

**Status of Small Carnivores with a Special Focus on Clouded Leopard in  
Makalu-Barun National Park**

**Submitted by**

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## **Abstract**

The study was carried out during January – August 2010 with the help of extensive sign survey, camera trapping and social survey. The total trap night for the whole study period was 1184 days. The effort revealed 7 small carnivores in the national park area and a total of 28 mammal species. Trap nights per photo for Yellow throated marten, leopard cat and masked palm civet was 74, 74 and 132 which is considerably higher than other studies in Asia. Clouded leopard was not camera trapped but we were able to record clouded leopard pelts in the buffer zone area. Asiatic golden cat was recorded after 178 years in Nepal. Barking deer was the most abundant prey species with a capture rate of one photo per 25 trap nights. Himalayan black bear, yellow throated marten and barking deer the top three animals to be involved in human-wildlife conflict. Poaching and wildlife trade was found to be the primary threat for the survival of small carnivores in the area because of the area's proximity to the Tibetan border.

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### **List of acronyms and abbreviations**

MBCA	Makalu-Barun conservation area
MBNP	Makalu-Barun national park
VDCs	Village development committees
RAI	Relative abundance index
ISAs	Intensive Survey Areas

# **1. Introduction**

## **1.1 Background**

The small carnivores are not studied in Nepal compared to the studies conducted to know the status, ecology and population of the bigger carnivores. These species seem to lack charisma associated with species such as tiger and rhino which may have played a role in keeping them far away from the sight of conservationists. This has been the prominent reason why we are not being able to know and understand the status and behavior of the small carnivores. The history of wildlife research is relatively quite new in Nepal. However, it has been fortunate to be home of some of the pioneer wildlife researches in the world such as tiger and snow leopard (Sunquist 1981, Jackson 1996). Yet the attention that was captured by the big mammals didn't do the small carnivores any good as they remain unstudied and the science still has deficient data on these species.

Small carnivores such as small wild cats (I have also included small cats and canids for my purpose), martens, mongooses and civets play very important role as the predators in the mid hills of Nepal. They help in regulating the population of different species such as rodents and other animals. Besides preying on prey species some of these species even feed on fruits and berries. The frugivory habit of yellow throated marten is clearly documented and they are considered to be important potential seed dispersers (Zhou et. al. 2008, Parr and Duckworth 2007, Corlett 1998, Herrera 1989, Willson 1993). Masked palm civet is even looked upon as a harmful pest because of its habit of feeding on cardamom plantations. However, its feces are very valuable as they feed on the edible part of the cardamom seeds and leave the seeds as they were from the body. The resulting seeds are often sold in hefty price (2 times to 5 times the original price).

The conservation status of these species in most parts of the country is very little known. Moreover their status around the world is also not known in a way that helps building strategy for conserving those species. Thus this study focuses on assessing the status of these small carnivores and prepare a baseline for Makalu-Barun national park.

## 2. Objectives

The proposed research work has the following specific objectives

1. Assess the status of the small carnivores in the area
2. Document and rank the threats to the survival of the small carnivores and
3. Make students aware and involve in small carnivores' conservation

### 2.1. Scope of the study

Small carnivores represent over half of all species in the order Carnivora. This diverse group includes over 150 species in 9 families (Ailuridae, Eupleridae, Herpestidae, Mephitidae, Mustelidae, Nandiniidae, Prionodontidae, Procyonidae, and Viverridae; Schipper et al. 2008). Nepal is home to 20 species of small carnivores (Baral and Shah 2008). The list is provided in the table below.

S. No.	Family	Name	Conservation status
1	Herpestidae	Indian grey mongoose <i>Herpestes edwardsi</i>	Least concern
2		Small Indian mongoose <i>Herpestes auropunctatus</i>	Least concern
3		Crab eating mongoose <i>Herpestes urva</i>	Least concern
4	Prionodontidae	Spotted linsang <i>Prionodon pardicolor</i>	Least concern
5	Ailuridae	Red Panda <i>Ailurus fulgens</i>	Vulnerable
6	Mustelidae	Yellow throated marten <i>Martes flavigula</i>	Least concern
7		Beech marten <i>Martes foina</i>	Least concern
8		Yellow bellied weasel <i>Mustella kathiah</i>	Lest concern
9		Mountain weasel <i>Mustella altaica</i>	Near threatened
10		Siberian weasel <i>Mustella sibirica</i>	Least concern
11		Back striped weasel <i>Mustella strigidorsa</i>	Least concern
12		Stoat/Ermine <i>Mustella ermine</i>	Least concern
13		Honey badger <i>Mellivora capensis</i>	Least concern
14		Hog badger <i>Arctonyx collaris</i>	Near threatened
15		Burmese ferret badger <i>Melogale personata</i>	Data deficient

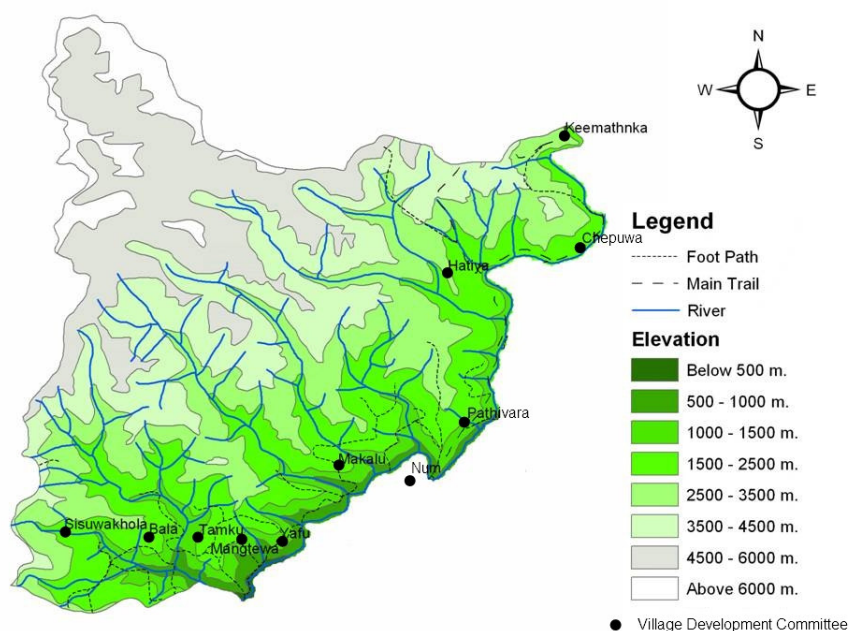
16	Viverridae	Large Indian civet <i>Viverra zibetha</i>	Near threatened
17		Small indian civet <i>Viverra indica</i>	Least concern
18		Masked palm civet <i>Paguma larvata</i>	Least concern
19		Common palm civet <i>Paradoxurus hermaphrodites</i>	Least concern
20		Binturong <i>Arctictis binturong</i>	Vulnerable

**Table 1: Small carnivores found in Nepal (Baral and Shah 2008)**

However the small wild cats and canids were also considered as small carnivores over this study period. Species of cats such as clouded leopard *Neofelis nebulosa*, golden cat *Pardofelis temminckii*, leopard cat *Prionailurus bengalensis*, jungle cat *Felis chaus* and canids such as red fox *Vulpes vulpes*, jackal *Canis aureus*, Indian fox *Vulpes bengalensis* were also brought under the umbrella of small carnivores.

## 2.2 Study Area

The research work was carried out in Makalu-Barun National Park. Makalu-Barun is one of the 16 protected areas of Nepal located in the north-eastern part of Nepal. This PA is the only one in Nepal that is deemed to be the strict nature reserve. Makalu Barun National Park and Buffer zone area (previously conservation area) was established in 1992 with an area of 1500 + 830 sq, km.



**Fig. 1: Map of study area**

Map source: [www.digitalhimalaya.com](http://www.digitalhimalaya.com)



The Makalu-Barun Conservation Area (MBCA), established in 1991 by Dept. of National Parks and Wildlife Conservation, His Majesty's Government Nepal, has been designated as a development-assisted buffer area enhancing conservation efforts within the adjacent Makalu-Barun National Park. An estimated population of approximately 32,000 inhabitants, primarily subsistence agriculturalists, live within the 830 sq. km. of the buffer zone (earlier conservation area). Implementation of the National Park and the MBCA are included in a series of reports and a comprehensive Management Plan (Makalu-Barun Conservation Project Task Force, 1990).

The study area comprises a narrow zone along the upper reaches of the Arun River, inside the national park and even in the buffer zone environs (Fig. 1). The "tropical" valleys of the upper Arun River Basin, referred to as the "world's deepest valley" by Cronin (1979), lie along the bottom of the steep eastern slope of the Everest massif. Although, geographically outside the tropics, this zone is frost free with mean monthly temperature above 18<sup>0</sup>C throughout the year. Average annual precipitation within this region of eastern Nepal generally is high (4000 mm). During the monsoon season (June-September) the tropical zone in the Arun basin receives an average of 1000-2000 mm of precipitation depending upon the location. During the cool season (November-March) precipitation totals are only 20-40 mm (Walter and Leith 1965; Shrestha 1989). However, within the complex mountainous terrain, there is a high spatial and temporal variability associated with the distribution of precipitation. In the dry season (November - March), precipitation is sparse and highly variable, with average monthly precipitation totals below 50 mm. Pre-monsoon drought stress within the tropical zone limits distribution of less tolerant plant species (Singh and Singh, 1987, 1992; Shrestha, 1989).

Stepping up the slopes are a series of vegetation zones starting with tropical sal forest below 1,000 m elevation. Schima-castanopsis forests at 1000-2000 metres. Fir, birch, rhododendron forests in the sub-alpine region i.e. 3000-4000 m, and herbs, grasses and rhododendron/juniper shrubs in the alpine pastures around 4000-5000m.

### 3. Methodology

#### 3.1 Study Design

The entire study area was first delineated into area greater than 3000 metres and area less than 3000 metres. This was done with the help of the topographic sheet of the study area. The area below 3000 meters was visited during the reconnaissance survey. Normal walk was done in order to observe the signs of the carnivores on the trails. The function of sign abundance was used to select the potential trap stations for the intensive camera trapping work. Small carnivores' habitat was directly observed

Habitat type, habitat quality and altitudinal range were the three variables considered during the process of selecting an Intensive Study Area (ISA). Three sampling blocks of area 52, 73 and 47 sq. km. were selected as ISAs. The blocks were Apsuwa valley, Saldim valley and Sisuwa valley, catchments of the Arun river.

Three blocks were selected based on their forest condition and keeping in mind their altitudinal variation. One of the most important criterias was that the study area be lying below 3000 meters. The altitudinal range of the first block was 1500 – 2600 meters and the second block was 2000 – 3300 meters. The last block had an altitudinal variation of 1200 – 3100 meters.

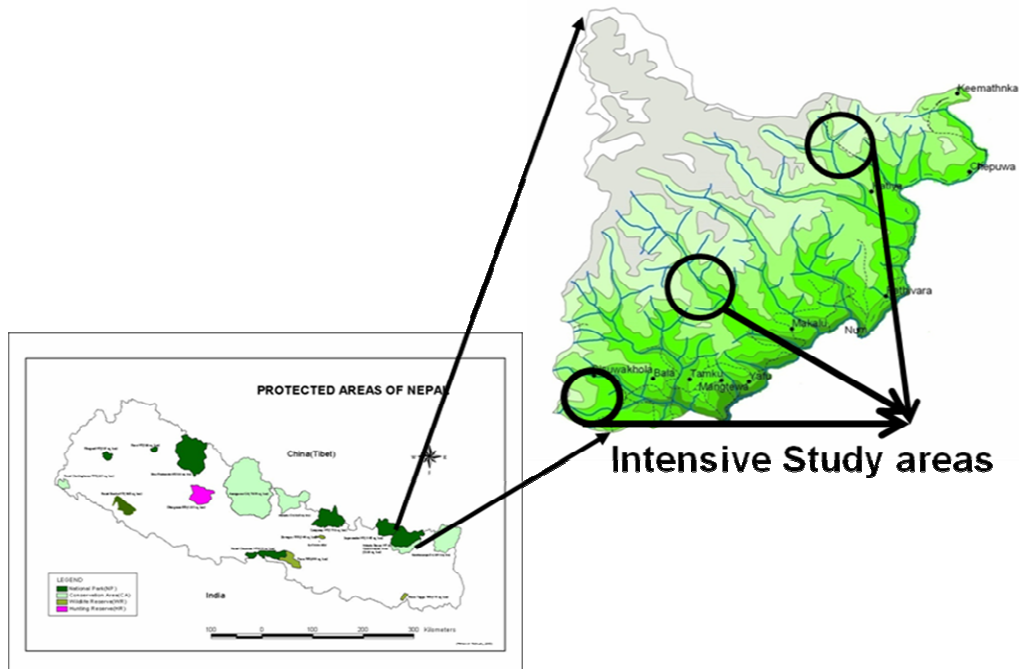


Fig. 2: Intensive study areas

### **3.2 Field Methods**

The primary method followed for completing the study was camera trapping. The cameras used were 1) Sony P32 (Zack Young, Gobble Cams LLC, 601.248.3801) and 2) Reconyx RM45 (RECONYX, Inc. 3828 Creekside Lane, Suite 2, Holmen, Wisconsin 54636). 18 Sony P32 were used whereas 3 units of reconyx RM45 were used. In total 21 camera trap units were used to complete the study.

All the trails in the ISAs were walked upon to look for the signs of the clouded leopard. Transects of different lengths, preferably shorter than 1.5 kms, were laid down in the trails available. 5 meters belt was searched for the scats, pugmarks and other indirect signs of the concerned species. Trap stations were selected based on the sign abundance indicative of frequent activity of the concerned species to maximize the capture probability of the species (Karanth 1995). Habitat characteristics of the site were noted down. The gps point of the trap station was saved in the gps unit (GPS garmin 60CSX, Garmin corp. USA). Camera traps were deployed at all the points. All 21 (18 units for the first survey, 20 for the next two surveys) camera trap units were deployed at the locations where indirect signs such as scats, pugmarks and scrapes were found. The minimum distance between the two consecutive camera traps was kept at 200-500 meters considering the rugged terrain and since small carnivores have small home ranges. Cameras were placed at a height of 50-60 cm depending upon the species targeted. The cameras were monitored regularly to check the batteries and the captured images. The trap units that did not produce any images even after 10 – 12 days of operation were transferred to other locations with a probability of capturing clouded leopard. Any sightings of the small carnivores and their prey species were recorded.

Semi-structured questionnaires were used to acquire the information about the status of the species in the area. Different information such as the threats associated with the survival of the species were collected. Emphasis was given to the informal discussions with the locals. During the informal discussions, different anecdotal evidences were also documented which help in having a general idea regarding the distribution of the species in the area.

### **3.3 Data Analysis**

Data generated from the camera trapping of the animals were first of all collected. Since photographic captures and recaptures were not done during the limited period of the survey as such the population size could not be calculated for any species.

The data was used to simply calculate the capture rate  $[(\text{Species' photos}/\text{Total trap nights}) * 100]$  often used as an index of relative abundance (RAI) defined as the number of days required to obtain a photo-capture of a species (Carbone et al. 2001). This is done to assess the abundance of a particular species in the area. Capture rates of small carnivore species were obtained. Only independent images of a particular species were counted as valid. O'Brien et al. (2003) was referred to define the independence of capture as (1) successive photographs of different individuals of the same or different species, (2) consecutive photographs of individuals of the same species taken more than 0.5 h apart and (3) non-consecutive photos of individuals of the same species. Capture rates from the current study were compared with those obtained from studies in geographically and climatically similar forests in different sites in South-east Asia (Grassman 2003; kawanishi and Sunquist 2004; than Zaw et al. 2008; Datta et. al. 2008; Johnson et. al. 2006). The camera trap images were also used to analyse the activity pattern of some species.

Questionnaire was prepared to extract the information regarding the conservation status and habitat condition of the species. Information regarding human-wildlife conflict was also considered important since conservation status of any species could not be assessed and evaluated. The data collected using the questionnaire was processed with the help of Microsoft excel program.

## 4. Results

### 4.1 Sign survey

Extensive sign survey was done to ensure the maximum capture probability of the target species. The most commonly found signs were the scats. Other signs such as pugmarks and scrapes were extremely difficult to record owing to the presence of excessive leaf litter on the ground. Track plates (Pugmark Impression Pads) were also constructed in some places to monitor whether the small carnivores have movements in the study area as expected or not. The table below presents the signs encountered during the study

S. No.	Species	Scats / Droppings	Pugmarks	Scrapes	Tree marking
1	Himalayan black bear				
2	Asiatic golden cat				
3	Leopard cat				
4	Red fox				
5	Yellow throated marten				
6	Mountain weasel				
7	Siberian weasel????				
8	Masked palm civet				
9	Nepal grey langur				
10	Assamese macaque				
11	Serow				
12	Barking deer				
13	Himalayan tahr				

### 4.2 Camera trapping

The camera traps were placed based on the results of the sign survey, informal discussions and interview with key informants. They were placed basically along the trails following the basic camera trapping methodology.



**Fig. 3: Setting up a camera trap**

Camera trapping was conducted in three sample blocks of area 52, 73 and 47 sq. km. respectively. The total area covered was 172 sq. km. Camera traps were left in the field for 90 nights which resulted in the total of 1184 trap nights.

### **4.3 Species recorded**

Occurrence of species was primarily recorded with the help of camera trapping. The data from the camera trapping were further aided by the sign survey, social survey data, habitat observation, informal discussions, records of pelts and other body parts and rare anecdotal records.

1184 trap nights of sampling effort was put during the whole study period. No images of clouded leopard were captured by any of the 21 camera traps placed at different locations in the study area. Signs such as pugmarks, scent spray was also not encountered. Scats were encountered however the scats need to be taken to the lab for DNA analysis for which there is no facility in Nepal currently. The identification of scat was also difficult as the area is a probable habitat of other sympatric carnivores such as common leopard *Panthera pardus*, marbled cat *Pardofelis marmorata*, leopard cat *Prionailurus bengalensis*, Asiatic golden cat *Catopuma temminckii*, red fox *Vulpes vulpes* and wolf *Canis lupus*.

<b>S. No.</b>	<b>Mammals</b>	<b>Recording media</b>	<b>independent images (I)</b>	<b>Capture rate (I/1184)*100</b>
1	Asiatic golden cat	Camera trapping	1	0.1
2	Himalayan Black Bear	Camera trapping	1	0.1
3	Red fox	Camera trapping	1	0.1
4	Yellow bellied weasel	Camera trapping	1	0.1
5	Siberian weasel	Camera trapping	1	0.1
6	Nepal grey langur	Camera trapping	1 (Troop)	0.1
7	Hoary bellied squirrel	Camera trapping	1	0.1
8	Flying squirrel (unidentified)	Camera trapping	1	0.1
9	Wild Boar	Camera trapping	2	0.17
10	Serow	Camera trapping	2	0.17
11	Orange bellied Himalayan squirrel	Camera trapping; direct observation	2	0.17
12	Himalayan field mouse (probable)	Camera trapping	3	0.29
13	Assamese macaque	Camera trapping	7	0.59
14	Masked palm civet	Camera trapping	9	0.76
15	Yellow throated marten	Camera trapping, Pelt	16	1.35
16	Leopard cat	Camera trapping, Pelt	16	1.35
17	Barking deer	Camera trapping, Direct sighting	48	4.05
18	Clouded leopard	Pelt	5	0.48
19	Jungle cat	Pelt		
20	Black giant squirrel	Pelt		
21	Red giant flying squirrel	Pelt		
22	Orange bellied Himalayan squirrel	Photo (Direct sighting)		
23	Himalayan striped squirrel	Photo (Direct sighting)		
24	Blyth's vole	Photo (Direct sighting)		
25	Himalayan water shrew	Photo (Direct sighting)		
26	Pygmy white toothed shrew	Photo (Direct sighting)		
27	Goral	Direct sighting		
28	Musk deer	Direct sighting		
29	Himalayan tahr	Direct sighting		



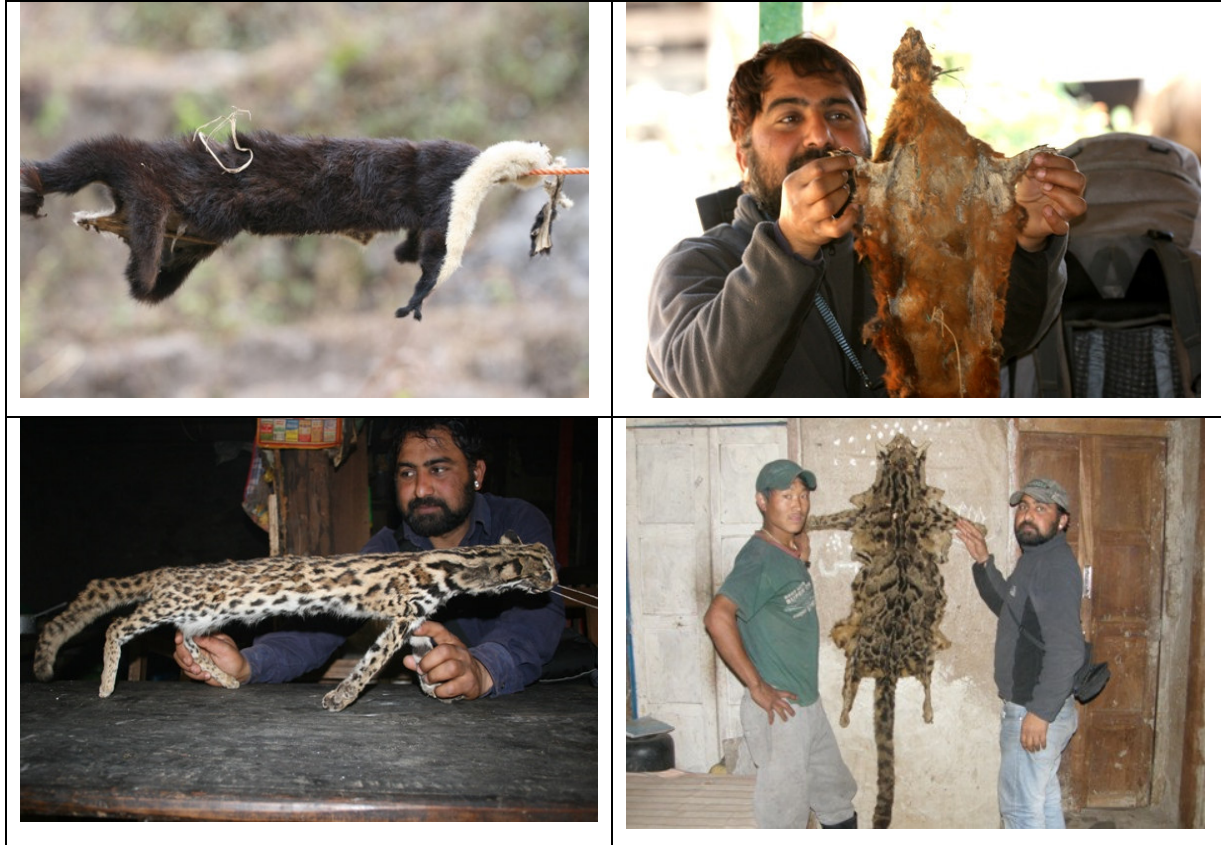
Direct observation of some species was also done. Photos were duly taken whenever it was possible. Prey species were mostly observed rather than the small carnivores, their elusiveness may be the reason behind it.



**Fig 4: The animals directly observed during the study. a) Barking deer *Muntiacus muntjac*, b) Orange bellied Himalayan squirrel *Dremomys lokriah*, c) Yellow throated marten *Martes flavigula* and d) Nepal grey langur *Semnopithecus schistaceus***

Pelts of different species were also recorded from clouded leopard to squirrels. Two pelts of clouded leopard were also recorded from two villages of *Hatiya* and *Chyamthang*. The informal interview with the person in *Hatiya* revealed that the pelt was bought from a man from *Bala* or *Sisuwa* VDC before 8-9 years which lies at the western part of the district. A pelt of black giant squirrel was also recorded in *Num* which is one of the westernmost record for the species.





**Fig. 5: Co-investigator posing with pelts of different animals. 1) Black giant squirrel, 2) Red giant flying squirrel, 3) Leopard cat and 4) Clouded leopard**

### **Conservation awareness**

Awareness workshops were scheduled in this quarter as it was not possible to be conducted in the previous quarter.



**Fig. 6: Awareness camp at Himadri secondary school, Seduwa**

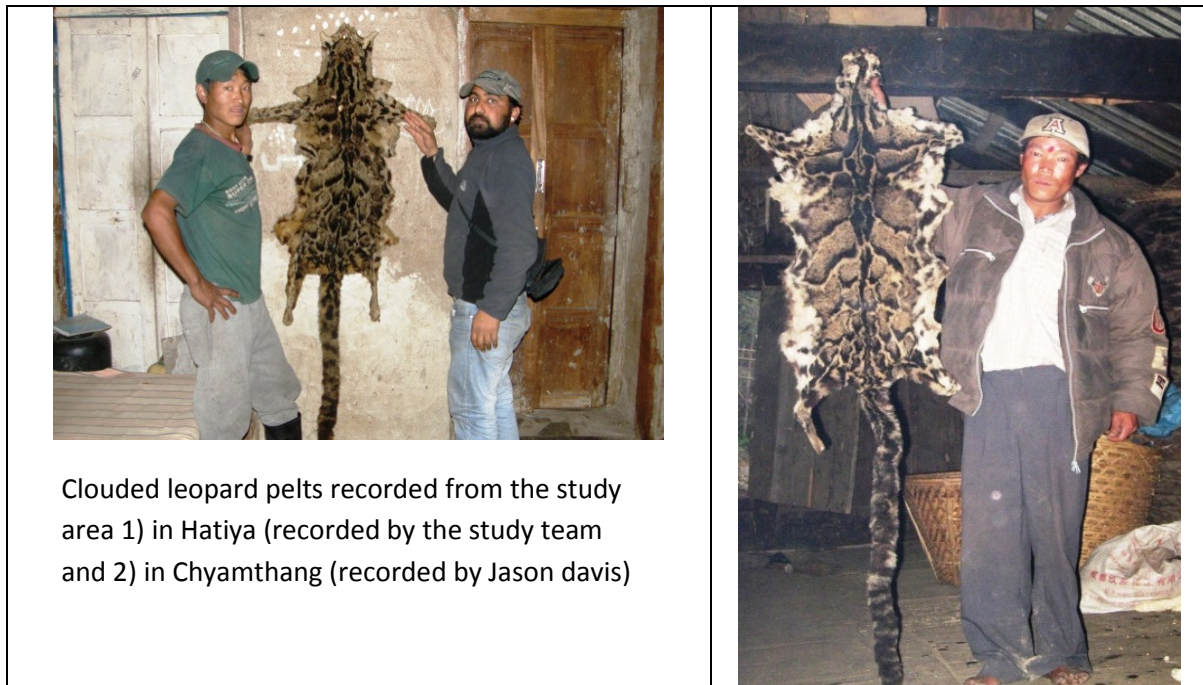
Five awareness programs were conducted in the schools in the buffer zone of the national park whereas three awareness/progress sharing workshop were conducted in the national park office and district headquarters. The details of the programs were conducted in the area are as below

<b>S. No.</b>	<b>Description</b>	<b>Participants</b>	<b>VDC/Municipality</b>	<b>Total number of participants</b>
1	Awareness program	Students of Arunodaya High School (Class IX and X)	Lingam, Chepuwa	60
2	-do-	Students of Sagarmatha Higher Secondary School (Class VIII, IX and X)	Sukrabare, Tamku	61
3	-do-	Students of Hemadri Secondary School (Class IX and X)	Seduwa, Makalu	74
4	Progress sharing and awareness program	Chief Warden, District Forest Officer, Chief District Officer, Local Development Officer, District Education Officer, Deputy Superintendent of Police, Journalists and other stakeholders	Khadbari	34
5	Progress sharing program	Chief warden of NP, Rangers and other staffs of the national park office	Makalu	11
6	Awareness program	Students of Golechaur Higher secondary school (Class IX, X)	Hedangna, Pathibhara	45
7	-do-	Students of Newatar High School (Class X)	Newatar, Sisuwa	35

## 5. Discussion

### 5.1 Presence/absence of Clouded leopard

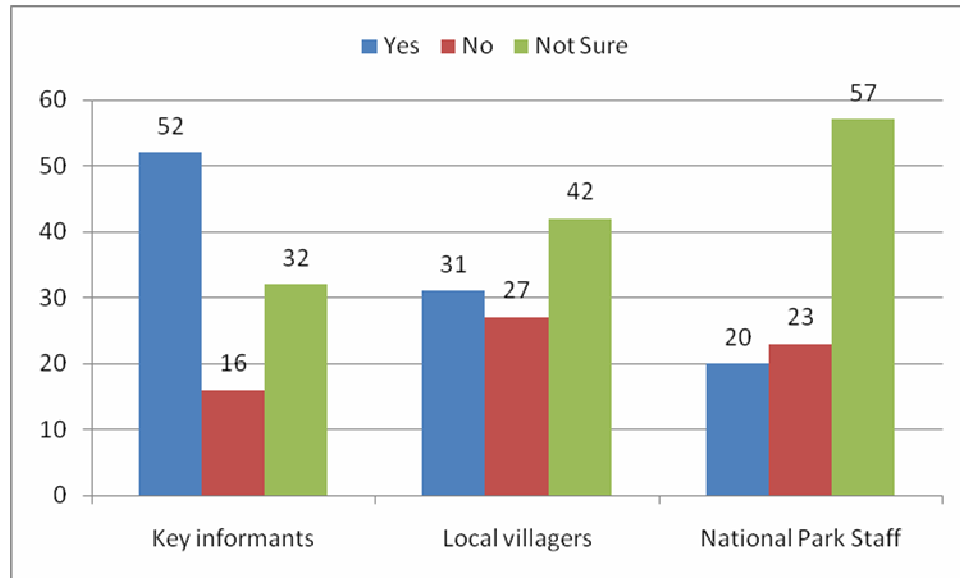
The target species of the study i.e. Clouded leopard was neither camera trapped nor directly observed however literature review shows that the habitat type in the area is suitable to its existence. Signs of the species were also not found in the area. However the pelt of the species was recorded in two different villages in the buffer zone i.e. Hatiya and Chyamthang. The owner of the pelt at one site (Hatiya) says that he bought the pelt from a person from Bala/Sisuwa before 8-9 years. Since the owner was not at home during the time of inquiry the rate of purchase was not known.



Clouded leopard pelts recorded from the study area 1) in Hatiya (recorded by the study team and 2) in Chyamthang (recorded by Jason davis)

**Fig. 7: Clouded leopard pelts encountered in the study area**

Key informants' survey done with previous hunters, poachers, locals and national park staffs points that the species' status is uncertain in the area. The reason for this could be the elusiveness of the species. The owner of another pelt could not be found and met thus the presence/absence of the species in Makalu-Barun national park is inconclusive for now.



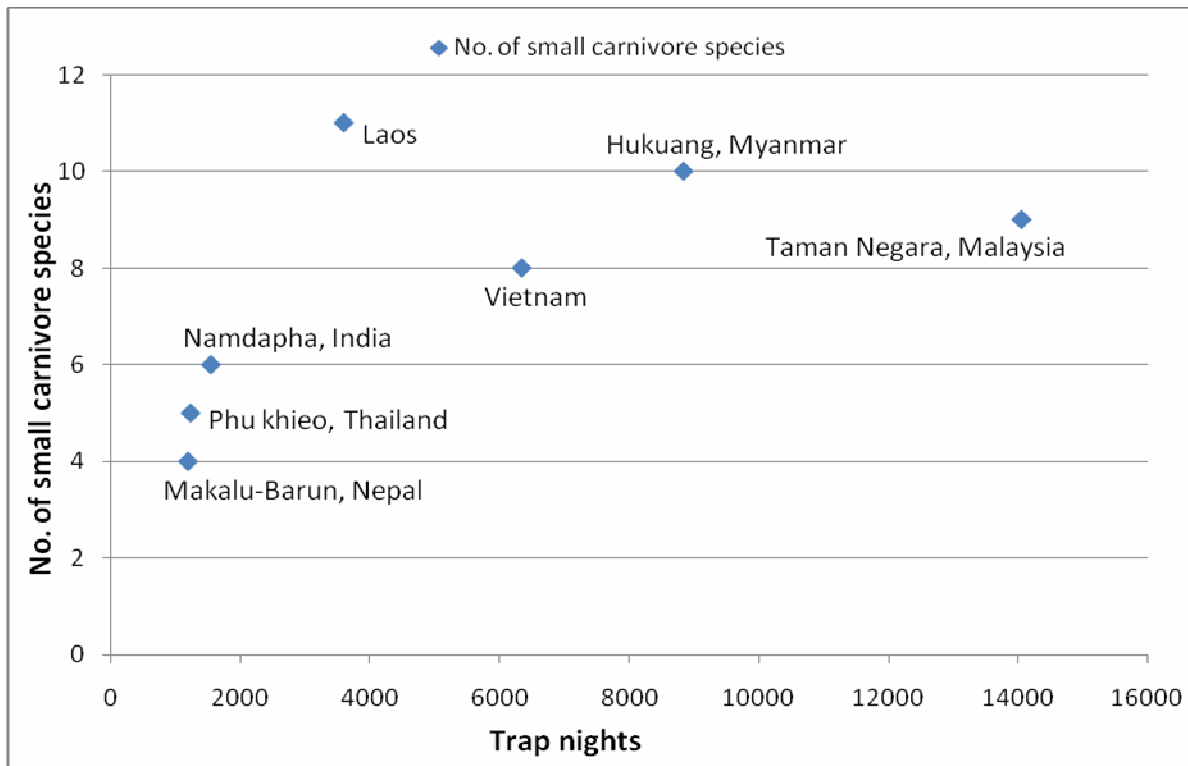
**Fig 8: Clouded leopard's presence in MBNP and buffer zone**

## 5.2 Small carnivore species

Seven species of small carnivores were recorded in Makalu-Barun national park with a sampling effort of 1184 trap nights. The number is small when compared to what has been reported. The park is reported to harbor 12 species of small carnivores excluding one species of Eurasian otter *Lutra lutra* (Baral and Shah 2008).

S. No.	Mammals/Animals Small carnivores	Total images (T)	Independent images (I)	Capture rate (I/1184)*100	Trap nights per photo
1	Yellow throated marten	35	16	1.35	74
2	Leopard cat	16	16	1.35	74
3	Masked palm civet	19	9	0.76	132
4	Yellow bellied weasel	1 (video)	1	0.1	1184
5	Siberian weasel	1 (video)	1	0.1	1184
6	Asiatic golden cat	1	1	0.1	1184
7	Red fox	1	1	0.1	1184

Trap nights per photo for yellow throated marten, leopard cat and masked palm civet is 74, 74 and 132 respectively which is better compared to other studies in Asia (Datta *et. al.* 2008, Grassman 2003, Than zaw *et. al.* 2008).

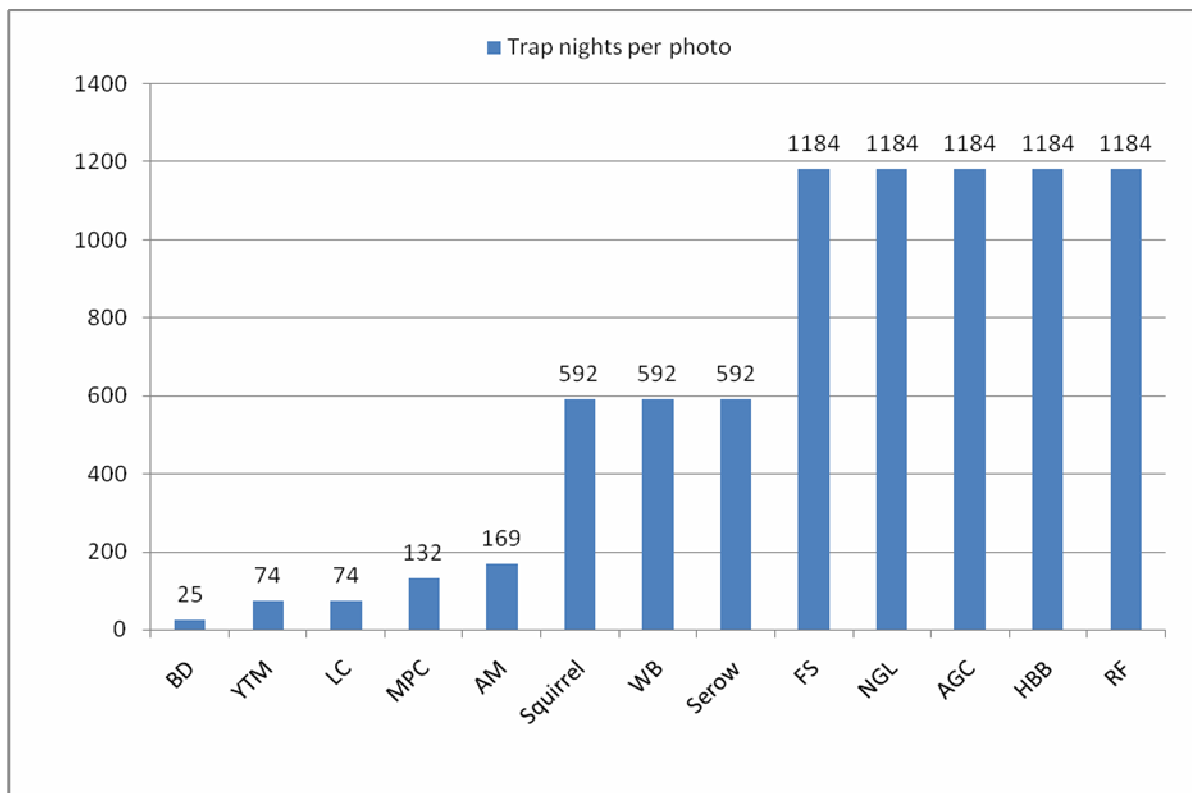


**Fig. 9: Species richness and abundance: comparison with other sites**

From comparisons with other studies, it appears that very high trapping effort is required to capture many small carnivore species in a given area. Datta *et. al.* (2008) recorded four species in Pakke with an effort of only 231 trap-nights while six species were captured in Namdapha with 1,537 trap-nights. In Thailand, with 1,224 trap-nights, only five species were captured (Grassman 2003). In the Hukaung Valley, Myanmar, even after 8,836 trap-nights, only ten species were captured (Than Zaw *et al.* 2008). Only nine small carnivore species were recorded in Malaysia with an effort of 14,054 trap-nights. In all these studies, only about half or much less than half (22–62%) of the total small carnivore species assemblage, predicted to be within the camera-trapped area, were captured. 20% of the predicted species were recorded in Makalu-barun national park which seems normal. Variation in species recorded and capture rates may reflect real differences in abundance among sites but it is difficult to make conclusions.

No information on beech marten, back striped weasel, yellow bellied weasel and mongooses could be captured nor could any information about them be acquired because of the difficulty in knowing their local names.

Anecdotal reports about a bear species were also documented which is smaller and is predominantly arboreal. We thought it to be binturong however no convincing evidences of the species could be found. They used to call the animal as *Rukh bhaalu* in Nepali meaning tree bear.



**Fig. 10: Trap nights per photo for different mammals of the area**

Leopard cat's activity was analysed by recording the time of capture of its individual images. The analysis of 16 images showed the presence of strict nocturnal behavior of the species as all images were captured from 19:12 hours to 03:31 hours. The peak activity period, however, was between 22:00 hours to 02:00 hours which accounted for 71% of the images. Such strict nocturnal behavior of the species in an undisturbed area is difficult to understand. This behavior could be as a result of the disturbance during the monsoon season when Saldim valley gets

crowded because of sheep and yak herders shifting their cattles there. Hunters and poachers' mobility in the area could also be the reason behind such strict nocturnality.

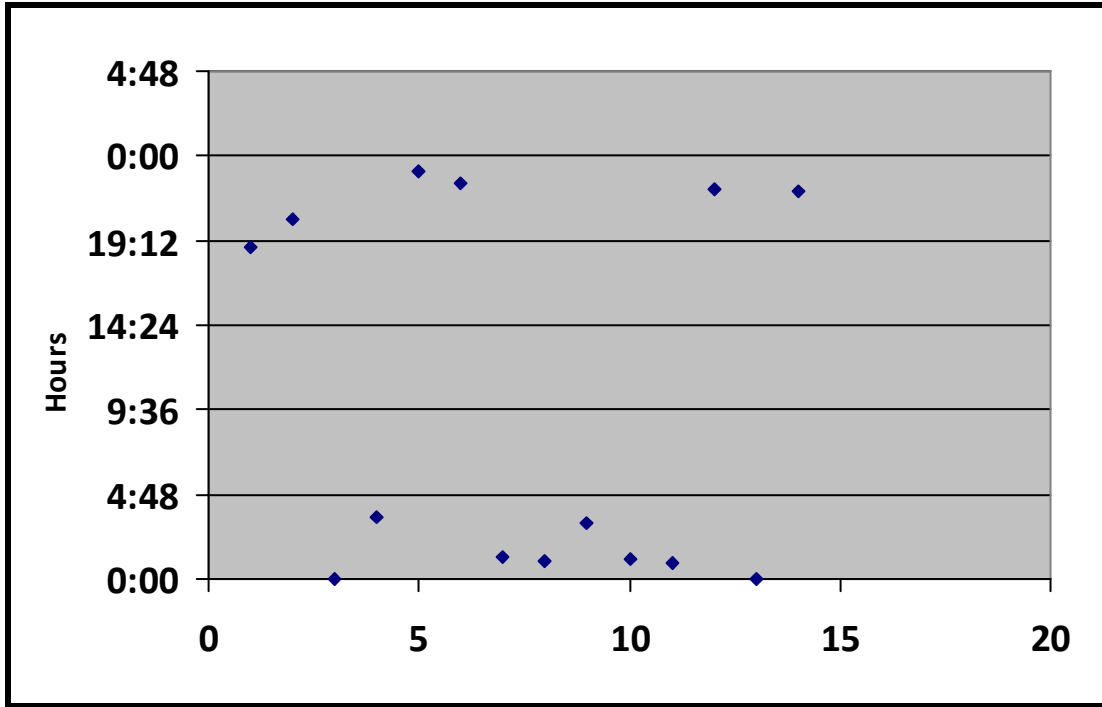


Fig. 11: Activity pattern of leopard cat

### 5.3 Prey species

Prey species varied widely from serow to pheasants and partridges. The most abundant prey species was barking deer with 25 trap nights per photo. Camera trapping methodology was followed for assessing the status of the prey species of clouded leopard. During the study, it was observed that the area is very rich in terms of prey base for the species.

Serial number	Mammals/Animals	independent images	Trap nights per photo
1	Nepal grey langur	1	1184
2	Hoary bellied squirrel	1	1184
3	Orange bellied Himalayan squirrel		
4	Flying squirrel	1	1184
5	Rufous throated partridge	1	1184



6	Hill partridge	1	1184
7	Serow	2	592
8	Squirrel	2	592
9	Satyr tragopan	3	395
10	Kalij pheasant	3	395
11	Impeyan pheasant		
12	Black faced laughing thrush	3	395
13	Assamese monkey	7	169
14	Blue whistling thrush	9	132
15	Barking deer	48	25
16	Pygmy white toothed shrew		
17	Himalayan water shrew		
18	Rat/mice		

## 5.4 Threats

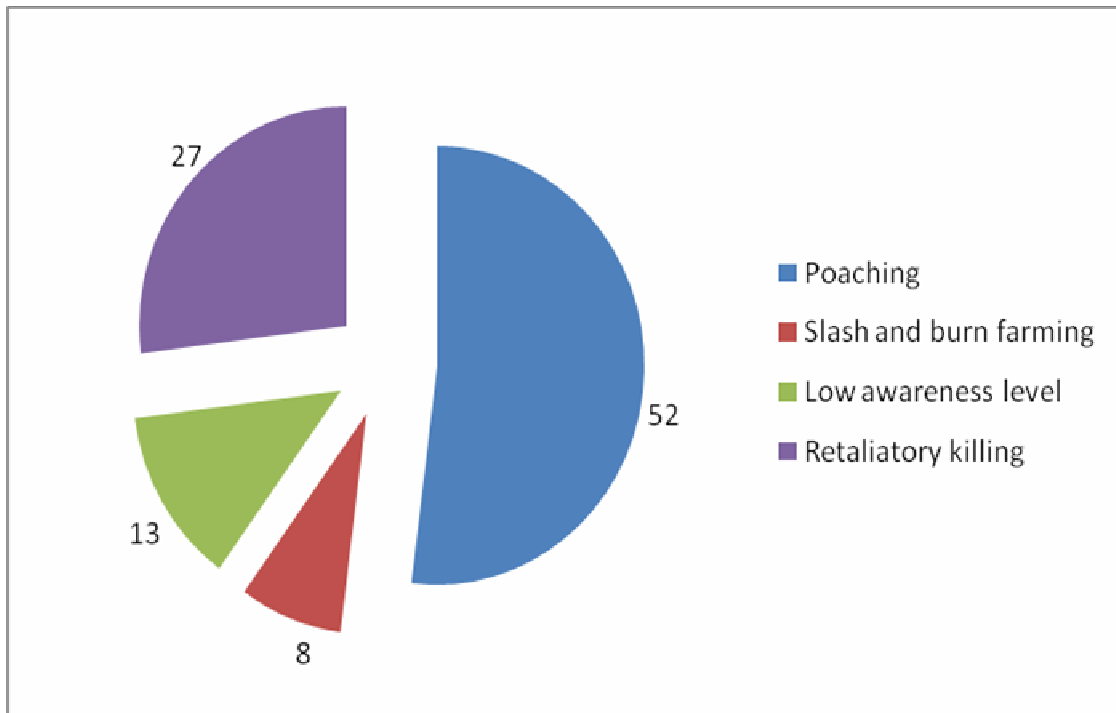
Questionnaire survey was done to document the threats for the species in the area. At the same time, informal discussions and habitat observation were also conducted to have a close view at the species' habitat quality. Informal discussion with the locals was also done to get assess and evaluate the threats to the species under concern. During our time in the field only, three red panda and a musk deer were brutally slaughtered (Personal communication with Jason davis, USA). The threats for the survival of the species is provided in prioritized form in the table below

S. No.	Threats	Intensity
1	Hunting/poaching for illegal wildlife trade	Very High
2	Human wildlife conflict	High
3	Low level of conservation awareness among locals	High
4	Slash and burn farming	Moderate

**Fig. 12: Most damaging animals as perceived by respondents**

The resulting graph shows as follows

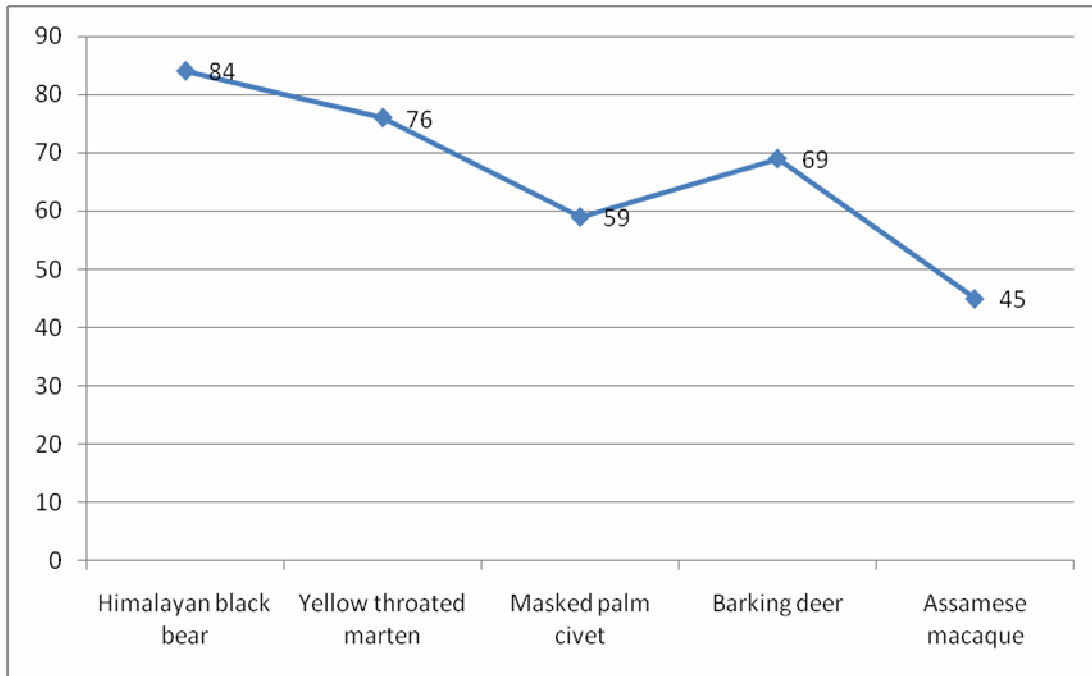




**Fig. 13: Threat ranking on percentage basis**

Hunting is a major threat to the survival of many species in the area including the clouded leopard. The Shingsawa tribe has originally migrated from Tibet. They inhabit the northern part of the park and has coexisted with the park area since long way back.

Human-Wildlife conflict is also a major threat as shown by the questionnaire survey. Different animals were found to be harmful to the residents in the buffer zone. Questionnaire survey about the most damaging animals shows that Himalayan black bear tops the poll with 84% of people not happy with its indulgence in crop depredation. Yellow throated marten is close second with 76%. Barking deer, masked palm civet and Assamese macaque were also found to be involved in the conflict.



**Fig. 13: Animals most responsible for human-wildlife conflict**

The other threats include slash and burn farming which is very prevalent in the area. Many households engage in slash and burn practices in the form of rotational agro-forestry in order to supplement the food supply from rainfed fields, and for almost half of households, slash and burn agro-forestry makes up approximately 55% of their agricultural landholdings. Earlier, the rotation cycle of the slash and burn farming was large thus enabling the soil to regain the nutrients but we found, upon enquiring, that the rotation cycle is slowly decreasing which could pose a potent future threat. Rotation cycle for slash and burn farming used to be as long as 20 years as per communication with the locals in the study area. With an increased population, the cycle now has come down to almost 5-7 years in some parts of the buffer zone.

## 6. Conclusion

The study was carried out for a period of one and a half year in Makalu-Barun national park. The list of the mammals prepared from previous visits and studies were mostly based on infrequent sightings and some anecdotal records.

The study has revealed an average density of small carnivores and of mammals as a whole in the area. The list of mammals generated by the study will serve as a baseline for the future research works in the area. A total of 28 mammal species were recorded during the sampling effort of 1184 trap nights of which 7 were small carnivore species (Asiatic golden cat, leopard cat, jungle cat, red fox, yellow throated marten, masked palm civet, mountain weasel, Siberian weasel). The density of small carnivores is not very high compared to the other studies conducted in South-east Asia (Datta et. al. 2008, Than Zaw et. al. 2008, Kawanishi and Sunquist 2002) but not low either since the sampling effort was not very large. Moreover, the trap nights per photo for leopard cat, yellow throated marten and masked palm civet were highest in south asia (Datta et. al. 2008, Than Zaw et. al. 2008, Kawanishi and Sunquist 2004; Grassman 2003) at 74, 74 and 132 respectively. The abundance of the three species could thus be concluded high in the study area.

Abundance of prey species (as a result of camera trapping) cannot be said high except barking deer which has the highest capture rate (25 trap nights/photo) among mammals. However, direct sightings of different species (Squirrels, flying squirrels, rats, mice) of the order *Rodentia* during the field work cannot be neglected. Different species of birds (kalij pheasant, hill partridge, satyr tragopan, blue whistling thrush) were also camera trapped and their call heard which are good enough evidences of healthy prey density for the small carnivores in the area.

Threats of different magnitude and extent, however, exist in the area that directly and indirectly threaten the small carnivores' survival in the study area. The contact with businessmen and poachers and response from the locals and park staffs corroborates that the illegal wildlife hunting and trade is the biggest threat in the area. The problem is further aggravated due to very near international border to Tibet. Retaliatory killing is also a big threat as shown by the study which can only be tackled if a properly streamlined and reliable process of compensation can be formulated and implemented.

The low level of conservation awareness of the local people regarding the benefits of species' conservation is also a problem that needs to be addressed. The study team came across two incidents of intentional killing but of the wrong animal. In Barun bazaar, a lady was pointing at a leopard cat's pelt hanging in her house and told that it is a *Kaalaa* (Civet) which destroys their cardamom plantation. Another incident involved black giant squirrel which was killed by a boy in Num thinking it to be a *Kaalaa* only as it was on their cardamom field.

The study also recorded one species i.e. Asiatic golden cat whose presence was new to the area. However, the camera trapping effort of 1184 days was just enough only to get one image of the species.

## **7. Recommendations**

### **7.1 Strict enforcement of the laws and policies in place**

National Park and Wildlife Conservation Act 1973 (NPWC Act) has strict and stern policies in place that has been formulated to address the problem of illegal wildlife hunting, poaching and trade. These include punishment that orders 5 years to 15 years imprisonment or 50,000 NPR to 100,000 NPR or both for poaching of animals on the protected list or keeping their body parts. Besides, illegal killing of other animals which are not included in the schedule 10 of NPWC Act 1973 also deserve punishment of various degree depending upon the animal. However these are not enforced strictly which has encouraged the poachers to operate freely even in the protected areas. During the visit to the different places inside the park different signs of the presence and operation of the poachers were observed and recorded. The interaction with the park officials and other people inside the park corroborate the evidences. However, easily said than done, every sector office of the park needs to have full staff placement before such actions can be effectively and efficiently taken.

### **7.2 Long term camera trapping studies inside the park**

Researches would help in generating useful baseline data on the conservation status, behavior and other aspects of wildlife of an area. However, researches done irregularly would not help in the long term conservation of species in the area. As such the national park must device a mechanism by which it can itself conduct long term camera trapping and behavioral studies inside the park. The area, being one of the least explored protected areas, is virtually unknown in terms of its biological diversity. Co-ordination with NGOs, INGOs, universities working in the field of wildlife research and conservation for such study would be a great start.

### **7.3 Regular patrolling inside the park area**

Primary source of income of the buffer zone residents is cattle rearing. As such they bring large herds of sheep and yak inside the park area during monsoon. This period is pretty critical as more humans will be entering the park. Moreover, the people would conduct different activities (both legal and illegal) that will pose serious threats to the otherwise pristine environment. Thus park

staffs must patrol the park area regularly to monitor the activities of the sheep and yak herders during the monsoon season. This will also help in overturning poachers' intention of encroaching the area for their purpose.

#### **7.4 Compensation scheme must be monitored carefully**

The national parliament has recently passed a bill that speaks about the compensation scheme for the loss incurred to the villagers by the animals included in the protected list of the National Park and Wildlife Conservation Act, 1973. The compensation scheme will, hopefully, help to reduce the human-wildlife conflict in and around the park. However, the national park staff must make sure that the scheme is monitored carefully.

#### **7.5 Saldim valley must be declared a strict nature reserve**

Saldim valley inside the national park is a very important site in terms of the richness of biological diversity. Its location (3200 masl) is strategic in terms of the transition between temperate and sub-alpine environment. The movement of animals higher up during the summer season and lower during the winter makes it a common ground for a large number of species. But the encroachment by the herders in the monsoon season and by businessmen and poachers is evident in the area. One camera trap unit of the study team was also lost in the area. It is very unusual to lose a unit in otherwise such an undisturbed area if there is no disturbance from poachers. To maintain its pristineness the national park must declare it a strict nature reserve except for very important wildlife research purpose under tight supervision and monitoring.

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