catapults, air guns, and local guns.

Table 4.2: List of mammal species hunted in the study area

Sl.no	Animal species	Scientific Name	IUCN status	Local Name (Rongmei)
1	Himalayan Serow	*Capricornis s. thar*	VU	*Chalung*
2	Brush-tailed porcupine	*Atherurus macrourus*	LC	*Rengthan*
3	Hoolock gibbon	*Hoolock*	EN	*Apeng*
4	Wild pig	*Sus scrofa*	LC	*Chakau*
5	Assamese macaque	*Macaca assamensis*	NT	*Zou*
6	Bengal slow loris	*Nycticebus bengalensis*	EN	*Zaitung, Mitungkui (Kuki)*
7	Rhesus macaque	*Macaca mulatta*	LC	*Zou*
8	Sambar	*Rusa unicolor*	VU	*Chakhaeng*
9	Barking deer	*Muntiacus vaginalis*	LC	*Asan*
10	Asiatic black bear	*Ursus thibetanus*	VU	*Chagam, Hagum(Zeme)*
11	Yellow throated marten	*Martes flavigula*	LC	*Atee*
12	Masked palm civet	*Paguma larvata*	LC	*Akhui*
13	Small-tooth ferret badger	*Melogale moschata*	LC	*Adui*
14	Himalayan porcupine	*Hystrix brachyura*	LC	*Rengthan*
15	Clouded Leopard	*Neofelis nebulosa*	VU	*Zoukie/Alay /Zao*
16	Leopard cat	*Prionailurus bengalensis*	LC	*Zoukie*
17	Chinese pangolin	*Manis pentadactyla*	CR	*Mphau*
18	Eurasian otter	*Lutra lutra*	NT	*Maram/Araam*
19	Small-clawed otter	*Aonyx cinereus*	VU	
20	Smooth coated otter	*Lutrogale perspicillata*	VU	
21	Marbled cat	*Pardofelis marmorata*	NT	NA
22	Pallas's squirrel	*Callosciurus erythraeus*	LC	*Lai*
23	Hoary bellied squirrel	*Callosciurus pygerythrus*	LC	*Lai*
24	Flying squirrel sp	*Petaurista sp.*	LC	NA
25	Tiger	*Panthera tigris*	EN	*Kamang*
26	Binturong	*Arctictis binturong*	VU	NA
27	Lesser bamboo rat	*Cannomys badius*	LC	NA
28	Mongoose sp.	-	-	*Ahiaou*

A recent trend in the use of air gun and easy availability of its pellets has increased incidents of birds and squirrels hunted during the dry season. Many medium-sized bird species commonly hunted include Ashy Bulbul, Great Barbet, Orange-bellied leafbird, Rufous-bellied Niltava, and different unidentified species of ground birds (Quail spp., Pheasant spp.). According to a few

hunters, the dry season is ideal for hunting birds as they are healthier and provide more nutrition.

The commonly hunted mammals include wild pig, civets, and deer species. The best time for hunting is during the new moon and the dry season. While most of the shooting during a hunt is opportunistic, and the hunters don't know what animal he will encounter. The use of traps can be specific to animals of different size groups. The most common driver for hunting is domestic consumption and retaliation for crop loss. As reported from various other studies in northeast India, the recent trend due to modernization is also impacting the study area with purpose shifting towards hunting for monetary benefits, illegal trade and leisure purposes. (Betlu et al. 2013, Kumara & Singh 2004, Datta et al. 2008, Aiyadurai et al. 2010, Velho et al. 2012, Bhupathy et al. 2013, Selvan et al. 2013, Velho & Laurance 2013). The demand for species like Chinese pangolin, turtles, and animal parts used in Chinese medicines has resulted in increasing reports of species being hunted specifically for illegal wildlife trade. Locally made traps increase the likelihood of capture as they are more effective than guns and are active for a long time. The main types of traps used are:

a) *Bai*: Effective in capturing small to medium-sized animals like mongoose, civet cats, badgers, porcupines, and small cats. A log of wood is generally used in a trigger-based mechanism to pin the animal on the ground and are placed at main entry points to the crop fields.

b) *Nthang*: Used for mainly hunting larger animals like deer species and wild pig. It is constructed by using a rope tied to a tree branch and a ground trap. The animal leg after getting trapped gets pulled up in the air.

c) *Tangbai* and *Haduak*: *Tangbai* is used for hunting birds while *Haduak* for small-sized animals, which traps the neck region.

Tiger Presence

Tiger (*kamang*) presence was reported from the forest areas neighboring three villages- Katangnam, Zeiladjang, and Chingkao. These sighting records from last year by hunters, during the interview also pointed out the migratory behavior of the large carnivore, coming from the Assam side and not staying in one village for long. Respondents more than 70 years age also mentioned the trend in animal populations of other species to be declining. Numbers of Asiatic black bears and macaque species have been severely decreasing, resulting in local extinction from several villages. Villagers reported the troop size to have decreased from 35-40 or more monkeys to less than ten individuals. Hoolock gibbon populations are left to few fragmented pockets with less than 15 individuals surviving in the total surveyed villages as reported by

hunters. These areas need to be explored and prioritized for estimation of population, habitat status, and conservation efforts.

Crop Raiding and Mitigation

Villages (about 80%) are facing crop depredation by wild animals that includes wild pig, serow, squirrels and rats. Some birds including parakeet sp., and small bird called 'araina' are also known to attack fields in flocks of more than 100 birds. The harvest season during the month of September-November is the time when most of crop raiding happens in these villages. Several other incidents of poultry and livestock predation were also reported. (**Table 4.3**). There is no active compensation mechanism to mitigate the crop loss and cultivators use traditional methods by building traps to protect their fields or hunting the conflict animals regularly. Other methods in practice include using scarecrows and building *machan* for patrolling in the field at night.

Table 4.3: Crop raiding problems and list of conflict animals

Sl. No.	Conflict species	Problems caused	Season when conflict occurs
1	Wild pig	Attacks Rice, Potato and other tubers	Harvest season during Sept-October
2	Serow	Attacks chilly and vegetables	Harvest season for chilly
3	Squirrel sp.	Attacks fruiting trees like orange, jackfruit, guava, papaya, etc	NA
4	Leopard cat	Predates on chicken	2-3 times a month
5	Yellow-throated marten	Predates on chicken	2-3 times a month
6	Macaque sp.	Fruiting trees like orange, jackfruit, guava, papaya, etc	Fruiting season
7	Eagle (*Mou*)	Predates on chicken	Occasionally
8	Otters (*Araam*)	Attacks fishing nets	Occasionally
9	Rat sp.	Attacks stored grains mostly	Post-harvest season
10	Clouded leopard	Attacks on poultry and livestock	Occasionally
11	Elephants	Crop raiding in paddy fields in herds	During Oct-November (reported only in Beisempuikam)
12	Asiatic Black bear	Crop raiding and attacking fruit orchards	July to October
13	Parakeet sp.	Crop raiding	July to October

Trophies

In some villages, trophies were kept for wild pig, serow, macaque sp., and barking deer, etc. Most of the respondents in Manipur don't keep trophies in their household and usually burn the unwanted parts of the animals hunted. They only keep the parts used for medicinal importance or one or two skulls for display. Respondents from the survey conducted on Imphal-Tamenglong road provided information on animals hunted throughout their lifetime (**Table 4.4**).

Table 4.4: Number of trophies present or claimed to have hunted during their lifetime

Sl. No.	Village Name	Species Name	Number of trophies present or claimed to have hunted during their lifetime
1	Gelnal, Senapati district	Himalayan Serow	25
		Wild pig	8
		Macaque sp.	20
		Barking deer	50
		Sambar	14
2	Govajang, Senapati district	Wild pig	60
		Macaque sp. (2 types)	100
		Barking deer	50
3	Waichong 1, Senapati district	Wild pig	Total of 50 individuals
		Himalayan Serow	
		Sambar	
		Barking deer	
		Macaque sp.	
4	Waichong 2, Senapati district	Wild pig	Total of 20 individuals
		Himalayan Serow	
		Barking deer	
		Macaque sp.	
5	Songpijang, Senapati district	Himalayan Serow	80
		Wild pig	8
		Macaque sp. and Hoolock gibbon	200
		Barking deer	70-80
		Pangolin	370
		Porcupine	3
6	Songjang, Senapati district	Himalayan Serow	13
		Wild pig	70
		Barking deer	420
		Asiatic Black bear	2
		Pangolin	370

Sl. No.	Village Name	Species Name	Number of trophies present or claimed to have hunted during their lifetime
		Sambar	32
		Porcupine	2
7	Bamgaijang, Tamenglong district	Wild pig	11
		Himalayan Serow	7
		Macaque sp.	2
		Barking deer	2

Conservation efforts and perception towards wildlife

Northeastern states face a conservation conundrum concerning wildlife conservation. To balance dependency on the forest for sustenance, preserving cultural and traditional practices alongside protecting natural resources is extremely challenging. The lack of awareness of rare and endangered species and the increasing level of hunting due to the easy availability of guns accompanied by hunting dogs in recent times need urgent attention. With access to modern technology, perception about wildlife and natural resources is also changing. Many photographs of unique plants and dead animals are forwarded on social media platforms occasionally inciting mixed reactions with discussions on monetary benefits of trading wild animals.

While few taboos prevent hunting of species like Bengal slow loris, ferret-badger, and Hoolock gibbon, these animals still are hunted regularly. Also, the deployment of traditional hunting traps inside the forest for a long time results in potential threats to many rare birds and mammals. To change the perception towards wildlife, the forest department should deal crop-raiding problems proactively. Compensatory assurance or effective mitigation measures for crop loss and awareness about the conservation importance of rarer species will help in protecting them.

People in Tamenglong district of Manipur are recently becoming aware of the need for biodiversity conservation due to Amur falcon campaign, awareness done by Forest department and Rainforest Club Tamenglong. Villages like Kahulong, Azuram and Teguram have even banned the use of air guns. Some villages have kept aside part of the forest as reserved, where hunting is completely prohibited.

Realizing the decreasing trend of animal populations, village chiefs are also giving instructions to not hunt rare species like Hoolock gibbon, Tigers, and Hornbill (*Rengdai*), imposing a large sum of fines on hunters found to break the rules. Some suggestions given by respondents for preserving wildlife include giving enough job opportunities, alternative livelihood options, long-term governmental schemes; reduce cutting trees, and hunting of species. Providing awareness about the ecotourism potential, alternative livelihood options, and initiating compensation

mechanisms for loss due to conflict animals might be effective ways to provide employment and conserving biodiversity while supporting the rural agriculture economy.

Way forward

For the next season, remaining areas in Peren district, Chaka forest in Senapati district, Intanki National park will be surveyed. Camera trapping will be carried out in high-priority areas of Tamenglong district. The priority areas for intensive study covers the protected areas Zeilad WLS, Buning WLS, Jiri-Makru WLS, Chingkao forest, and its nearby areas. Hunting trails will be explored by accompanying hunters to understand the hunting rate in some selective villages. We will conduct more awareness programs with the forest department and local NGOs about the importance of wildlife and community reserves. Contacting interested youths from primary schools and teaching them how to collect data on biodiversity by providing some incentives will help in engaging students for conservation.

PLATES

Image 4.1: House type from Bamgaijang village near Barak River in Tamenglong

Image 4.2: Animal trophies of Wild pig, Serow and Macaque species in Tamenglong District from Bamgaijang village near Barak River

Image 4.3: Interviewing locals and identifying the animal species using field guide

Image 4.4: Interviewing local hunters and elders in the community hall in Impa-Nkang village in Tamenglong, Manipur

Image 4.5: Household inside Zeilad WLS (Zeiladjang village) with poultry and piglets

Image 4.6: Firewood collection done by kids accompanying their mother in one of the village

Image 4.7: A) Flying Squirrels for sale during the Hornbill Festival in Nagaland; B) Traditional traps used by locals in Tamenglong district to protect crops; C) Ferret Badger species hunted in Senapati district and D) Kill of Leopard cat hunted by villagers from Chingkao Village

Image 4.8: Smoked meat of Bengal slow Loris, Masked palm civet and Frog species

Image 4.9: Bengal slow loris, considered a taboo by elders from Zeliangrong community, with a belief that killing it will result in lot of sufferings before death. The species continues to be hunted occasionally by younger generation

Image 4.10: Conducting a nature learning camp about importance of biodiversity and conservation in Chiuluan village

Image 4.11: One day awareness camp conducted in Azuram village with the Forest department

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F. No. 5-1/2018-NTCA
Government of India
Ministry of Environment, Forest and Climate Change
National Tiger Conservation Authority
***

B-1, Wing, 7th Floor,
Pt. Deendayal Antyodaya Bhawan,
CGO Complex, Lodhi Road,
New Delhi - 110003.
Email: dig2-ntca@nic.in
Tel. (EPABX) 011-24367837-42
Fax: 011-24367836
Dated: 13.04.2018

To,

The Director,
Wildlife Institute of India,
Post Box No.18,
Chandrabani, Dehradun,
Uttarakhand -248001

Sub: Submission of Memorandum of Understanding (MoU) for the proposal to conduct a study on Developing a collaborative management strategy for conservation of tigers in North East India: Component-1.

Ref: Your letter No. WII/ESM/GGVNETIGERS dated 13th January, 2018

Sir,

Please find enclosed herewith a copy of MoU between the National Tiger Conservation Authority and Wildlife Institute of India duly signed by ADG (PT) & Member Secretary (NTCA) for kind perusal.

Encl: As above.

Yours faithfully,

Nishant Verma

(Nishant Verma) 13/4/18
Deputy Inspector General (NTCA)

OC
issued with
Encl by SP
Deoke
13/4/18

5-1/2018-NTCA

MEMORANDUM OF UNDERSTANDING
BETWEEN
NATIONAL TIGER CONSERVATION AUTHORITY
AND
WILDLIFE INSTITUTE OF INDIA, DEHRADUN

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Made this day on 27.03.2018 between the National Tiger Conservation Authority, B-1 Wing, 7th Floor, Pt. Deendayal Antodaya Bhawan, CGO Complex, New Delhi – 110 003 and the Wildlife Institute of India, Dehradun, herein referred to as NTCA and WII. Funds are required for the project titled "Developing a collaborative management strategy for conservation of tigers in North East India, Component 1: Status and Conservation of Tigers and Their Habitats in Hill Ranges of North East India with special reference to Mishmi Hills, Manipur and Nagaland". The Principal Investigator for the implementation of the project is Dr. Gopi.G.V, Scientist E, WII and co-investigators are Dr. S. A. Hussain, Scientist G (WII), Dr. Ruchi Badola, Scientist G (WII), Mr. Nishant Verma, DIGF, NTCA and Dr. Vaibhav Mathur, AIGF, NTCA. Collaborators are respective state forest departments of Arunahcal Pradesh, Manipur and Nagaland. The Memorandum of Understanding will be effective from the date of signing by both the parties **for a period of four years.**

Project Objective/s:

The objectives of this project/proposal are:

a. Determine the status and distribution of tigers and associated species in the Mishmi hills (Dibang Valley District, Kamlang Tiger Reserve in Lohit District), Tamenglong District and Dimapur District
b. Evaluate the effects of environmental features and anthropogenic pressure on the tigers and associated species occupancy patterns
c. Assess local people's knowledge, beliefs, attitudes and perceptions about conservation of tigers, co-predators and their prey species
d. Identify areas that have high conservation value as well as those that are under threat for tigers, co-predators and their prey species, with the ultimate aim of planning future long term monitoring and conservation strategy.

Agreed Actions:

A. National Tiger Conservation Authority

Funding support for the proposal to conduct a study on the "Developing a collaborative management strategy for conservation of tigers in North East India, Component 1: Status and Conservation of Tigers and Their Habitats in Hill Ranges of North East India with special reference to Mishmi Hills, Manipur and Nagaland" and field implementation of the project in association with the Forest departments of Arunachal Pradesh, Manipur and Nagaland.

B. Wildlife Institute of India, Dehradun

(a) The proposed study will be conducted in Dibang Valley, Lower Dibang Lohit, Tamenglong and Dimapur Districts of Arunachal Pradesh, Manipur and Nagaland states of the North East Region. The deliverables of this project will be to (a)

strengthen occurrence records and abundance of tigers in and outside the PAs of Mishmi and Barail Hill Ranges that includes Dibang WLS, Mehao WLS, Kamlang TR, Intangki NP and Dimapur District in Nagaland and Tameglong District in Manipur and (b) gather baseline data and Strengthened knowledge base to inform appropriate conservation interventions like declaring potential areas as tiger reserves

Terms and Conditions:

1. Set out below are the terms and conditions under which the WII has agreed for the proposal for conducting a field survey titled "Developing a collaborative management strategy for conservation of tigers in North East India, Component 1: Status and Conservation of Tigers and Their Habitats in Hill Ranges of North East India with special reference to Mishmi Hills, Manipur and Nagaland". Funding assistance would be provided in the following manner:

Year	Amount in Rs.	1st installment	2nd installment	3rd installment
1	13985620	11188496 (80%)	279124 (20%)	
2	6907120	5525696 (80%)	1381424 (20%)	
3	6907120	5525696 (80%)	1381424 (20%)	
4	6680140	4008084 (60%)	2004042 (30%)	668014 (10%)
Total	34480000	26247972	7564014	668014

2. Release of subsequent installments will be subject to submission of Utilization Certificate and the progress report.
3. Progress Reports (PR) and update would be submitted to the NTCA on physical and financial progress along with Utilization Certificate in the prescribed form.
4. The National Tiger Conservation Authority may review the progress as and when required.
5. For administrative purposes the Member Secretary (NTCA) has been assigned to administer the assignment.
6. The National Tiger Conservation Authority may if find it necessary, can postpone or cancel the assignment and/or shorten or extend its duration. However, every effort will be made to give, as early as possible, notice of any changes. In the event of termination, WII shall be paid for the services rendered for carrying out the assignment to the date of termination, and the WII will provided the National Tiger Conservation Authority with any reports or parts thereof, of any other information and documentation gathered under this MoU prior to the date of termination.
7. This MoU, its meaning and interpretation and the relations between the parties shall be governed by the Laws of Union of India.
8. This MoU will become effective upon confirmation of this letter on behalf of the WII and will terminate on completion of four years from the date of signing it, or such other date as mutually agreed between the National Tiger Conservation Authority and the WII.

9. Payments for the services will not exceed to the budget estimate as approved by the NTCA. This includes all the costs related to carrying out the services, including overhead and any taxes imposed on the WII.
10. The project report so prepared by WII shall be the property of WII and NTCA and shall be free from all legal encumbrances like Intellectual Property Rights (IPRs) etc between these two agencies.
11. The WII undertakes to carry out the assignment in accordance with the highest standard of professional and ethical competence and integrity, having due regards to the nature and purpose of the assignment, and to ensure that the staff assigned to perform the services under the WII will conduct themselves in a manner consistent herewith.
12. All date, reports and other documents or software submitted by WII in the performance of the services shall become and remain joint ownership of respective States, NTCA and WII. The WII may use this information, only for academic training purposes. Any other use would require a prior written approval of the NTCA.
13. The WII will not assign this Contract or sub-contract any portion of it without the NTCA's prior written consent.
14. No information shall be shared in public domain on processes and outcomes of the said study till completion, that too only on approval of the NTCA; unless and otherwise approved by the NTCA.
15. Assets acquired wholly or subsequently out of NTCA's shall be the property if the NTCA and shall not be disposed off without obtaining the prior approval of the NTCA.
16. The accounts of the WII shall be audited by C&AG or by any person authorized by him on his behalf in accordance with the provisions laid down in Section 14 of C&AG (DPC) Act, 1972 as amended from time to time.
17. The accounts of WII shall be open for inspection by the NTCA and Audit, both by the Comptroller & Auditor General of India under the provision of C&AG (DPC) Act, 1972 and internal party by the Principal Accounts Office of Ministry of Environment, Forest & Climate Change, whenever it is called upon,
18. Funds so granted to WII are subject to the Economy instructions issued from time to time by the Ministry of Finance or by the Competent Authority.
19. WII will maintain a separate account and will present their annual accounts in the standard format as required under Rule 209 (6) (xiii) of GFR, 2005 [Rule 230 (5) of GFR, 2017]
20. No deviation from the approved items of expenditure as enumerated in the sanction letter shall be made without prior concurrence of NTCA.
21. At no stage shall data, information, outputs and outcomes be made available in public domain or released to the media (of any nature) without prior written concurrence of the NTCA.

Funding for the project:

The proposal is funded by the National Tiger Conservation Authority from Grants-in-aid to NTCA

The total cost of the Project: INR 3,44,80,000 including 10% institutional charges (details at annexure-I).

Institutional Representatives:

The parties listed below may make amendments, deletions and additions to this MoU on behalf of each party on the basis of mutual agreement:

Member Secretary,
National Tiger Conservation Authority,
B-1 Wing, 7th Floor,
Pt. Deendayal Antodaya Bhawan,
CGO Complex, New Delhi – 110 003.
Phone: 011-24367835
Fax: 011-24367836
E-mail: ms-ntca@nic.in

Director,
Wildlife Institute of India,
Dehradun – 248 002
Chandrabani, Dehradun.
Phone: 0135-2640910
Fax: 0135-2640117
E-mail: dwii@wii.gov.in

The investigators shall undertake to act in good faith with respect to each others right under agreement and adopt all reasonable measures to ensure the realization of the objectives of project.

The parties have signed the Memorandum of Understanding as a token of acceptance of the mentioned above and have thus put their hands upon it with the signatures on this day.....2018.

For

National Tiger Conservation Authority B-1 Wing, 7th Floor, Paryavaran Bhawan, CGO Complex, Lodhi Road, New Delhi-110003

For

Wildlife Institute of India Post Box # 18, Chandrabani, Dehradun – 248001 Uttarakhand

Signed:

Dr. Debabrata Swain
Member Secretary
National Tiger Conservation Authority

डॉ. देबब्रत स्वाईं / DR. DEBABRATA SWAIN
अ.व.म.नि. (बाघ परियोजना) एवं सदस्य सचिव
ADGF (Project Tiger & Member Secretary (NTCA)
राष्ट्रीय व्याघ्र संरक्षण प्राधिकरण
National Tiger Conservation Authority
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
Ministry of Environment, Forest and Climate Change
भारत सरकार, नई दिल्ली / Govt. of India, New Delhi

Signed:

Dr. V.B. Mathur,
Director
Wildlife Institute of India

डा. वि.वि. माथुर/Dr. V.B. Mathur
निदेशक/Director
भारतीय वन्यजीव संस्थान
WILDLIFE INSTITUTE OF INDIA
देहरादून/Dehradun

Annexure I: "Developing a collaborative management strategy for conservation of tigers in North East India, Component 1: Status and Conservation of Tigers and Their Habitats in Hill Ranges of North East India with special reference to Mishmi Hills, Manipur and Nagaland"

BUDGET HEAD	Rate (Rs.)	Unit	Year 1	Year 2	Year 3	Year 4	Total
MANPOWER							
Project Fellow (@ Rs. 25000 + HRA 20% + Other Allowances)	30000	6	2160000	2160000	2160000	2160000	8640000
Project Assistant	20000	3	960000	960000	960000	960000	3840000
Field Assistant	10000	10	1200000	1200000	1200000	1200000	4800000
TOTAL MANPOWER	**60000**	**19**	**4320000**	**4320000**	**4320000**	**4320000**	**17280000**
EQUIPMENTS AND CAPITAL							
Camera traps (including mount, case and viewer)	15000	400	6000000	0	0	0	6000000
Water proof Binoculars (10 nos)	-	10	60000				60000
Field gears	-	Lump sum	200000	0	0	0	200000
GPS	10000	5	50000	0	0	0	50000
Digital camera with accessories	25000	5	125000				125000
TOTAL EQUIPMENTS			**6435000**	**0**	**0**	**0**	**6435000**
Operational							
Base camp establishment & maintenance	10000	4	480000	480000	480000	251000	1691000
TOTAL OPERATIONAL			**480000**	**480000**	**480000**	**251000**	**1691000**
CONSUMABLES							
Contingency, basic camping equipments and miscellaneous	-	-	100000	100000	100000	54000	354000
Batteries for camera traps	-	-	100000	100000	100000	100000	400000
Final report publication	-	-	0	0	0	100000	100000
TOTAL CONSUMABLES	**-**	**Lump sum**	**200000**	**200000**	**200000**	**222654.5**	**822654.5**
Travel							
Accommodation & travel	-	Lump sum	425000	425000	425000	425000	1700000
Hiring of Field vehicle per month		4 (Lump Sum)	648000	648000	648000	648000	2592000
POL per month		Lump sum	206200	206200	206200	206200	824800
TOTAL TRAVEL			1279200	1279200	1279200	1279200	5116800
TOTAL			**12714200**	**6279200**	**6279200**	**6072855**	**31345455**
Administrative cost (10%)			**1271420**	**627920**	**627920**	**607285**	**31345455**
GRAND TOTAL			**13985620**	**6907120**	**6907120**	**6680140**	**34480000**

Total project outlay of Rs. 3,44,80,000/- (Rupees Three crore Forty Four lakh Eighty Thousand Only), with annual break up of Rs. 1,39,85,620/- for Ist year, Rs. 69,07,120/- for IInd year and Rs. 69,07,120/- for the IIIrd year and 6907120/- for the IV Year.

SPEED POST

GOVERTMENT OF ARUNACHAL PRADESH
OFFICE OF THE PRINCIPAL CHIEF CONSERVATOR OF FORESTS (WL & BD), ITANAGAR.

****

No. CWL/G/173/2018-19/Pt.VII/ 566 - 69 Dated 04 July, 2019

To,

Dr. G.S. Rawat
Dean, Faculty of Wildlife Science, WII
Post Box No. 18, Chandrabani
Dehradun – 248001, Uttarakhand, INDIA
Email: wii @wii.gov.in

Sub:- Permission to carry out field research in A.P. for the project Developing a collaboration management strategy for conservation of tiger Reserve in their habitats in hill ranges of North East India with special reference to Mishmi Hill , Manipur and Nagaland" regarding.

Ref: - Your letter No. WII/ESM/GGV/NETIGERS Dated 27.03.2019

Sir,

With reference to your above mention subject, I am directed to convey the approval of the CWLW under section 12 (b) of the Wildlife (Protection) Act, 1972 (Amended upto 2006) and in pursuance to the guideline issued by the ministry of Env. & Forests, Govt. of India for scientific research in Wildlife Sanctuary/National Park of Arunachal Pradesh.

The permission is governed by the following terms & conditions which are furnished below:-

1. Permission for collecting 3 nos. of specimens from each site / Forested area from the Wildlife Sanctuary/National parks and Protected Areas.
2. The survey will governed by the usual rules and regulations applicable to Wildlife Sanctuary/ National Parks and other forests, under relevant section of the WPA, 1972 (Amended upto 2006) and Assam Forest Regulation Act, 1891 (Amended upto date).
3. Before taking up work, the matter should be informed to the concerned DFO & for his clearance showing the permission order and payment of entry fee and other fees applicable in Sanctuaries & National Parks along with the photocopy of D/D.
4. No fire arms will be allowed inside the wildlife Sanctuary / National Parks and other protected Areas of Arunachal Pradesh.
5. The research will be conducted under the close monitoring of officers/ staff of the concerned DFO.
6. On completion of the work, copies of the report along with soft copies should be submitted to the concerned DFO & this office for future management purpose and records.
7. Prior permission has to be obtained from the CWLW before publication of the report in any Journal(s).
8. Necessary Inner Line Permit in respect of team members/ surveyor/ researchers/ visitors have to be obtained from the competent authority of the area/ District.
9. The copyright of all photographs and literature shall lie vested with the Government of Arunachal Pradesh.
10. No volunteers are to be engaged by the researcher. In case of need of engaging volunteers, necessary indent with terms and conditions are to be given to PCCF (WL & BD) & CWLW and PA manager for further necessary action.
11. The project proponent has to provide the details of project assistant with photographs.
12. A refundable security of 5,000/- only in the form of pledged Demand Draft /NSC pledged to the PCCF (WL & BD) & CWLW, Arunachal Pradesh, Itanagar, is to be deposited to this office before taking up of the survey / research works. After submission of necessary report etc and receipt of NOC from concern DFOs as mentioned above, the same shall be refunded after completion of the survey/ research works. In case of lapse in any of the conditions, the refundable security deposit shall be forfeited to Government and the concern researcher shall not be allowed to take up any further research.
13. The order is valid for a period of 1 (one) years from the date of issue of the letter. Further Extension shall be given after submission of interim report and its evaluation.

This issues with the approval of State Government.

Yours sincerely,

01.07.19

DCF (WL & BD)
O/o the PCCF (WL & BD)
Itanagar.

Copy to:-

Government of Manipur
Office of the Principal Chief Conservator of Forests (Wildlife)
& Chief Wildlife Warden
Imphal: Manipur

No.3/22/2018-WL(Vol-II):/1275 Imphal, the 30th March 2019.

To

The Dean,
Faculty of Wildlife Sciences,
Wildlife Institute of India,
Post Box No.18, Chandrabani,
Dehradun-248001.

Subject:- Permission to carry out field research in Manipur- regarding,

Sir,

Reference is invited to your letter No.WII/ESM/GGV/NETIGERS dt. 18.3.2019 on the above mentioned subject. In this context, I am to inform you that permission under Section 12(b), 27, 28(b), (c) of the Wildlife (Protection) Act 1972 is hereby granted in favour of Dean, Faculty of Wildlife Sciences, WII, Dehradun for carrying out a four year research project entitled **"Developing a collaborative management strategy for conservation of tigers in North East India Component 1: Status and Conservation of Tigers and Their Habitats in Hill Ranges of North East India with special reference to Mishmi Hill, Manipur and Nagaland:"** with particular reference to the following:

1. To carry out the proposed study in the Manipur, State.
2. For collection of scat samples of tigers, co-predators for understanding prey selection and to use in genetic analysis for estimating population size during the study period.
3. Field support in terms of accommodation and camping for the research team, access to departmental records as maps, working plan, management plan, census date etc.

Further, you are requested to include the research work in Senapati District, Manipur, too which is biodiversity rich having potential tiger habitats. This is for your information and necessary action.

Yours faithfully,

(D.J.N. Anand) 30/3/2

Principal Chief Conservator of Forests (Wildlife)
& Chief Wildlife Warden,
Government of Manipur.

GOVERNMENT OF NAGALAND
OFFICE OF THE CHIEF WILDLIFE WARDEN
DEPARTMENT OF ENVIRONMENT, FORESTS & CLIMATE CHANGE
NAGALAND: DIMAPUR

TeleFax: 03862-248067, Email: nagacwlw@yahoo.co.in

No. CWL/GEN/96 (Vol-III)/ 1060 Dated: Dimapur, the 21st November, 2019

To

The Director,
Wildlife Institute of India,
Post Box No. 18, Chandrabani,
Dehradun – 248001, Uttarakhand, India.

Sub: Permission to carry out field research in Nagaland regarding.

I am directed to inform that, in pursuance of the Section 12(b), 27, 28 (b), (c) of the Wild Life (Protection) Act, 1972, permission is hereby granted to Dr. Gopi. G.V, Scientist E, WII, Principal Investigator and co-investigators Dr. S. A. Hussian, Scientist G (WII), Dr. Ruchi Badola, Scientist G (WII), Mr. Nishant Verma, DIGF, NTCA and Dr. Vaibhav Mathur, AIGF, NTCA to carry out study in **"Developing a collaborative management strategy for conservation of tigers in North East India, Component 1: Status and Conservation of Tigers and Their Habitats in Hill Ranges of North East India with special reference to Mishmi Hills, Manipur and Nagaland"**, from December, 2019 to 31st December, 2023 as requested under the terms and conditions enumerated below:.

(i) Permission is given to carry out study in Dimapur and Peren District of Nagaland and Intanki National Park.
(ii) Permission is given for the collection of scat samples of large carnivores during the study period.
(iii) A copy of the research/ study work carried out shall be submitted to this office after completion of the research/ study within a reasonable time.
(iv) The permission is given purely for research/ scientific purpose and not for any commercial use.
(v) Any profit if obtained through this research/ study shall be worked out on the basis of access and benefit sharing mechanism between the institution and Nagaland Government or Communities as the case may be.

(Suman W M Sivachar) IFS
Deputy Conservator of Forests

No. CWL/GEN/96 (Vol-III)/ Dated: Dimapur, the November, 2019

Copy:

1. The Principal Chief Conservator of Forest & Head of Forest Force, Nagaland, Kohima for his kind information.
2. The Deputy Inspector General (NTCA), MoEF & CC, Govt. of India for information.
3. Dr. Gopi. G.V, Scientist E, WII, Principal Investigator and his team for information.
4. The Wildlife Warden, Dimapur/Director, Intanki National Park for information.

Deputy Conservator of Forests

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

G.V.Gopi, Ph.D , Scientist E
Department of Endangered Species Management
Wildlife Institute of India
P.O. Box # 18, Chandrabani
Dehra Dun – 248 001 (Uttarakhand)
gopigv@wii.gov.in