

**STATUS, DISTRIBUTION, BEHAVIOR AND CONSERVATION OF  
PANGOLINS IN PRIVATE AND COMMUNITY FORESTS OF BALTHALI  
IN KAVRE, NEPAL**



**TULSHI LAXMI SUWAL  
T.U. REGISTRATION NO.: 2352-92  
EXAMINATION NO.:346  
BATCH NO.:2063/64**

**A THESIS SUBMITTED IN PARTIAL FULLFILMENT OF THE  
REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE  
CENTRAL DEPARTMENT OF ZOOLOGY-ECOLOGY PROGRAM  
INSTITUTE OF SCIENCE AND TECHNOLOGY  
TRIBHUVAN UNIVERSITY  
KATHMANDU, NEPAL**

**2011**

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## DECLARATION

I, hereby, declare that the work presented in this thesis entitled “**STATUS, DISTRIBUTION, BEHAVIOR AND CONSERVATION OF PANGOLIN IN PRIVATE AND COMMUNITY FORESTS OF BALTHALI IN KAVRE DISTRICT, NEPAL**” was carried out by me and has not been submitted anywhere for the award of any degree. All sources of informations have been specially acknowledged in the references to the authors or institutions to whom they belong.

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**RECOMMENDATION**

It is my pleasure to mention that Mrs. Tulshi Laxmi Suwal has completed the thesis entitled “**STATUS, DISTRIBUTION, BEHAVIOR AND CONSERVATION OF PANGOLIN IN PRIVATE AND COMMUNITY FORESTS OF BALTHALI IN KAVRE DISTRICT, NEPAL**” under my supervision and guidance. To the best of my knowledge, this thesis has not been submitted for any other degree.

I recommend that the thesis be accepted for the partial fulfillment of the requirements for the degree of Master of Science in Zoology specializing in Ecology.

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**ACCEPTANCE**

This thesis submitted by Tulshi Laxmi Suwal, entitled “**STATUS, DISTRIBUTION, BEHAVIOR AND CONSERVATION OF PANGOLIN IN PRIVATE AND COMMUNITY FORESTS OF BALTHALI IN KAVRE DISTRICT, NEPAL**”, has been accepted for the partial fulfillment of the requirements for the degree of Master of Science in Zoology specializing in Ecology.

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## ABSTRACT

The pangolin is one of the strangest small mammals with some typical morphological characteristics which survive on highly specialized diets of ants and termites. Although the pangolin is protected by National Parks and Wildlife Conservation Act 1973, and also internationally enlisted in the list of Appendix – II of CITES and mentioned as a threatened species in IUCN Red Data Book, detailed biological information is lacking in Nepal. This study was conducted from the month of April 2008 to August 2009 in community and private forests of Balthali, Kavre with the main objectives of investigating status, distribution, behavior, and threats of the species. A literature survey and GIS analysis has explored the status and distribution of the species in local and global scales. Population density was estimated using three plots and total covering area was 19.5 hectare in different altitudes. The average density of burrows (average diameter 18cm and depth 90 -115 cm) was 8/hectare. They were significantly associated with plots ( $\chi^2 >29.42$ ,  $df=2$ ,  $P<0.05$ ) and aspect ( $\chi^2 >90.84$ ,  $df=3$   $P<0.05$ ) but not with soil types ( $t=1.16$ ,  $df=2$   $P>0.05$ ). The highest number of burrows was recorded from 1500-1550m with *Pinus*, *Alnus* and *Betula* dominating habitats. Captive observation of a pangolin mother and her baby in the Central Zoo and lab for a week showed that they were active for 5-6 hours during a 24-hour period. The main activities were walking (45%), rolling and resting (14%), and feeding and weaning (12%) at nights and rolling and resting (58%) and walking (17%) during the day. The mother ate eggs besides insects and termites and exhibited unique maternal care. Poaching, grazing, deforestation, mining, fire and developmental activities were the major threats to pangolins. Recommendation from this study include: a further scientific research on ecology of pangolin, develop awareness programs among the local people and increase their involvement in controlling, poaching and conservation activities and reward those who help in such activities for the long term conservation of pangolin.

## ACKNOWLEDGEMENTS

My sincere thanks and deep respect goes to my academic supervisor Prof. Dr. Khadga Basnet, the Central Department of Zoology, Tribhuvan University for his perpetual advice, continuous supervision, and valuable inspiration throughout the study period.

I would also like to thank sincerely to Prof. Dr. Ranjana Gupta, Head of the Central Department of Zoology and other respected teachers and staffs of Department for their encouragement and academic support. I am highly obliged to Associate Prof. Mr. Paras Mani Acharya, Assistant Campus Chief of Patan Multiple Campus for his valuable suggestion and encouragement.

I am very grateful to the Department of Forests and Department of National Parks and Wildlife Conservation granted me permission to initiate the study on pangolin in the forest of Bhaktapur and Kavre Districts and other valuable suggestions. I am also indebted to Metropolitan Police Sector, Jagati, Bhaktapur and Journalists of different media persons which makes the people conscious on pangolin.

I express my gratitude Mrs. Sarita Jnawali, Director of the Central Zoo for encouragement and providing me opportunity to study captive behaviors of pangolins. I am equally thankful to Mr. Radha Krishna Gharti Veterinary Assistant and all staff of Central Zoo for helping me in the captive behavioral study. I am greatly indebted to Joe JC Guo, Veterinary doctor of Taipei Zoo for providing online relevant information on pangolin and suggestions.

I would like to express my special thanks to Mr. Nhuchhe Krishna Shrestha Assistant ranger of Suryabinakya Rangepost and also to Mr. Dipendra Thapa, Miss Sangita Tamang and Mr. Gopal Tamang, who enthusiastically participated and cooperated in the field survey and made my field work possible. I owe my gratitude to Mr. Madan Suwal, Rameshwor Kaphle, Chandeswori Kawya and Swornima Shrestha for helping me in the field survey.

I would like to express my respect to my family members for their inspiration, continuous encouragement and support in each and every step of my study during the period.

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# 1. INTRODUCTION

## 1.1 General Background

The pangolins are small mammals native to Asia and Africa. The word “pangolin” is a French origin derived from Malayan phrase, "Pen gulling” belonging to the animal ability to curl up into a ball. The pangolins are commonly known as the scaly anteaters due to their structure and food habits. They are popularly known as *Salak* in Nepal, although different communities have local names like *keyn neyan*(केइया) in Newari and *Ghose* in Tamang. Similarly in India, pangolins are known by different names in different places, such as *Basrakit* - Haryana, *Silu* - Madhya Pradesh, *Sal sala* - Uttaranchal, *Chalo*, *Pingaroo*, *Shalma* etc in Gujrat and in parts of Maharashtra as *Hochik* and *Salak* in Assam and North - Eastern states (Chakroborty et al. 2002).

There are altogether seven - species of pangolins included in the single order - pholidota, family - Manidae and Genus - Manis. The word pholidota is derived from Greek, pholis or pholidos, which means the animals, have horny scales and the words Manidae and Manis also came from Latin manes, which means the spirit of the dead or ghost because of their nocturnal habits. Among the seven species of pangolin, four species such as Giant pangolin *Manis gigantea*, Ground pangolin *Manis temminckii*, Long tailed pangolin *Manis tetradactyla* and Tree pangolin *Manis tricuspis* are African pangolins and the remaining three species include the Chinese pangolin *Manis pentadactyla*, Indian pangolin *Manis crassicaudata* and Sunda pangolin *Manis javanica* which are all Asiatic pangolins. All three species of Asiatic pangolins and one African species *Manis temminckii* which seem alike to the *Manis pentadactyla* are classified as lower risk: or near threatened by IUCN and Appendix - II of CITES (Neely 1988).

## 1.2 Pangolins in Nepal

Nepal lies on the transition zone of the Oriental and Palearctic regions. Among three species of Asian pangolins, two species such as Chinese pangolin *Manis pentadactyla* (Linnaeus, 1758) and Indian pangolin *Manis crassicaudata*( Gray, 1827) are found in Nepal (Shrestha 1981) .The differences between Chinese and Indian pangolins are shown in table -1.

Table 1. Differences between Chinese and Indian Pangolins

S.N.	Chinese pangolin	Indian pangolin
1	Prefers sub-tropical regions (1000 m- 2000 m).	Prefers tropical regions ( Below 1000 m).
2	Smaller (Length:70-100 cm) in size and weight (2-8 kg).	Bigger than Chinese pangolin in size (Length:100-120 cm ) and weight (8-9 kg).
3	External ears are well developed.	External ears are not well developed in as Chinese pangolin .
4	Scales are in rows of 15-18 in middle part of the body.	Scales are in rows of 11-13 in middle part of the body.
5	The color of scales are dark brown.	The color of scales are Yellowish brown.

Source: Chakraborty et al. 2002

### 1.3 The Pangolin

#### 1.3.1 Physical Characteristics

The pangolins are strange reptilian - looking animals distinct from all other old world mammals by their unique covering of Horny body scales. They have small, smooth and tapered heads. The eyes are small with no lubricating glands for eyelids. The nose is fleshy and has nostrils. Depending on the species, the exterior ears may be reduced in size or be totally absent. They are edentate, that is, without teeth and they use their tongue for foraging. The tongue is a long and worm - like organ and the salivary glands supply the tongue, a tacky coating of saliva to which the insects get stuck. They possess small, short but powerful limbs, and each is tipped with sharp, clawed digits with the middle digit being the largest. Their powerful fore feet have large digging claws, while the shorter hind feet contain smaller claws. The limbs are used for digging into the termite mounds and anthills. They have prehensile or semi-prehensile tails that help to maintain balance during movements and they keep their body in a curved position.

Pangolins are a similar shape to armadillos and anteaters. The Asian species are more specialized than Africans because of the presence of 3 - 5 hairs at the base of each scale, and the row of scales is continuous upto the tail, but in African species, there are no hairs at the base of the scales and a double row of scales on the tail (Chao 2001).

### **1.3.2 Habit and Habitat**

Pangolins live in diverse habitats including tropical rainforests, subtropical and deciduous open forests, grasslands, thick bush, as wooded shrubby slopes and steeps. In the context of Nepal, Pangolins are found in open grasslands, re-forested coniferous forests, bamboo forests, thorny bushes, agricultural fields, corn and soya bean cultivated lands and in the steep slopes as well as near the human settlements. They are also recorded at soft rocky hills (present study). The habitats of pangolins are mostly found on red and brown type of soil where their food-ants and termites, are available.

### **1.3.3 Feeding Ecology and Diet**

Pangolins are insectivorous animals that specialize to feed on ant and termites. They prefer polyrhachis ant to crematogaster ants (Chao 2001). Due to their lack of teeth, they tear open anthills or termite mounds with their powerful front claws and probe deep into them with their very long tongue. Ants stick on their tongues due to the presence of ant -catching saliva. Pangolins drink water regularly, lapping it up with their tongues in a flicking motion.

### **1.3.4 Social Behavior**

Pangolins are generally unsociable creatures. All species of pangolins except *Manis tetradactyla* are nocturnal and sleep in burrows during the day. They have poor vision, but have sharp sense of smell which helps them to find food and intra specific communication. They are slow and deliberate movers with hissing and snorting sounds and most of them are able to climb and swim. They dig a hole to deposit urine and faeces and then cover it with earth as well as mark their territories with droppings (Fang and Wang 1980). When they feel threatened or frightened they roll up into a tight ball to hide or protect their sensitive snout, which is not covered by scales and at the same time, they erect their bristle scales as protective armor. They also emit bad smelling secretion from their anal glands and urine, which announces to neighboring and trespassing animals that the area is already occupied, and this makes the enemies run away from them.

### **1.3.5 Reproduction Biology**

Little is known about the reproduction pattern of pangolins. The reproduction biology is only observed in captivity so that, sexual maturity, mating behaviors gestation period and lactation period of pangolins are still unknown. But Yang et al. (2007) estimate the gestation period of *Manis pentadactyla* to be 169 + days and fecundity rate to be fairly low. They usually give birth to one offspring but also there are observed case of birth of 2 to 3 offsprings . Nowak (1991), Donald (2006) and Yang et al. (2007) observed the reproduction biology of *Manis pentadactyla* in Taiwan at Taipei Zoo. They found that the sexual maturity was two of years, mating in captive was during May and June. Gestation period lasted about 2 - 3 months. During the observation they found that the birth of young *Manis pentadactyla* took place in February.

*Manis pentadactyla* gave birth to an offspring in February 2007 in Central Zoo, Nepal (Personal communication, Sarita Jnawali May 5, 2009). It was 0.45 kg in weight and its length was 26 cm. at birth but, died after one month. I also found a female *M. pentadactyla* with a male baby in 3<sup>rd</sup> of May 2009 with 1.395 kg in weight and 60 cm in length during my field visit to Kavre. I studied detailed biology, feeding ecology, behavior as well as parental care of pangolins. The scales of baby pangolin were light brown in colour. They were soft and not so bristly sharper like the mother's, but the number of scales was nearly equal throughout the body.

Every animal loves their child more than themselves. Pangolins are also good parents that take care of their babies and wean like other mammals. They give to care their babies until five months of age and weaning period is about three months, (Payne and Francis 1998). The baby pangolin is able to move over the body of the mother after it is born (Central Zoo 2007). I have also observed parental care of pangolin in captivity, weaning to the baby was 5 - 8 times per day. The baby makes short excursion with the mother, riding at the base of tail or on the back and grabbing on to the scales. While sleeping and being alarmed, the mother rolls up around the young, which also rolls up into a light ball.

### **1.4 Geographical Distribution**

Research on pangolin is limited and the current status and distribution of them is unclear. Chinese pangolins are distributed in Nepal, India, China, Bangladesh, Lao

PDR, Myanmar, Taiwan, Thailand and Vietnam, where as Indian pangolins are distributed in Nepal, India, Pakistan, Bangladesh, Srilanka and Myanmar (WCMC 1999).

In the context of geographical range, Indian pangolins are distributed in Bara, Parsa, Chitawan (Suwal and Verhugt 1995). Chinese pangolins are distributed in Taplejung, Illam, Panchthar, Sindhuli, Ramechhap, Paunauti, Annapurna conservation Area, Makalu - Barun conservation Area, Nagarjun, Sundarijal, Barabise and Baglung (Shrestha 1981). They are also distributed in different places of Bhaktapur and Kavrepalanchok as well as in Dhading (Suwal 2008). Pangolins are also reported from various places of Kathmandu such as Sitapaila, Phutung, Ichangu, New Baneshwor, Imadol, Kirtipur, Lalitpur, Dillibazar, Gyaneshor, Jawalakhel, Taudaha and Naikap (Central Zoo 2009).

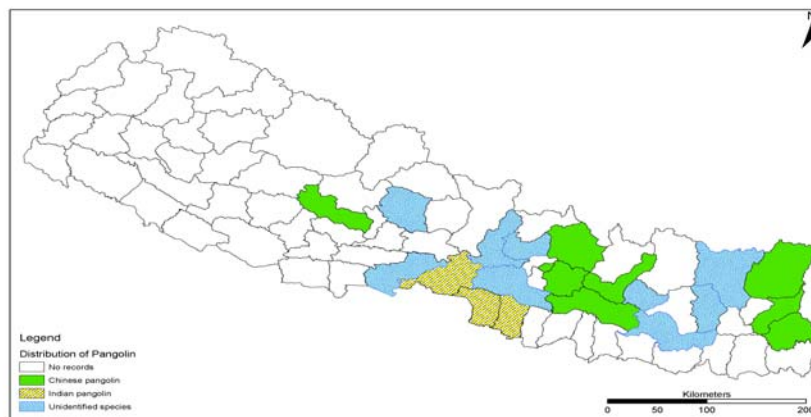


Figure 1. Distribution of pangolin in geographical range of Nepal



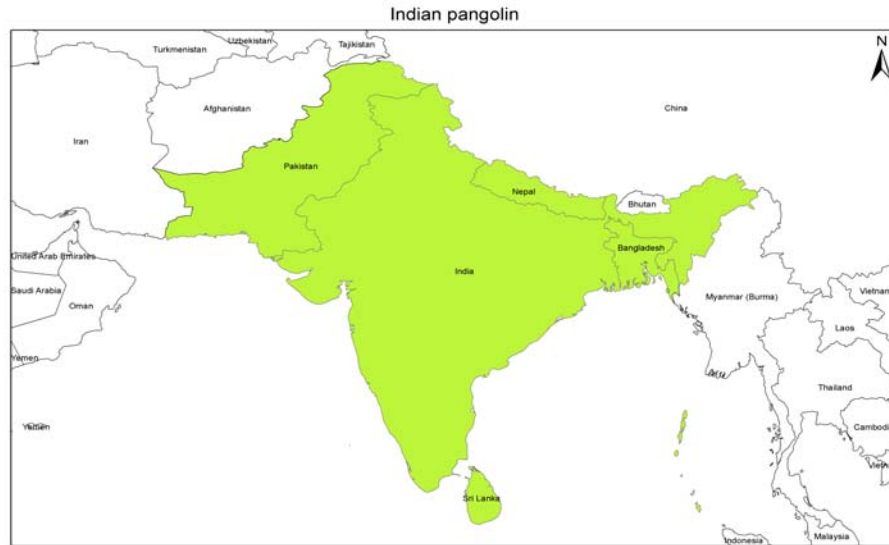


Figure 2. Global Distribution of Chinese and Indian Pangolin

## 5 Objectives

The main objective of this study was to collect and develop baseline ecological data on pangolin. Specific objectives were:

- a) To explore the morphometrical characteristics and behavior of pangolins
- b) To investigate population status and distribution patterns
- c) To identify the conservation threats.

### 1.6 Rationale of the Study

Wildlife in general is threatened by the loss of habitat brought about by the encroachment of ever - burgeoning human population. Many studies have been carried out on big mammals like tiger, rhinoceros and elephant, but the study of small mammals like pangolins seem to be overshadowed. Information on pangolins about their habits, habitats, and distribution and conservation status is very limited in Nepal.

The scaly anteater, pangolins are enlisted in the protected list of National Parks and Wildlife Conservation Act 1973, although they are widely distributed throughout the country and most of the local people are familiar with them. Due to lack of knowledge and information, local people hunt, poach and trade the pangolins. So, this study is designed to explore and fulfill the information gap and identify the conservation threats that will be helpful in developing conservation strategies.

## 2. LITERATURE REVIEW

### 2.1 Habit and Habitat Utilization.

Gurung (1996) conducted pangolin survey in the protected Royal Nagarjun Forest during January 1-7 and found fifty old burrows along a four kilometer distance in Raniban. He had observed six new, and ten old burrows close to human settlements above the Ratamata, and mostly in the grasslands where the dominant species were *Imperata cylindrica* and *Gleichemia fern* species. He had found the burrows to be 21 - 23 cm in diameter and about 2 m in depth. He had noted the similarities in pangolins' habitat in Nagarjun with the reports from Tumlingtar of Sankhuwasabha in eastern Nepal, Chainpur of Dhading, and Balephi of Sindhupalchok district. He found a close relationship between the red soil and burrow distribution.

Shrestha (2005) studied on pangolin in Shivapuri National Park. He found the burrows in red soil at open forests with less coverage on south, south-east, south-west facing slopes. The burrows were disturbed by fodder collection, trees cutting and livestock grazing causing decline of species.

Hsiao-wei and Yuluen (2001) studied burrows and habitats of Chinese pangolin in Taiwan hill which was covered with second growth broad-leaved trees and patches of bamboo forest. They had found thirty two burrows, but only two were active based on the presence of recently excavated soil. Nine burrows were within 2 m of one another. The average diameter of burrows was 2.1 cm and its depth was 108 cm. He had noted the similarities of vegetation within thirty two burrows.

Chinese pangolin is largely terrestrial, though it is fully capable of climbing trees, and like other pangolins it can swim as well (Heath and Vanderlip 1988). The species was found in a range of different habitats, including primary and secondary forests and grasslands (Chao 2001). This species digs its own burrows or enlarges passages made by termites (Fang and Wang 1980). Allen and Coolidge (1940) noted that in China, there appears to be a close correlation between the distribution of two termite species (*Coptotermes formosanus* and *termes formosanus*).

## **2.2 Status and Distribution**

Acharya, (2001) conducted survey on status and distribution of pangolin in the Nagarjun forest in central Nepal. They had found six freshly dug burrows below Jamachowk in sloppy areas mostly in laterite soil on south facing slope. They had recorded the habitat utilized by the pangolin in the Schima wallichii and pine forests with burrows greater than 2 m deep and 21-23 cm in diameter.

Indian pangolin was only one species distributed throughout the island of Sri Lanka, Weerakoon (2001). It was also recorded in India, Pakistan, Bangladesh and Nepal. Head and body were longer than the tail and both, the body and tail carried horny yellowish brown to reddish brown scales increasing in size from neck towards hindquarter with the largest scale found at the base of tail with 6.5 cm and diminishing in size towards the tip of the tail. Due to hunt for meat and scales, as well as habitat loss caused by deforestation, these species were rapidly depleted in Sri Lanka.

Chinese pangolin was distributed throughout most part of Asia. In South East Asia, it was distributed in Taiwan, and most of the southern China, including the island of Hainan through North India, Bhutan, Nepal and Bangladesh (Chao 2001). He had recorded the availability of pangolin in different habitats including primary and secondary forests, bamboo forests miscanthus grasslands and the agricultural fields. Because of low fecundity rate and a high economic importance, pangolins are decreasing in number and thus classified as lower risk in Taiwan.

Very little information is available on the status of Chinese pangolins anywhere in its range (WCMC 1999). It is classified by IUCN (1996) as "lower risk (near threatened)". Tikader (1983) accorded Chinese pangolin an indeterminate status in India. This species was reported in the 1980's as common in the undisturbed hill forests of Arunachal (Zoological survey of India 1994). Duckworth et al. (1999) noted that pangolin population in general have been so reduced in Lao PDR that field sightings are exceptionally rare.

### **2.3 Behavior and Home Range**

Shrestha (1981) recorded the behavior of pangolin in Panauti Bebar area. He found that the Pangolins use to wriggling out of the burrows at night for stalking termites and ants and remain alive till dawn. He noticed the movement of pangolins searching for foods over a long distance from their burrows. He found that the home range of pangolins was about two sq. miles and also reported that the pangolins were able to swim and climb trees and rocks with the help of their powerful claws and prehensile tails.

Chinese pangolin has specific type of food habits. The foraging behaviors were surveyed at Maoming Dawuling Natural Reserve, (Wu et al. 2005). They classified twelve observations of foraging behaviors into six categories, such as walking, searching, walking and searching, digging, feeding and pause etc. They had found that the most feeding sites occurred in needle broad-leveled mixed forests and mainly located at the base of grass, tree and shrub, under leaf litters, near fallen logs and dead stumps and in termite nests. They had noted the diet of pangolin was composed of eleven species of ants and termites including five genera and five species of ants, and four genera and six species of termites. They had also recorded the ants and termites to be summer diet and winter diet respectively.

### **2.4 Population Trends**

Very little is known about the reproductive success of Asian pangolins. There is evidence that it is very low. Female *M. crassicaudata* usually gives birth to a young one, although twins are apparently not unknown (Prater 1971). Inference from other species indicates that one *M. javanica* young is born at a time, after a gestation period of at least 130 days (WCMC 1999). In addition, very little is known of the breeding habits of *M. pentadactyla*, although in China and Taiwan, young (normally one, occasionally two) ones are reportedly born in spring (Allen 1940, and Chao 2001). Due to these facts, it appears that any external factors such as hunting or forest activities could have negative impacts on the species.

### **2.5 Conservation Threats**

Evidence suggests that pangolins, in general are able to adapt to modified habitats (e.g. secondary forest), provided their termite food resource remain abundant and they

are not unduly persecuted (Prater 1971). However, habitat destruction is indicated as a factor affecting the status of Chinese pangolin in countries like Nepal (Gurung 1996), Taiwan (Chao 2001) and Malaysia (WCMC 1999). Chinese pangolin is reported to be under pressure from habitat destruction, especially by insecticide spraying in Taiwan (Chao 2001). Road killings are apparently common as well as habitat loss; particularly the opening of new areas to oil palm monoculture is reportedly one of the main threats to pangolin in Malaysia (WCMC 1999).

The Asian pangolins are also intensively used for their skins, scales and meat, and are evidently subject to heavy collection pressure in many parts of their ranges (WCMC 1999). Hunting is identified as having a negative impact on *Manis* species in China (Fellowes and Hau 1997), Nepal (Gurung 1996), India (Tikader 1983), Lao PDR (Duckworth et al. 1999) and Taiwan (Chao 2001).

The greatest threat to the conservation of pangolin is illegal hunting for trade, largely to supply the demand in China for meat and scales, which is used for tonics and traditional medicines (Wu et al. 2004). Surveys in China have found pangolin (live or scales) to be commonly available in markets (Li and Wang, 1999). Pangolin parts are also used in other East Asian pharmacopoeia such as South Korea (Kang and Phipps, 2003). Scales are particularly targeted in Chinese and other traditional medicines and are considered to be the most valuable part of the pangolin for trade.

Pangolins are exceptionally vulnerable to over exploitation as they are easily hunted. They have a very slow reproduction rate and do not easily breed in captivity (Wu et al. 2005, Lim and Ng 2007). While subsistence hunting of pangolins has largely been prevalent for centuries, large scale commercial harvesting appeared long ago. Harrison and Loh (1995) reported over 60 tones of pangolin scales being legally exported from Sarawak, Malaysia.

### 3. STUDY AREA

#### 3.1 Physical Setting

##### 3.1.1 Location and Topography

The study area was situated in Balthali VDC of Kavrepalanchok district which is located about 13 km south-west of Dhulikhel. It is surrounded by four VDCs. In the North lies the Sankhupati Chaur, and in the south lies Chalala Ganeshtan and Chyasing kharka. Similarly in the East lies Bhugdeu Mahankal and in the West lies Paunauti Municipality ward number - 12 Khopasi. It lies between 27 ° 32' 57" latitude and 85 °32 ' 56" longitude. Topographically, the study area is divided into two parts. Ward number 5 is covered by hills, steep slopes, streams and valleys and remaining Eight wards are plains and useful for the cultivation. The elevation is about 1462 m above sea level.

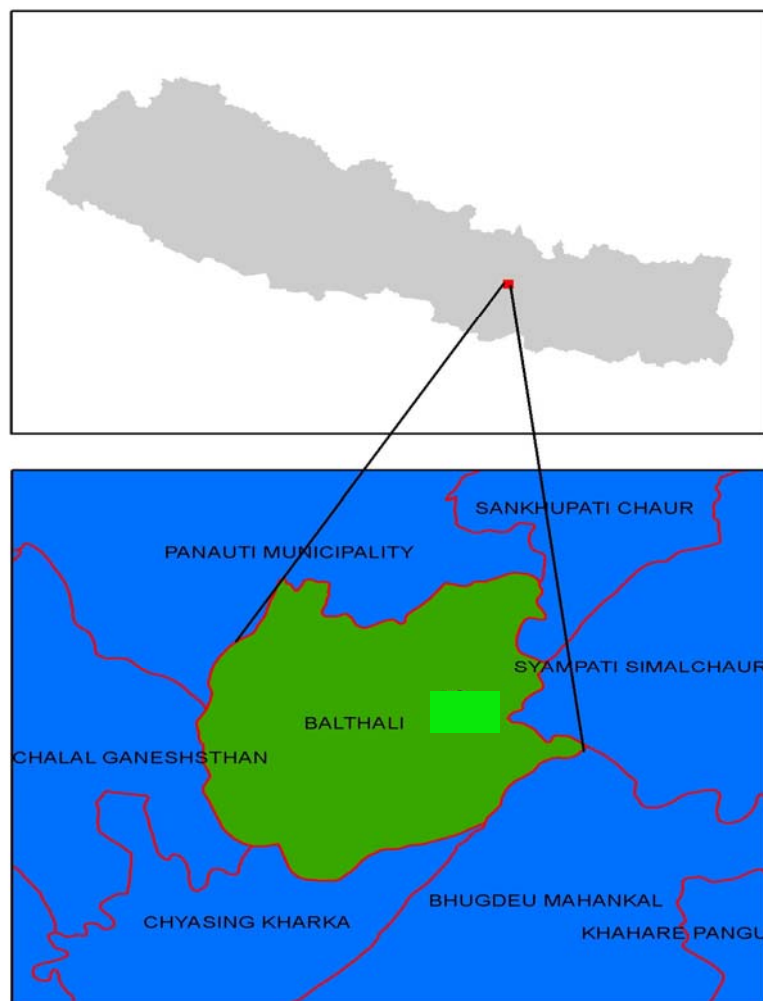


Figure 3. Map of Study Area

### **3.1.2 Geology and Soil**

The soil of the study site was dry due to sandy and porous ranging from sandy to clay soil which was brown in colour but on the Northern site it was reddish brown in color. Whereas the lowland plains were more fertile consisting of finer sand and clay loams.

### **3.1.3 Hydrology**

The study site was very rich in water system. The major rivers were Rosi and Ladku which were permanent rivers where water level slightly decreases in winter season. Khopasi Hydropower is run by the water system of Rosi River. There are three small streams and a drinkable water system around the habitat of pangolin. So that water is not a problem for local people and wild life in the study area.

### **3.1.4 Climate**

The study area has subtropical monsoon climate. The monsoon starts in June till September. The average annual rainfall was 113 mm, maximum rainfall was in August and minimum rainfall was in February and November. The average annual maximum and minimum temperatures were 23° c and 12° c respectively.

Climatically three seasons, hot and dry, monsoon and winter were prevailing in Balthali, Kavre. The hot and dry season starts from February to May. The average monthly rainfall was 40 mm and average monthly maximum and minimum temperatures were 23° c and 10° c respectively. The Monsoon season begins from June and continues until September. The days are hot and humid with average monthly rainfall of 237 mm. The maximum average monthly temperature was 26° c and minimum of 18° c. The winter season lasts for four months starting from October till January. It is dry and cold, and there is very little precipitation during this period, thus there is an average monthly rainfall of 7 mm and average monthly temperature of 8° c to 13° c.

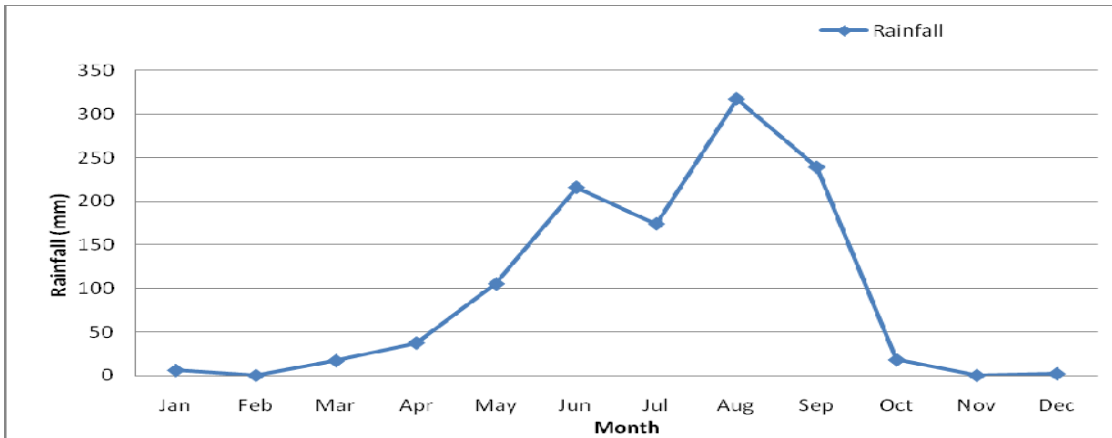


Figure 4. Monthly Rainfall (mm)

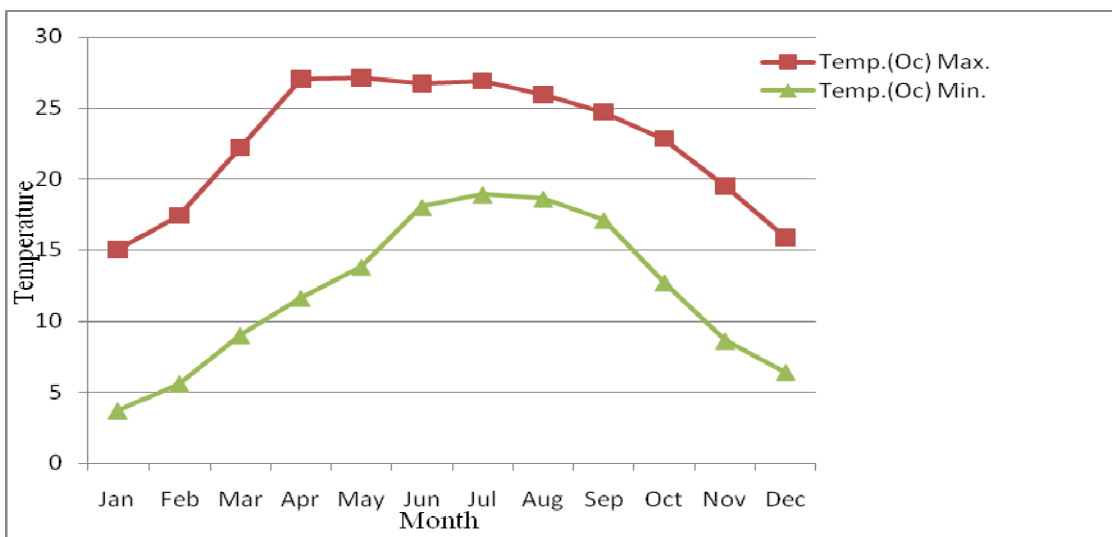


Figure 5. Monthly Maximum and Minimum Temperatures (° C)

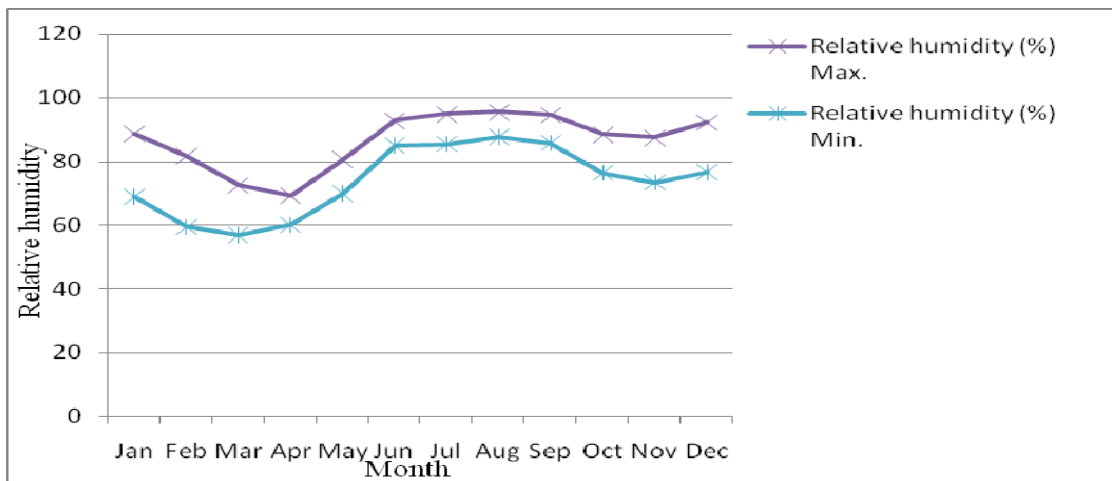


Figure 6. Monthly Maximum and Minimum Relative Humidity (%)

Source: Department of Hydrology and Meteorology 2008.

## 3.2 Biological Component

### 3.2.1 Flora

Most of the land at Balthali is covered by agricultural crops and a few lands are covered by private and community forests as well as land for grazing animals. The community forest is of a mixed type and reforested with pine trees. The major vegetations of community forests are pine (*Pinus roxburghii*), Uttis (*Alnus nepalensis*), Mayal (*Pyrus pashia*), Saur (*Betula alnoides*), Paiun (*Prunus cerasoides*), Siris (*Albizia chinensis*), Banjha (*Buercus sp.*), Chilaune (*Schima wallichii*) etc., whereas the private forests are also mixed of a type, and major flora are Laliguras (*Rhododendron arboreum*), Timila (*Ficus auriculata*), Falaht (*Quercus lineata*), Angeri (*Lyonia avalifolia*), Lakuri (*Fraxinus floribunda*), Gogana (*Quercus lamellose*), Kabro (*Ficus lacor*), Lapsi (*Choerospondias axillaris*), Kaphal (*Myrica esculenta*), Okhar (*Juglans regia*), Tejapat (*Cinnamomum tamala*), Kaulo (*Persia sp.*), Dar (*Boehmeria rugolusa*), Kayniyo (*Grevelia robusta*), etc. The small vegetations in the study area are Siru (*Imperata cylindrica*), Babiya (*Eulaliopsis binata*), Khar, Banmara (*Eupatorium adenophora*), Unu (*Gleichemia*), Panisara (*Nephrolepis cordifolia*) and Dubograss (*Cynodon dactylon*) etc.

### 3.2.2 Fauna

The study site is the good habitat of a dozen mammals and most of them are under the protected list. They include Chinese pangolin (*Manis pentadactyla*), Porcupine (*Hystrix sps.*), Common leopard (*Panthera pardus*), Mongoose (*Herpestes auropunctatus*), Yellow-throated Marten (*Martes flavigula*), Common lungur (*Presbytis entellus*), Squirrel (*Funcambulus sp.*), Jackal (*Canis aureus*), and Rabbit (*Lepus sp.*) etc. It is equally rich in avifauna and some important birds are Black Francolin (*Francolinus francolinus*), Kalij pheasant (*Lophura leucomelanos*), Great Barbet (*Megalaima virens*), Rock pigeon (*Columbia livia*), common Myna (*Acridotheres tristis*), Bulbul (*Pycnonotus sp.*), Babbler (*Pomatorbinus sp.*), Russet sparrow (*Passer rutilans*), Robin (*Tarsiger sp.*), crow (*Corvus spenders*) and Large-tailed Nightjar (*Caprimulgus macrurus*) etc. Similarly, there are also some common reptiles such as ground Lizard (*Calotes versicolor*) and dhamum (*Zamenis mucosus*) amphibians, Common toad (*Bufo melanostictus*) and Indian bull frog (*Hoplobatrachus tigerinus*). Asla (*Schizothorax sps.*) and Faketa (*Barilius sps.*) fauna are rich in Rosi river.

### 3.3 Socio – Economy

The majority of the indigenous people living in Balthali are Chhetris (35%), Tamangs (32%), and Bahuns (22%). Other ethnic groups mainly comprise of Magars (7%), Newars (1.2%), Bharatis (2%), Kamis (1%) and Damais (0.5%).

Agriculture is the main occupation and source of income in this area. About 850 Ropanis of land are fertile for cultivation. More than 30% of the household have less than 10 Ropanis of cultivated land, and 20% of the households are landless so that many people are engaged in daily wages in this area. Major crops grown here are paddy, wheat, maize, mustard, pea and barley which are also the principle cash crops. The cultivation of potatoes and oranges are other income generating sources. Animal husbandry is another important occupation of the local villagers. The most popular livestock are buffaloes, cows, goats and poultry. Nowadays goat farming, buffalo keeping and milk produced (1000 liters per day) are increasing, which has become alternative sources of income for the villagers.

### 3.4 Intensive Study Plots

The main study site was covered by hills, steep slopes, forests and few cultivated lands. The area was divided into three plots according to aspect, soil type and type of forests, i.e., private and community forests.

Plot A: It was *Sana gau Community Forest*, where the pine trees were reforested. It lies in a very steep slope between 27°32'53.54" N and 85°33'07.85" E at an altitude of 1523 m. It was a west facing slope of 45°- 50° and with brown soil.

Plot B: It was *Thulo gau Private Forest*, which was a mixed type of forest. It extended from 27°32'50.66" N to 85°33'11.25" E and 1540 m in altitude. It was an east facing steep slope of 26° - 30° with brown soil.

Plot C: It was *Chihandada Community Forest*, and predominate species here were the pine trees. It was a north and north south facing slope of 15° - 20°. It was a pine forest, where people were buried after death so it was also called Chihandada. It extended between 27°32'07.39" N to 85°32'55.38" E and an altitude of 1505 m which had a reddish brown soil.

## **4. METHODS**

### **4.1 Reconnaissance Survey**

I conducted a reconnaissance survey from April 1, 2008 by field visits to find out the pangolin areas. I discussed with experts, DFO authorities, rangers and also interviewed the local villagers and herder and hunter groups of Balthali, Kavre. During this survey, I observed different burrows of pangolins and biophysical parameters of the study area. During this period, various relevant literatures, journals, reports, books and internet were thoroughly studied to collect secondary data on pangolins.

### **4.2 Direct and Indirect Field Observations**

#### **4.2.1 Direct Observation**

The pangolins were closely observed in the field on May 3, 2009 in Kavre. The morphometric measurements such as length of head, body and tail, number of scales in each row and length of fore and hind claws were taken by using measuring tape and digital balance. During the field survey behaviors were observed for about five hours. Because of nocturnal and burrowing habits of the species, foraging behavior and other activities were observed in captivity. But their climbing and swimming behaviors were observed in the Suryabinayak Range post before releasing them in the natural habitat.

#### **4.2.2 Indirect Observation**

Indirect observation included burrows, scats, scales, pugmarks, traces of tail and hunting tunnels. Threats to the pangolin in the study area were also identified by indirect evidences such as droppings, pugmarks of wildlife and livestock. Anthropogenic factors were also observed and noted.

Different parameters such as burrows, footprints, scratches were used to assess the pangolin distribution patterns and frequency of occurrences. GPS points were recorded and GIS maps were prepared to produce the distribution map of pangolins in the study area were prepared using GIS software. The burrows were categorized into new and old ones such as:

If the burrow contained compact and dry soil with dry fodders and spider net, it was classified as an old burrow, and if the burrow contained fresh and loose soil devoid of dry fodders but having fresh scratches it was classified as a new burrow.

GPS points of whole boundaries of the study area were taken and the total area was calculated using GIS software. The total number of burrows were counted using belt transect method and random search.

The density of burrows was calculated by dividing total number of fresh burrows by total area;

$$\text{Burrow density} = \frac{\text{Total number of burrows}}{\text{Total area}}$$

### **4.3 Observation in Captivity**

Foraging behavior and other activities of pangolins were observed in the Central Zoo, Jawalakhel through focal method. The observation of activities was of twenty four hours divided into day and night of twelve hours each. The night time activities (19:00 to 07:00) and day time activities (07:00 to 19:00) were observed in every hour as well as in between the intervals. Foraging behavior was observed for a week.

### **4.4 Questionnaire Survey**

Fifty local people residing in the study area were purposefully sampled and interviewed by using a set of structurally scheduled questionnaires to find out the abundance and distribution. According to age groups, the highest 55% of the people were between the age of 25 to 35, 25% of them from 36 to 55 ages and above and 20% were from the age below 25 years. Among them 53% were females and 47% males. Group discussion was also conducted with different age and sex groups, as well as hunter groups to get information about the past and present status, distribution and conservation threats of pangolins.

### **4.5 Analysis of Vegetation Characteristics**

I conducted systematic sampling method in the line transect, based on the spatial variation. A 10 m X 10 m quadrat size was taken for tree species. Each quadrat was placed 50 m apart from one another. The number of tree species in each quadrat was counted and also measured for their circumference. Density, Relative density,

Frequency, Relative frequency, Dominance and Relative dominance were used to estimate the Important Value Index (IVI) as follows:

$$\text{IVI} = \text{Relative density} + \text{Relative frequency} + \text{Relative dominance}$$

#### **4.6 Data Analysis**

The primary and secondary data were presented in tables and charts and analyzed by using Microsoft excels and related programs.

Null hypotheses were,  $H_0: \mu_A = \mu_B = \mu_C$ ,  $H_0: \mu_E = \mu_W = \mu_N = \mu_S$  and  $H_0: \mu_X = \mu_Y$ , i.e. there were no significant differences between the distribution of burrows in different plots, aspects and type of soils.

Alternative hypotheses were,  $H_1: \mu_A \neq \mu_B \neq \mu_C$ ,  $H_1: \mu_E \neq \mu_W \neq \mu_N \neq \mu_S$  and  $H_1: \mu_X \neq \mu_Y$ , i.e. there were significant differences between the distribution of burrows in different plots, aspects and type of soils.

Chi – square test ( $\chi^2$ ) was used to examine the association of distribution of burrows with different plots and aspects.

T –test was used to test significant difference between distributions of burrows in types of soils.

## 5. RESULTS

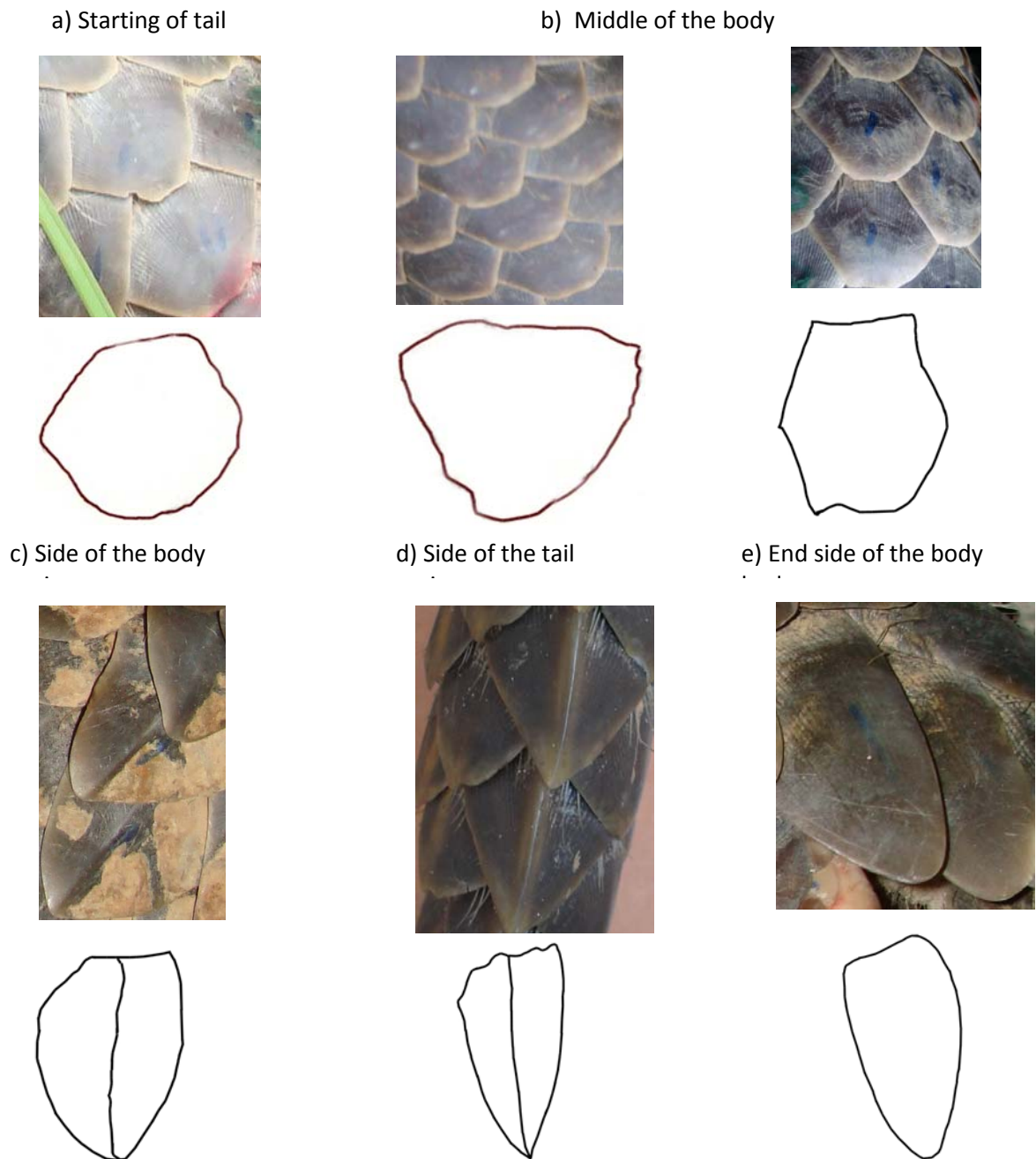
### 5.1 Morphometrical Characteristics and Behavior of Pangolins

The body of pangolin was covered by armor, over - lapping, and dark brown colored scales on the upper part of the head, body, both upper and lower surfaces of the tail and outer surfaces of limbs, but the tip of the snout was not covered by the scales. The pangolin was small in size and weight and its external ears were well developed (Table 2). The Morphometrical measurements of pangolins were tabulated in table 2.

**Table 2. Morphometrical Measurement of Pangolins**

<b>Description</b>	<b>Mother</b>		<b>Baby</b>	
Sex	Female		Male	
Length of snout	10 cm		8 cm	
Length of body	40 cm		25 cm	
Length of tail	40 cm		25 cm	
Total body length	90 cm		58 cm	
Weight of body	4.75 kg		1.39 kg	
Size of ears L/W	2/2 cm		1.5/1.5 cm	
Size of eyes L/W	1.5/0.5 cm		1/0.5 cm	
Size of hairs smaller to bigger	0.5 cm to 1.5 cm		0.2 to 0.9 cm	
Length of foreleg L/W	12 cm/3 cm		9 cm/2.5 cm	
Length of hind leg L/W	11 cm/3 cm		7 cm/2.5 cm	
Length of pawn	7 cm		5 cm	
Color of scales	dark brown		Light brown	
Size of nipple L/W	1/0.5 cm		—	
Total column of scales from snout to tail	49 columns		49 columns	
Number of scales in snout	33		30	
Number of scales in head	32		29	
Number of scales in body	240		231	
Number of scales in tail (upper + lower )	89+57=146		85+51=136	
Number of scales in forelegs	46*2=92		44*2=88	
Number of scales in hind legs	40*2=80		40*2=80	
Total number of scales	623		594	
Circumference of rolling body	88 cm		56 cm	
<b>Claws (Nails)</b>	<b>Fore Limb</b>	<b>Hind limb</b>	<b>Fore Limb</b>	<b>Hind Limb</b>
First	1.5 cm	1.0 cm	1.5 cm	1.0 cm
Second	4.0 cm	2.0 cm	3.5 cm	1.5 cm
Third	5.5 cm	2.5 cm	4.5 cm	1.7 cm
Fourth	4.0 cm	2.0 cm	3.5 cm	1.5 cm
Fifth	1.5 cm	1.0 cm	1.5 cm	1.0 cm

The scales were hexagonal, circular hexagonal, conical and oval shaped (Figure 7). The undersurface or base of the scales of these animals has three to five strong, bright, brown colored thread-like hairs. The scales of babies were smaller, light- brown colored and not bristly sharper than mother pangolin's but number of scales were almost equal. The palm of pangolins was similar to the palm of baby of the human being (Figure 8). Front feet were large and powerful with digging claws, where the middle claws were the largest and the hind feet was short with small claws (Table 2).

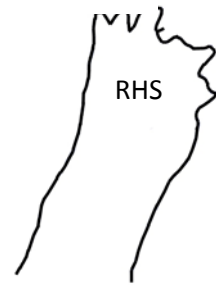
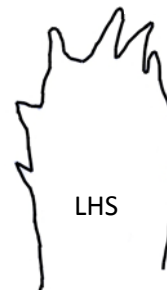
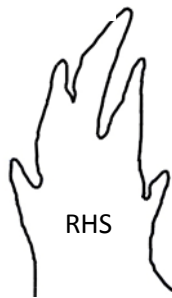


**Figure 7. Photographs and Traces of different Shape of Scales**

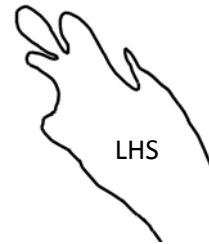
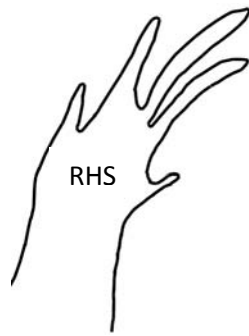
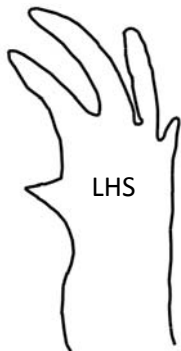


Fore legs

Hind legs



**Baby Pangolin**

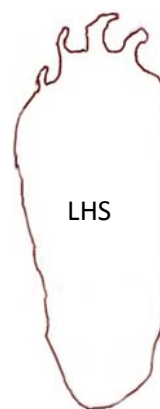
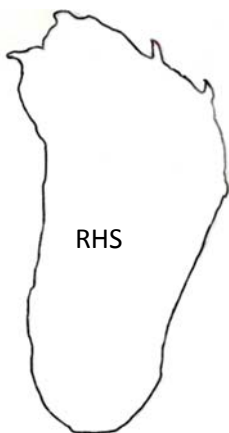


**Mother Pangolin**

Fore legs

**Mother Pangolin**

Hind legs



Palms

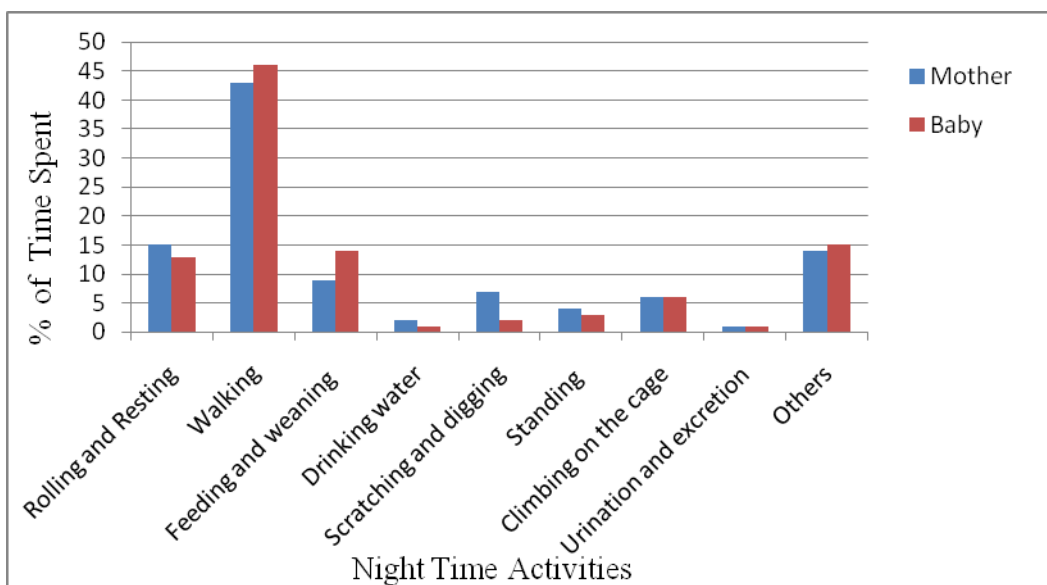
**Figure 8. Photographs and Traces Foot Prints and Palm**

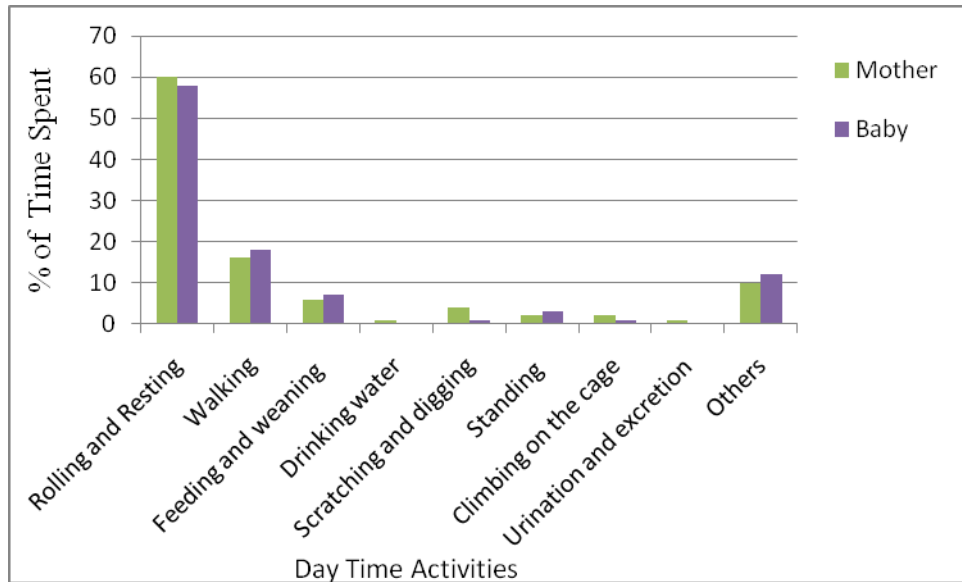
## Behavioral Activities of Pangolins

A careful consideration of the fact shows that, in presence of people, they feel threatened and immediately get rolled into a ball with their babies. When seen again, after sometime, they tried to run away, scratched and dug on the ground and quietly foraged.

At night (19:00 to 07:00), the pangolins were found mostly walking, standing in a kangaroo position to find out the way to exit, scratching and digging, feeding and weaning to their babies. They were found to be drinking water, climbing on the cage as well as urinating and excreting. During the day time (07:00 to 19:00), they were active early morning from 6:00 am to 8:00 am. Mother pangolin walked by carrying its baby on its tail, drank water by lapping their tongues and weaned to its baby but after 8:00 am till 10:00 am, both of them took rest by rolling with its baby. They were very inactive after 10:00 am in comparison to the night time and early morning, confirming their natural habit. For about five hours they took rest sleeping and rolling from 10:00 am to 3:00 pm and took out their snout part to find out the surrounding conditions and lactated to its baby from time to time. After 3:00 pm, a mother pangolin ate a boiled egg, walked a little bit, urinated and excreted and again quickly rolled with its baby.

The Mother pangolin preferred boiled and un boiled eggs rather than meat and fruits, but both of them frequently drank water as well and weaned to its baby from time to time. Pangolins were good swimmers and also able to climb the trees.





**Figure 9. Percentage of Time spent in Behavioral state during Night and Day by both the female pangolin (P<sub>1</sub>) and male baby pangolin (P<sub>2</sub>).**

**Table 3. Food items provided to the pangolins in the Zoo.**

Provided food items		Observation in Days							Remarks
		1st	2nd	3rd	4th	5th	6th	7th	
Water		√	√	√	√	√	√	√	Both pangolins
Meat	a) Fine pieces of buff.	—	√	√	√	√	—	√	Not preferred by both pangolins
	b) Fine pieces of chicken	—	√	√	√	√	—	√	
Eggs	a) Boiled	—	√	√	√	√	√	√	Mother pangolin
	b) Un boiled	√	—	—	—	—	—	—	Mother pangolin
Fruits and others	a) Apple	—	√	√	√	√	√	√	Not preferred by both pangolins
	b) Papaya	—	—	—	—	—	√	—	
	c) Banana	—	—	—	—	—	√	—	
	d) Carrots	—	√	√	√	√	—	√	
	e) Bread and milk	—	—	—	—	—	—	√	

## 5.2 Status and Distribution

### 5.2.1 Population Status

All respondents indicated that pangolins were present in their locality. From the result of the interviews 38% of the respondents had seen live pangolins in evenings, 28% of them in the mornings, and 20% of them at night and 14% during the day. Among these respondents, some had seen live pangolins which were cut by hunters. Most of respondents had seen evidences of pangolins and 62% of them had seen their burrows, 16% of them had seen scratches, 12% of the respondents had seen pugmarks and 10% of them had seen the collected scales. About 48% of the respondents said the food of pangolins were ants, 42% of the respondents said termites were the food of pangolins and the remaining 10% of the respondents said that pangolins also ate grass, soybean and corn. About 52% of the respondents said that they trapped or ate the meat of pangolins at least one time, 22% of them said that they trapped or ate meat of pangolin for twice, 20% of them said thrice and only 6% said that they trapped or ate meat of pangolins more than three times. About 50% of the respondents said the pangolins were trapped for meat, 22% of the respondents said for medicine, 20% of the respondents said they were trapped for trade and 8% of the respondents said pangolins were trapped for enjoyment.

**Table 4. Opinion of Local People about the Status of Pangolins**

S.N.	Main points	Opinions of the respondents			
		Present	Absent		Not sure
1	Presence of pangolins	70%	10%		20%
		Evening	Morning	Day	Night
2	Sighting period of live pangolins	38%	28%	14%	20%
		Burrows	Pugmarks	Scratches	Scales
3	Seen the evidences of pangolins	62%	12%	16%	10%
		Ants	Termites	Grass	Other
4	Natural food of pangolins	48%	42%	8%	2%
		Once	Twice	Thrice	More than three
5	Frequency of eating or trapping pangolins	52%	22%	20%	6%

S.N.	Main points	Opinions of the respondents			
		6	Purposes of trapping pangolins	Meat 50%	Medicine 22%
7	Identification of age and sex of pangolins	Sex organ 48%	Body size 38%	Mammary gland 8%	No. of rays at liver 6%
8	Reproduction period of pangolins	Summer 38%	Winter 14%	Spring 18%	Not know 30%
9	Enemies of pangolins	Man 48%	Leopard 32%	Dog 6%	Other 14%
10	Pangolin as endangered or protected species	Yes 28%	No 8%		Not know 64%
11	Frequency of encounter with pangolins	Frequently 8%	Occasionally 32%		Rarely 60%
12	Population of pangolin for the last 5 years	Increasing 12%	Decreasing 34%	Stable 20%	Not known 34%

About 48% of the respondents said that the age and sex of pangolins were identified by sex organs, 38% of the respondents said by their body size, 8% of the respondents said by mammary glands and 6% of the respondents said that the age of pangolins could also be identified by number of rays at liver. About 48% of the respondents said that the main enemies of pangolins were human beings, 32% of them said leopard and 14% of the respondents said pangolins were also killed by fire, landslide and soil erosion. Most of the respondents nearly 64% of them said that they did not know that the pangolins were endangered species or killing of pangolin was illegal. About population trend, 34% of the respondents said that the population of pangolin were decreasing, 20% of the respondents said that populations of pangolin remained stable and 12% of the respondents said the population of pangolins were increasing.

### 5.2.2 Distribution of Pangolins on the Basis of Burrow Distributions

A total of 180 new burrows and 220 old burrows were observed. Among the three plots, the number of New burrows was the highest in plot B (Thulo Gaun private forest), whereas the number of old burrows was highest in plot A (Sanu Gaun community forest), but the number of both the New and old burrows were the least in plot C (Chihandada community forest).

**Table 5. Burrows distribution in different Plots, Aspects and Soil type:**

Burrows	Plots			Aspect				Soil type	
	A	B	C	E	W	N	S	Brown	Red
New	55	89	18	89	55	7	11	144	18
Old	85	71	32	71	85	12	20	156	32
Total	140	160	50	160	140	19	31	300	50
Percent	40	46	14	46	40	5	9	86	14
Mean	70	80	25	80	70	9.5	15.5	150	25
Level of significance	5%			5%				5%	
Degree of freedom	3 - 1 = 2			4 - 1 = 3				2 + 2 - 2 = 2	
Calculated value	$\chi^2_{cal} = 29.42$			$\chi^2_{cal} = 90.84$				$t_{cal} = 1.16$	
Tabulated value	$\chi^2_{tab} = 1.38$			$\chi^2_{tab} = 2.36$				$t_{tab} = 4.30$	

The highest 46% of the burrows were distributed in plot B followed by 40% of them in plot A and 14% in plot C. According to the aspect, the frequency of occurrence of burrows in east facing steep was the highest which was 40%, followed by 35% in the west facing slopes, 16% in north-south facing slopes and only 9% in the north facing slopes. The occurrences of burrows in the East facing slopes was a private forest with a mixed and open type, where less human encroachments and high abundance of pangolin food, ants and termites were available. Most of the burrows (approx.75%) of pangolins were in brown soils where as 25% burrows were in red soils.

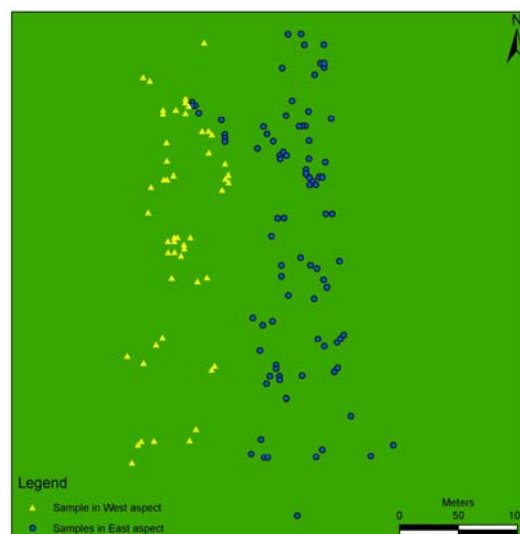
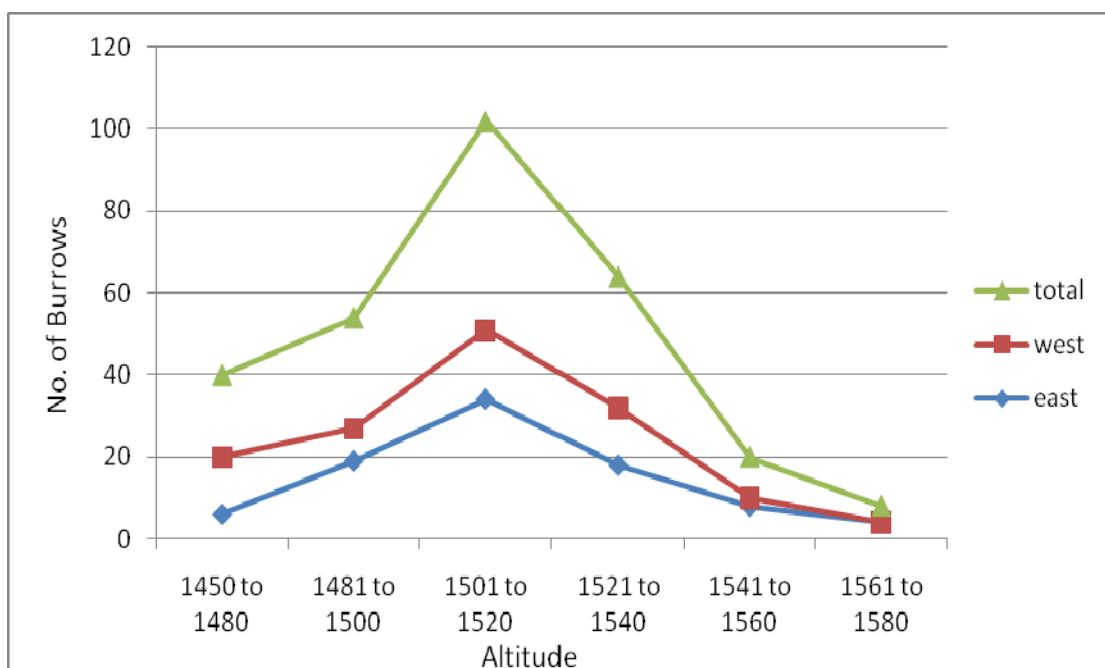


Figure 10. Distribution of Burrows in West and East Aspects

There was a significant difference ( $\chi^2 > 29.42$ ,  $df = 2$ ,  $P < 0.05$ ) and ( $\chi^2 > 90.84$ ,  $df = 3$ ,  $P < 0.05$ ) in distribution of burrows in different plots and aspects (Table 5). However there was no significant difference ( $t = 1.16$ ,  $df = 2$ ,  $P > 0.05$ ) in distribution of burrows in brown and red soils (Table 5).

### 5.2.3 Distribution of Burrows According to Altitude

Burrows were distributed up to 1580 m in altitude. The highest numbers of burrows were in the range of 1501 m to 1520 m in altitude. This was followed by 1521 m to 1540 m and 1481 m to 1500 m. The lowest burrows were at the height of 1561 m to 1580 m.



**Figure 11. Altitudinal Distribution of Burrows**

Burrowing activities of pangolins started from February. The highest digging of the burrows were observed from June to September because of the rainy season, which makes the soil loose and makes them easy to dig the burrows. The digging activities were decreased from October to January. The number of distribution of burrows according to season was highest in summer followed by winter season and least number of burrows was dug in spring season which is the starting period of digging of the burrows.

### 5.2.4 Burrow Density

Only fresh (New) burrows were used to calculate the density of burrows. There were altogether 152 burrows in the plots covering 19.5 hectares, showing 8 burrows per hectare (Table 5 or 6).

**Table 6. Assessment of Habitat of Pangolins**

Plots		Plot A	Plot B	Plot C
Latitude		27°32'53.54"	27°32'50.66"	27°32'07.39"
Longitude		85°33'07.85"	85°33'11.25"	85°32'55.38"
Altitude (m)		1523	1540	1505
Slope		45° - 50°	26° - 30°	15° - 20°
Canopy cover		Less than 25%	Less than 25%	Less than 25%
Softness		Open mixed and pine forest with grasses and shrubs.	Open mixed and pine forest with grasses and shrubs plus cultivated land	Open pine forest with grasses.
Burrows	New	55	89	18
	Old	85	71	32
Diameter (d1 <sup>-</sup> ) cm	New	17.5	18.9	17.9
	Old	18.0	18.0	18
Depth (d2 <sup>-</sup> ) cm	New	135	102	110
	Old	106	85	87
No. of Pugmarks		2	4	1

Note: Pugmark length - 9 cm. and breath - 7 cm.

The main habitat of Chinese pangolin is subtropical (1000 m – 2000 m), which is less steep. Open, mixed and pine forests with small grasses and shrubs like Chutro and Aiselu are good habitats of pangolins. More than three permanent burrows were found under or base of the bushes of Chutro. Less than 25% canopy cover was good for pangolin habitat. The burrows with many channels (Plate: 1,b ) were made by female pangolins and burrows with one or two channels were made by the male ones (Local People). I found a similar pattern of burrows in Balthali, Sardabatase of Kavre district and Sipadol of Bhaktapur district. The average diameter of burrows was 18 cm. and its depth varied from 90 cm - 115 cm.

**Table 7. Vegetation Characteristics****Plot - A**

Species	(d)	(Rd)	(f)	(Rf)	(D)	(RD)	IVI
<i>Betula alnoides</i>	53.33	3.69	0.27	10.65	1.14	0.06	14.40
<i>Alnus nepalensis</i>	53.33	3.69	0.27	10.65	1.77	0.10	14.44
<i>Pyrus pashia</i>	20.00	1.38	0.07	2.76	0.41	0.02	4.16
<i>Prunus cerasoides</i>	26.67	1.84	0.13	5.13	0.22	0.01	6.98
<i>Ficus auriculata</i>	6.67	0.46	0.07	2.76	0.04	0.00	3.22
<i>Rhododendron arboreum</i>	40.00	2.76	0.20	7.89	0.39	0.02	10.67
<i>Lyonia avalifolia</i>	33.33	2.30	0.13	5.13	0.92	0.05	7.48
<i>Albizia chinensis</i>	6.67	0.46	0.07	2.76	0.02	0.00	3.22
<i>Quercus lamellosa</i>	13.33	0.92	0.07	2.76	0.03	0.00	3.68
<i>Schima wallichii</i>	20.00	1.38	0.13	5.13	0.28	0.02	6.53
<i>Pinus roxburghii</i>	1113.33	76.96	0.73	28.80	1798.57	99.69	205.45
<i>Choerospondias axillaris</i>	6.67	0.46	0.07	2.76	0.09	0.00	3.22
<i>Juglans regia</i>	13.33	0.92	0.07	2.76	0.06	0.00	3.68
<i>Cinnamomum tamala</i>	6.67	0.46	0.07	2.76	0.01	0.00	3.22
<i>Boehmeria rugolusa</i>	13.33	0.92	0.13	5.13	0.06	0.00	6.05
<i>Grevelia robusta</i>	20.00	1.38	0.07	2.76	0.22	0.01	4.15
<b>Sum =</b>	<b>99.98</b>	<b>2.55</b>	<b>100.59</b>	<b>1804.23</b>	<b>99.98</b>	<b>300.55</b>	

**Plot - B**

Species	(d)	(Rd)	(f)	(Rf)	(D)	(RD)	IVI
<i>Betula alnoides</i>	22.22	2.15	0.17	5.66	0.28	0.04	7.85
<i>Alnus nepalensis</i>	27.78	2.69	0.11	3.66	1.77	0.24	6.59
<i>Pyrus pashia</i>	61.11	5.91	0.11	3.66	5.59	0.75	10.32
<i>Prunus cerasoides</i>	33.33	3.23	0.22	7.33	0.59	0.08	10.64
<i>Ficus auriculata</i>	16.67	1.61	0.11	3.66	0.41	0.05	5.32
<i>Rhododendron arboreum</i>	33.33	3.23	0.17	5.66	0.83	0.11	9.00
<i>Lyonia avalifolia</i>	22.22	2.15	0.17	5.66	0.64	0.09	7.90

Species	(d)	(Rd)	(f)	(Rf)	(D)	(RD)	IVI
<i>Albizia chinensis</i>	27.78	2.69	0.11	3.66	0.53	0.07	6.42
<i>Quercus lamellosa</i>	61.11	5.91	0.28	9.33	1.01	0.14	15.38
<i>Schima wallichii</i>	22.22	2.15	0.11	3.66	0.41	0.05	5.86
<i>Pinus roxburghii</i>	588.89	56.99	0.56	18.65	732.69	98.06	173.7
<i>Choerospondias axillaris</i>	16.67	1.61	0.17	5.66	0.66	0.09	7.36
<i>Juglans regia</i>	27.78	2.69	0.17	5.66	0.79	0.11	8.46
<i>Cinnamomum tamala</i>	11.11	1.08	0.06	2.00	0.05	0.01	3.09
<i>Boehmeria rugolusa</i>	22.22	2.15	0.22	7.33	0.24	0.03	9.51
<i>Grevelia robusta</i>	33.33	3.23	0.22	7.33	0.68	0.09	10.65
<i>Ficus sps.</i>	5.56	0.54	0.06	2.00	0.02	0.00	2.54
Sum =	100.01	3.02	100.57	747.19	100.01	300.5	

#### Plot – C

Species	(d)	(Rd)	(f)	(Rf)	(D)	(RD)	IVI
<i>Schima wallichii</i>	20.00	1.15	0.20	12.50	0.15	0.02	13.67
<i>Alnus nepalensis</i>	20.00	1.15	0.10	6.25	0.12	0.02	7.42
<i>Pyrus pashia</i>	10.00	0.57	0.10	6.25	0.01	0.00	6.82
<i>Pinus roxburghii</i>	1650.0	94.83	1.00	62.50	741.42	99.92	257.2
<i>Cinnamomum tamala</i>	10.00	0.57	0.10	6.25	0.01	0.00	6.82
<i>Boehmeria rugolusa</i>	30.00	1.72	0.10	6.25	0.28	0.04	8.01
Sum =	99.99	1.60	100.00	741.99	100.00	299.9	

**Note:** d - Density, Rd - Relative Density, f - Frequency, Rf - Relative Frequency, D - Dominance, RD - Relative Dominance and IVI - Important Value Index = Rd + Rf + RD.

The highest IVI in plot A was for *Pinus roxburghii* (205.45), followed by *Alnus nepalensis* (14.44), *Betula alnoides* (14.40) and *Rhododendron arboreum* (10.67), whereas the lowest IVI for were *Ficus auriculata*, *Albizia chinensis*, *Choerospondias axillaris* and *Cinnamomum tamala* (3.22).

The highest IVI in plot B was for *Pinus roxburghii* (173.70) followed by *Quercus lamellosa* (15.38), *Prunus cerasoides* (10.64) and *Pyrus pashia* (10.32) and the lowest was for *Ficus sps.* (2.54).

The highest IVI in plot C was for *Pinus roxburghii* (257.25), followed by *Schima wallichii* (13.67) and *Boehmeria rugolusa* (8.01), but the lowest IVI were for *Pyrus pashia* and *Cinnamomum tamala* (6.82).

#### **5.4 Conservation Threats**

About 26% of the respondents indicated that the main current threats were habitat degradation, followed by 24% by hunting and trapping where as 20% of the respondents indicated that it was habitat fragmentation and 16% of the respondents indicated due to others activities (table 8.)

The loss of habitat of pangolin was due to habitat degradation and habitat fragmentation. More than 38% of the respondents said that habitat degradation was caused by overgrazing, 23% said by human encroachment for cultivation and 15% said by fodder collection.

About 40% of the respondents said that habitat fragmentation was caused by construction of houses and 30% of the respondents said it was due to road construction where as 20% of the respondents said it was due to rock mining, and 10% of them said it was due to the construction of electrical and communication towers.

About 41% of the respondents indicated that pangolins were killed and trapped occasionally, 25% of them said pangolins were regularly trapped and hunted, 33% of them said pangolins were rarely trapped and hunted for meat and scales. There were others factors which threatened the pangolins such as 50% of the respondents said the pangolin population was affected by lack of awareness, 38% of them said by lack of information and 12% of them said it was due to lack of education. More than 75% of the respondents said that this was the first project they saw in and their place about the pangolins.

**Table 8. Opinion of Respondents About Threats on Pangolins**

<b>Main Points</b>	<b>Opinion</b>					<b>Remarks</b>
Currents threats	Habitat degradation	Habitat fragmentation	Hunting and trapping	Shortage of food	Others	
	26%	20%	24%	14%	16%	
Habitat degradation	Deforestation	Grazing	Encroachment		Fodder collection	Habitat Degradation
	23%	38%	23%		15%	
Habitat fragmentation	Road construction	Building construction	Electricity and communication tower		Rock mining	
	30%	40%	10%		20%	
Hunting and trapping	Regular	Occasional	Rare		None	Medicinal value and trade
	25%	41%	33%		-	
Shortage of food	Fire	Pesticides	Natural calamities		Buried place	Lack of food
	43%	28%	14%		14%	
Others	Information	Awareness	Research		Education	Lack of awareness
	38%	50%	-		12%	

## 6. DISCUSSION

### 6.1 Morphometrical Characteristics and Behavioral Activities

Four live pangolins were observed during this study. The length of head and body was 40-58 cm (Charkaborty et al. 2002, Shrestha 1981) and 48-58 cm (Prater 1971, Baral and shah 2008). The length of tail was 30 - 38 cm (Chakraborty et al. 1982) and 33-38 cm (Prater 1971). Therefore, the total length of Chinese Pangolins were 70– 96 cm (Chakraborty et al. 1982) and 81- 96 cm (Prater 1971). The weight of the body of a Chinese pangolin was 6.7 kg (Shrestha 1981) and 9 kg (Baral and Shah 2008). But the pangolin which observed by me was 90 cm. in length and 4.75kg in weight of the mother and 58 cm in length and 1.39 kg in weight that of baby which were the average in sizes and weights. The morphometrical measurements and physical structures of observed pangolins were compared with morphometrical measurements and physical structures of the Indian pangolins with Prater (1971), Yahya( 2001), Sharma (2002), Verma and Singh (2002). These morphological characteristics which were small in size, weight, well developed external ears and dark brown colored scales made confirmation, that the observed pangolins were of the Chinese type.

Foraging behavior was observed by focal method. The pangolins wriggled out of their burrows at night for stalking termites and ants (Shrestha 1981). The favorite ants and termites were *Coptotermes*, *Formosanus*, *Macrotermes barney* and *Polyrhachis dive* (Shibao et al. 2004). But according to Chao 2001, an adult pangolin fed on 60-70 millions ants and termites per year and, the preferred ants were *Polyrhachis* and *Crematogaster*. Although pangolins were insectivorous, they also preferred boiled and unboiled eggs and drank water frequently. The food of pangolins also contained fruits (apple, papaya, banana and carrot), meat of chicken and buffalo, and bread, milk and water in the Central Zoo, Jwalakhel. But in Taipei City Zoo, the food of pangolins contain powder of yeast,  $\text{CaCO}_3$  and coconut, bee larvae, mealworm, yolk, apple and water (Yang et al. 2004) in a formulated ratio. Because of the ratio of food and managed nature like habit, a pangolin in the Taipei Zoo was alive for a long time.

Night and day time activities of mother and baby pangolins were also observed for twenty four hours. The baby pangolin was more active than the mother. Mostly, during the night they walked, scratched, dug, drank water, climbed on the cage, weaned and feed, urinated and excreted. The mother rested by rolling with its baby,

stood and searched the way to exit. But during the day they were more inactive than the night. More percentage of time was spent in resting (sleeping) by rolling with its baby. They also fed and weaned, dug and scratched on the ground, drank water as well as urinated and excreted. When two other adult females and a male were kept in captivity, they almost showed the same activities like climbing on bed box, walking, drinking, feeding, excreting and urinating (Challender 2004). The swimming and climbing behaviors of pangolins were also observed and the same observation was conducted by Chao (2001).

## **6.2 Population Status and Distribution**

Population status of pangolin is declining according to the opinion of local villagers. A comparison of the number of old and new burrows in different plots, aspects and type of soils shows a habitat loss by deforestation, grazing, encroachment, road and house constructions. The status of Chinese pangolin in India is "indeterminate or greatly reduced" by hunting (Tikader 1983) and "at risk" in Lao PDR (Duckworth et al. 1999). The population of pangolins in China and Nepal was also decreased due to poaching and habitat loss (Chao 2001 and Gurung 1996). Very little information is available on the status of Chinese pangolin anywhere in its range (WCMC 1999). Because of the pangolin being highly secretive, solitary, nocturnal animals, they are rarely observed and are certainly not seen regularly enough to allow assessment of their population density. Their population density was calculated by total number of fresh burrows per unit area.

The distribution of pangolin was analyzed by the distribution of number of burrows in different places such as forests, grasslands, cultivated lands, streambed and soft rock hills. I found the distribution of pangolin to be the highest in a mixed forest at East facing steep with brown soil where there was less human encroachment, more availability of food, and less patches of forests with small grass. The pangolins were also found in different habitats including primary and secondary forests and grasslands (Chao 2001, Gurung 1996).

## **6.3 Conservation Threats**

There are direct and indirect factors affecting the population of pangolins. Hunting and poaching are the direct factors, where as habitat loss due to habitat degradation,

habitat fragmentation and natural disasters are the indirect factors. Although Nepal is a signatory of CITES, Shortage of food, lack of knowledge, lack of public awareness programs and management programs of pangolin, caused the threats of this species. It is slow, shy and burrowing animal therefore it easily falls on the cruel hands of local Villagers. Due to low economic status of the local people, pangolin has become trading item and open sale of scales are taking place (1kg scales = Rs 10,000). Local people are searching it for fulfilling their consumptive and non - consumptive household needs.

Hunting of pangolin was identified as a source of negative impact in China (Fellowes and Hau 1997), Nepal (Gurung 1996), India (Tikader 1983), Lao PDR (Duckworth et al.1999) and Taiwan (Chao 2001). The prices of scales of pangolins were very high, which was Rs 50 per piece and people could sale openly in Nepal as traditional medicine as well as trade internationally. One respondent in the study area told he sold four live pangolins for Rs 6000 to 10,000 each because of his poor economic condition. A shopkeeper sold one of the pangolins to a foreigner for Rs.25, 000.

Grazing of domestic livestock within the habitat area and human encroachment by unscientific cultivation, intentional forest fires and mining of stone caused the lost and degradation of habitat of pangolins which was the main threats to the pangolin in Nepal (Gurung 1996), Taiwan (Chao 2001), Malaysia (WCMC 1999).

Killings and displacement of ants and termites by using pesticides in Taiwan (Chao 2001) caused the shortage or lack of food. Due to lack of food, pangolins were found in dense human settlements at Phutung VDC of Kathmandu (Sagarmatha TV on July 5, 2009) and also a Chinese pangolin was found in paddy cultivated land of Chitapol VDC of Bhaktapur (National Daily Newspaper “Annapurna Post” on June 25, 2009).

Local people of study area were familiar with pangolins but did not know that there were two species in Nepal and they were protected and illegal to hunt, (Present study). They only knew the direct uses of pangolins by human being such as in meat, medicine etc but not know the pangolins would provide indirect benefits such as maintaining ecosystem balance, pest control (ants and termites) of agricultural crops and household properties.

## 7. CONCLUSION AND RECOMMENDATIONS

### 7.1 Conclusion

Bhaktapur and Kavre districts have a good and suitable habitat for Chinese pangolins. The live pangolins that were observed in the two districts during study the period were Chinese pangolins. The adult Chinese pangolins were average in size that was 70 cm to 96 cm in length and 5 kg to 9 kg in weight with well developed external ears. The total number of scales was around 600. The scales were of different shapes and dark brown in color, arranged as tiles of roof. There were 3- 5 numbers of light brown hairs found on the base of the scales.

Chinese pangolin also preferred boiled and unboiled eggs beside the insects and termites and drank water frequently. At night they mostly did walking, feeding, and weaning, searching the way to exit and rolling and resting, but during the day they mostly rolled, rested, walked and fed and weaned. They were active for 5-6 hours during a 24-hour period. It proved to be a good climber and swimmer and showed good parental care like other mammals.

Burrow density was 8 burrows per hectare. Chinese pangolins were found in Himalayan foothills in Nepal, Bhutan, Northern India, Bangladesh, Myanmar, China and Taiwan. They were significantly associated with plots ( $\chi^2 > 29.42$ ,  $df=2$ ,  $P < 0.05$ ) and aspect ( $\chi^2 > 90.84$ ,  $df=3$ ,  $P < 0.05$ ), but not with soil types ( $t=1.16$ ,  $df=2$ ,  $P > 0.05$ ). The highest percentage of burrow distribution (40%) was in East facing steep, (75%) in Brown soil and (35%) of the burrows in 1501 m to 1520 m altitude. The average diameter of burrows was 18 cm and depth varied from 90 cm to 115 cm. The average pugmark size of pangolin was 9 cm X 7 cm.

Chinese pangolins were found in sub tropical regions with less patches of pine and mixed forest with small grasses and shrubs, like Chutro (*Berberis asiatica*) and Aiselu (*Rubus ellipticus*). Three permanent burrows were found under the roots of Chutro. The IVI was the highest for *Pinus roxburghii* (212.13) and the lowest for *Cinnamomum tamala* (4.37) in Balthali. *Pinus*, *Alnus* and *Betula* were dominating species in the habitats of pangolins.

Pangolins faced many challenges including the habitat loss caused by factors such as habitat degradation and fragmentation, hunting and trapping as well as illegal trade of the body parts. Habitat loss by livestock grazing, deforestation, human encroachment

for cultivation road construction, rock mining and a negative attitude of local people towards the pangolins were the major threats in Balthali.

## **7.2 Recommendation**

The wild species of the earth represent a reservoir of genetic materials. Each species is irreplaceable. We cannot create it again if it is lost. Each is a store house of genetic information, we cannot afford to lose them. It is therefore necessary to concede a right of existence to other species which have evolved with us on earth (Dasmann 1976, Tamang and Shrestha 1998).

For the survival of pangolins in natural conditions, a maintenance of their habitat is necessary. The increase in human population and migration, poor economic status of local people and developmental activities, like the road constructions as well as a lack of information on pangolins is causing the population declination and a consequent habitat alteration. The following recommendations have been put forward from this study.

- Further scientific research on ecology and population status of pangolins is needed to fulfill the information gap, to find exact status and to provide baseline data for all relevant stakeholders.
- Habitat of pangolin should be protected by stopping and checking the illegal forest fire, deforestation, soil and rock mining, livestock grazing, human encroachment for cultivation and construction of houses.
- Increase the involvement of local people in controlling, poaching and conservation activities and reward those people who help in such activities.
- Income generating programs, skill developments activities, and attitudinal change and conservation programs should be launched in local level that uplift the economic status of local level, as well as provide the positive feedback to safeguard and prevent the endangered species.
- Awareness programs on importance, conservation and population status of pangolins should be launched among the local people, school students and others.
- Regular monitoring of indigenous pangolins and re-introduced pangolins and habitat of pangolins should be done to ensure the conditions of pangolins and their habitat.

- Wildlife conservation laws should be strictly enforced to punish those people who trap and trade the pangolins illegally.
- Stop or reduce the use of pesticides and promote organic farming and develop the agroforestry and prepare natural water reservoirs within or around the habitat of pangolins are recommended. Due to lack of food and water, pangolins come down near the human settlements and they easily get to the cruel hands of the people.
- Recognize the present habitat of pangolin and declare a "pangolin sanctuary" with a Gazette notification under the provision in the NPWC Act 1973 for long term conservation.

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## PHOTO PLATES



a) A Fresh Burrow



b) Female Burrows at closer distance



c) An Old burrow



d) Scratche for searching foods



e) Field visit with Supervisor



f) Ants at Pine trees

### Plate 1. Preliminary Field Visit



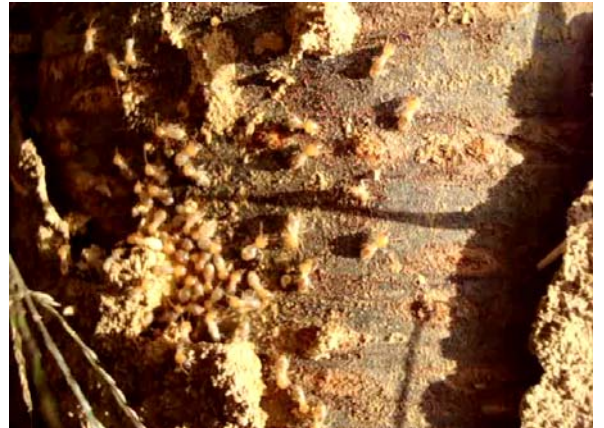
a) Pugmarks of pangolin



b) A Tick on the Pangolin Body



c) Termites at Open Grass land



d) Termites at stem of Paiun Tree



e) Dry Fecal samples of Pangolin



f) Released Pangolin at the Study Area

**Plate 2.** Foods and other Elements



a) Scale Counting and length measurement



b) A Pangolin climbing a tree



c) Weaning to its Baby Pangolin



d) Swimming Behavior of Pangolin



e) An eating of Unboiled Egg



f) Drinking Water by Lapping its Long Tongue

**Plate 3.** Morphometric measurement and Behaviorus



a) Questionnaire Survey at Sana gau



b) Questionnaire Survey at Thulo gau



c) A Burrow at human settlement



d) A Perement burrow at root base



e) A Burrow at soft rock



f) Circumference measurement for IVI

**Plate 4.** Status, Distribution and Habitat Quality



a) Pangolin Scales at Dhading



b) Pangolin Scales at Gundu, Bhaktapur



c) A Hunting Tunnel made by Poachers



d) Awareness Programme to the students



e) Awareness Programme before Releasing to its Habitat



f) An Interview given to Kantipur Television on Pangolins

**Plate 5.** Conservation Threats and Awareness

# दुर्लभ सालक वनमा छोडियो

सुशीलबन्धु थापा

भक्तपुर

नेपालमै पहिलो पटक भक्तपुरको सिपाडोल-८ तौडोल छाप सामुदायिक वनमा दुर्लभ वन्यजन्तुमा पर्ने बच्चासहितको सालक छोडिएको छ।

त्रिभुवन विश्वविद्यालय कीर्तिपुरमा एमएस्सी दोस्रो वर्षमा अध्ययनरत विद्यार्थी तुलसीलक्ष्मी सुवालले शोधपत्रको अध्ययनका क्रममा काभ्रे, बुढागाउँमा बच्चासहितको सालक फेला पारेकी थिइन्। स्थानीय अग्रजहरूसँगको छलफलपश्चात् उक्त सालकलाई वनमा छोडिएको उनले बताइन्।

दुई सालकमध्ये माउको लम्बाइ नब्बे सेमी र तौल ४ दशमलव ७५ केजी छ भने बच्चाको लम्बाइ ६० सेमी र तौल १ दशमलव ३९ केजी छ।



सालकलाई वनमा छोड्न लागिंदै ।

तस्वीर : सुशीलबन्धु/नेस

विद्यार्थी सुवालले भेटिएको सालक आईयूसीएनको सूचीमा सुरक्षित वन्यजन्तुमा पर्ने बताइन्। उनले हाल नेपालमा दुई प्रजातिका सालक मात्र भएको बताउँदै भेटिएका सालकहरूले घमिरा र कमिलाको मात्र भोजन

गर्नुका साथै जमिनमुनि दुलो खनेर बस्ने गरेको जानकारी दिइन्। यस्ता खालका सालकहरू रातको समयमा सक्रिय हुनुका साथै लजालु स्वभावका स्तनधारी वन्यजन्तुमा पर्दछन्।

भेटिएका सालकलाई यसअघि भक्तपुरको नखेलस्थित चिहानडाँडाको जंगलमा छाड्न खोजिए तापनि सालक सुरक्षाका कारण नछोडिएको उनले बताइन्।

आमनागरिकलाई जानकारी नभएका कारण सालक दिनप्रतिदिन मार्ने क्रम बढेको उनले बताइन्। जिउभरि खपटाले ढाकिएको सालक हेर्नका लागि नजिकैका गाउँबाट उल्लेखनीय रूपमा स्थानीय बासिन्दाहरूको सहभागिता रहेको थियो भने जिल्ला वन कार्यालयबाट पनि एक जना प्रतिनिधिको उपस्थिति रहेको थियो।

The News about the pangolin released with its Baby in “Nepal Samachar Patra” May 13, 2009

## बलथलीमा 'सालक' भेटियो

गोरखापत्र समाचारदाता

काठमाडौं, फागुन २० गते । काभ्रे बलथली गाविसमा दुर्लभ वन्यजन्तु सालक भेटिएको छ ।

स्थानीय बासिन्दा हरि तामाडले सोमबार देखेका उक्त पोथी सालक सोही स्थानको सामुदायिक वनमा छाडिएको छ ।

चार किलो तौल, ८६.५ सेन्टिमिटर लम्बाई र ६६.५ सेन्टिमिटर गोलाइ रहेको उक्त सालक सामुदायिक वन उपभोक्ता समितिका सदस्य लक्ष्मी सङ्गीता तामाड हीरालाल तामाड स्थानीय प्रहरीको रोहवरमा वनमा छाडिएको हो ।

सालककै विषयमा शोधपत्र तयार गरिरहनुभएका त्रिभुवन विश्वविद्यालय प्राणीशास्त्रका विद्यार्थी तुल्सी लक्ष्मी सुवालका अनुसार चिनियाँ प्रजातिको सो सालक राष्ट्रिय निकुञ्ज तथा वन्यजन्तु संरक्षण ऐनले संरक्षित वन्यजन्तुको सूचीमा सूचीकृत गरेको छ ।

कमिला र धमिरालाई आफ्नो आहारा बनाउँदै जमिनमुनि २ देखि ६ मिटरको दुलो बनाएर बस्ने यस प्रकारको सालक यसअघि भक्तपुरको सिपाडोलस्थित तौडोल छाप सामुदायिक वनमा तीनवटा छाडिएको सुवालले जानकारी दिनुभएको छ ।

गाई चराउने वन उपभोक्ता समितिका सदस्य सङ्गीता तामाडले उक्त क्षेत्र सालकको उपयुक्त बासस्थान रहेका तथा सालकको तस्करी बढ्दै गएको पाइएको हुनाले दुर्लभ वन्यजन्तुलाई आफ्नै बासस्थानमा छोडेर संरक्षण गर्न सम्पूर्ण गाउँलेलगायत सबैमा जागरण फैलाउने उद्देश्य रहेको बताउनुभयो ।

नेपालमा पाइने दुई किसिमका सालकमध्ये तराई क्षेत्रमा भारतीय प्रजाति र पहाडी क्षेत्रमा चिनियाँ प्रजातिको सालक हुने गरेको छ । वन्यजन्तुविद् प्रा.डा. खड्ग बस्नेतका अनुसार पारिलो घाम लाग्ने भिरालो र नरम खाले माटो सालकको उपयुक्त बासस्थान हो ।

## वनमा सालक छाडियो

कान्तिपुर संवाददाता

भक्तपुर- दुर्लभ सालक चित्तपोलवासीले भेटाएर बुधबार सिपाडोलस्थित सामुदायिक वनमा छाडिदिएका छन् ।

संरक्षित स्तनधारी सालकलाई सिपाडोलको तौडोल छाप सामुदायिक वन क्षेत्रमा छाडिएको हो । जिल्ला वन कार्यालयका प्रतिनिधि न्हुच्छेकृष्ण श्रेष्ठ, वन उपभोक्ता समितिका अध्यक्ष दीपेन्द्रकुमार थापा र सञ्चारकर्मीको रोहवरमा छाडिएको हो ।

६० सेन्टिमिटरको लम्बाइ, तीन दशमलव नौ सय किलोग्राम तौल, पाँच सय ९२ खपडा भएको त्रिभुवन विश्वविद्यालय प्राणीशास्त्र एमएससी दोस्रो वर्षमा अध्ययनरत भक्तपुरकी लक्ष्मी सुवालले बताइन् । यसअघि पनि सामुदायिक वनमा तीनवटा सालक छाडिएका थिए ।

सूर्यविनायक जंगलदेखि काभ्रेको



धेरै जंगलमा सालकको बसोवास रहेको उनले बताइन् । वन्यजन्तुविद्का अनुसार संरक्षित सूचीमा सूचीकृत मध्यपहाडी क्षेत्रको दक्षिण फर्केको भिरालो र न्यानो ठाउँ यसको उपयुक्त बासस्थान हो ।

- a) News about the released of Pangolin in "Gorkhapatra" March 5, 2010.

- b) News about the released of Pangolin in "Kantipur" June 25, 2009.

Plate 7. Published News of Pangolin

# दुर्लभ सालक वनमा छाडियो

अन्नपूर्ण समाचारदाता

भक्तपुर, १० असार : दुर्लभ वन्यजन्तु सालक बुधवार सिपाडल गाविसमा पर्ने तौडोल छाप सामुदायिक वनमा छाडिएको छ।

चित्तपोल-१ मा सोमवार स्थानीय बासिन्दाले फेला पारेको सालकलाई मंगलवार सूर्यविनायक रेन्जपोस्टका प्रमुख न्हुच्छेकृष्ण श्रेष्ठको रोहवरमा तौडोल छाप सामुदायिक वनमा छाडिएको हो।

स्थानीय तौडोलछाप सामुदायिक वन उपभोक्ता समूहका अध्यक्ष दीपेन्द्रकुमार थापा, सालकसम्बन्धी अध्ययन गरिरहेकी भक्तपुरकी तुल्सीलक्ष्मी सुवाल, सञ्चारकर्मी र स्थानीय बासिन्दाको उपस्थितिमा छोडिएको सालकसमेत यो वनमा दुई महिनामा चारवटा सालक छोडिएको छ।

यसअघि यसै वनमा भेटिएको एउटा सालक जिल्ला वन कार्यालयमार्फत सदर चिडियाखाना जाउलाखेलको जिम्मा लगाइएको थियो। त्यस्तै स्थानीय बासिन्दाले भेटाएको भाले सालकलाई पनि सोही वनमा छोडिएको थियो। त्यसको एक सातापछि सालक अध्ययनको क्रममा तुल्सीलक्ष्मी सुवालले काभ्रे बुढागाउँमा भेटाएको बच्चासहितको माउ सालक पनि सोही वनमा छोडिएको थियो।

सोमवार चित्तपोलमा फेला परेको पोथी सालकको लम्बाइ ७० सेन्टिमिटर, गोलाइ ५८ सेमि र तौल तीन किलो नौ सय ग्राम रहेको अध्ययनमा संलग्न सुवालले



तस्विर : अन्नपूर्ण

सिपाडोलस्थित तौडोल छाप सामुदायिक वनमा छोड्नुअघि सञ्चारकर्मीलाई सालक देखाउँदै सूर्यविनायक रेन्जपोस्टका प्रमुख न्हुच्छेकृष्ण श्रेष्ठ।

बताइन्। उनका अनुसार चिनियाँ प्रजातिको सालकको जीउमा पाँच सय ९२ कल्ला रहेका छन्।

विज्ञानमा स्नातकोत्तर तहअन्तर्गत सालकको विषयमा थेंसिस गर्दै रहेकी तुल्सीलक्ष्मी सुवालका अनुसार समुद्री सतहदेखि एक

हजारदेखि दुई हजार मिटर उचाइ भएको खैरो मलिलो माटो पाइने ठाउँ सालकको लागि उपयुक्त वासस्थान हो। कमिला र धमिरा खाने र लजालु स्वभावको सालक दुलो खनेर जमिनभित्र बस्ने गर्छ।

News about the released of Pangolin in "Annapurna Post" June 25, 2009.

## ANNEX- I

### Field Survey Form

- a) Burrow No:
- b) Date of survey:

#### Site Information:

- a) Name of Habitat:
- b) Location: Footpath /Road/ Stream beds / Inside forest.
- c) Habitat type: Barren land/ Grassland/ Woodland/ Riverbed
- d) Surface condition: soil type: sandy/ loamy/ clayey
- e) Texture of soil: Fine/ Medium/ Coarse
- f) Colour of soil: Brown/ Red/
- g) Moisture Level: Moist/ wet/ slushy
- h) Freshness of sign/scat: Previous night/.....days old.
- i) Canopy cover: less than 25%, less than 50%, less than 75%, less than 100%.

#### Specific Pangolin Information

- a) Sex: Male/Female
- b) Age: Young/ adult
- c) Abnormalities/ Deformities record

#### Measurement of footprints:

- a) Total length (TL):
- b) Total width (TW):

#### Measurement of burrows:

- a) Elevation of burrow:
- b) Depth of burrow:
- c) Diameter of burrow:

#### Other significant Information

- a) Threats to pangolin:
- b) Major disturbance:
- c) Vegetation Type:

## ANNEX - II

### Questionnaires used during PRA.

#### A) Abundance and distribution of pangolin:

1. Are there pangolin in this area?

- a) Yes                      b) No                      c) Not sure

2. Have you seen live pangolin?

- a) Yes                      b) No

If yes,                      i) When (time):                      ii) Where (place):

3. Have you seen evidences of pangolin?

- a) Yes                      b) No

If Yes, Which of the one?

- i) Burrows                      ii) Scratches                      iii) Scales                      iv) Pugmarks

4. Do you know what does it feed?

- a) Ants                      b) Termite's                      c) Grass                      d) Others.

5. How many time do you trap or eat the meat of pangolin?

- a) Once                      b) Twice                      c) Three times                      d) More than three times

6. For what purpose do you trap the pangolin?

- a) Meat                      b) Medicine                      c) Trade                      d) Enjoyment

7. Can you identify the sex and age of pangolin?

- a) Yes                      b) No

If Yes, How?

- i) Sex organ    ii) Body size    iii) Mammary gland    iv) Number of rays at liver.

8. Do you know the pangolin also give birth of baby like human being?

- a) Yes                      b) No

If yes,    i) Number: .....                      ii) Month: .....

9. What are the enemies of pangolin?

- a) Man      b) Leopard      c) Dog      d) Others

10. Do you know the pangolin is protected animal of hunting of pangolin is illegal?

- a) Yes      b) No

**B) Population trends:**

1. Population of pangolin for last 5years.

- a) Increasing      b) Decreasing      c) Stable      d) Not known

Reasons: .....

2. How often pangolin encounter with man?

- a) Frequently      b) Occasionally      c) Rarely

3. Where did you trap or hunt the pangolin?

- a) Forest      b) Cultivated land      c) Streambed      d) Narrow road

**C) Conservation threats.**

1. Current threats to the pangolin

- a) Habitat degradation      b) Habitat fragmentation      c) Hunting and trapping  
d) Shortage of food      e) Other.

2. Habitat degradation because of

- a) Deforestation      b) Grazing      c) Encroachment      d) Fodder collection

3. Habitat fragmentation because of

- a) Road construction      b) House construction      c) Tower construction      d) Rock mining

4. Occurrence of hunting and trapping

- a) Regular      b) Occasional      c) Rare      d) None

5. Shortage of food because of

- a) Firing      b) use of pesticides      c) Natural calamities      d) Buried place

6. Others lack of

- a) Information      b) Awareness      c) Research      d) Talk program.

### ANNEX - III

**Number of scales in Rows (vertically) from snout to body.**

Rows	No. of scales		Remarks
	Mother	Baby	
1 <sup>st</sup>	1	1	1st - 7th rows are snout region
2 <sup>nd</sup>	3	3	
3 <sup>rd</sup>	4	4	
4 <sup>th</sup>	5	4	
5 <sup>th</sup>	6	5	
6 <sup>th</sup>	7	6	
7 <sup>th</sup>	7	7	
8 <sup>th</sup>	7	7	8th - 11th rows are head region
9 <sup>th</sup>	7	7	
10 <sup>th</sup>	8	7	
11 <sup>th</sup>	10	8	12th - 30th rows are body region.
12 <sup>th</sup>	11	9	
13 <sup>th</sup>	11	11	
14 <sup>th</sup>	12	11	
15 <sup>th</sup>	13	10	
16 <sup>th</sup>	14	11	
17 <sup>th</sup>	14	14	
18 <sup>th</sup>	14	14	
19 <sup>th</sup>	13	13	
20 <sup>th</sup>	13	13	
21 <sup>st</sup>	13	13	
22 <sup>nd</sup>	14	14	
23 <sup>rd</sup>	14	14	
24 <sup>th</sup>	14	14	
25 <sup>th</sup>	14	14	
26 <sup>th</sup>	13	13	
27 <sup>th</sup>	13	11	
28 <sup>th</sup>	12	10	
29 <sup>th</sup>	11	10	
30 <sup>th</sup>	12	11	
<b>Total</b>	<b>310</b>	<b>289</b>	

**Number of scales at the Tail region.**

Rows	Upper region		Lower region	
	Mother	Baby	Mother	Baby
31 <sup>st</sup>	5	5	4	4
32 <sup>nd</sup>	5	5	3	3
33 <sup>rd</sup>	5	5	3	3
34 <sup>th</sup>	5	5	3	3
35 <sup>th</sup>	5	5	3	3
36 <sup>th</sup>	5	5	3	3
37 <sup>th</sup>	5	5	3	3
38 <sup>th</sup>	5	5	3	3
39 <sup>th</sup>	5	5	3	3
40 <sup>th</sup>	5	5	3	3
41 <sup>st</sup>	5	5	3	3
42 <sup>nd</sup>	5	5	3	3
43 <sup>rd</sup>	5	5	3	3
44 <sup>th</sup>	5	5	3	3
45 <sup>th</sup>	5	5	3	3
46 <sup>th</sup>	5	5	3	3
47 <sup>th</sup>	5	5	3	2
48 <sup>th</sup>	5	3	3	Little bit developed
49 <sup>th</sup>	1	1	2	Not developed
<b>Total</b>	<b>91</b>	<b>89</b>	<b>57</b>	<b>51</b>

**Number of scales at Fore Legs and Hind Legs.**

Rows	Single Fore leg		Single Hind leg	
	Mother	Baby	Mother	Baby
1 <sup>st</sup>	2	2	2	1
2 <sup>nd</sup>	3	3	3	3
3 <sup>rd</sup>	4	4	5	4
4 <sup>th</sup>	4	4	5	5
5 <sup>th</sup>	4	4	6	5
6 <sup>th</sup>	6	6	6	6
7 <sup>th</sup>	6	6	5	6
8 <sup>th</sup>	5	6	5	5
9 <sup>th</sup>	5	5	3	3
10 <sup>th</sup>	5	5	-	-
Total	44	45	40	38
<b>Total In Two legs</b>	<b>88</b>	<b>90</b>	<b>80</b>	<b>76</b>

## ANNEX – IV

### Plot - A

### GPS Reading, Dimension and Details of FRESH Burrows

S.N.	North (Latitude)	East (Longitude)	Elevation (m)	Depth (m)	Diameter (cm)	Remarks
1	27°32'47.8"	85°33'7.0"	1505	0.9	22.5	
2	27°32'48.4"	85°33'7.3"	1506	0.9	20.0	
3	27°32'48.3"	85°33'7.2"	1503	1.1	22.5	
4	27°32'48.4"	85°33'7.7"	1514	0.4	20.0	
5	27°32'48.4"	85°33'8.8"	1541	0.9	20.0	
6	27°32'48.7"	85°33'9.0"	1541	0.6	17.5	
7	27°32'50.4"	85°33'9.6"	1539	>6	20.0	fresh hole 1month
8	27°32'50.3"	85°33'9.5"	1534	0.4	20.0	fresh hole 1month
9	27°32'51.2"	85°33'8.0"	1509	0.8	17.5	
10	27°32'51.0"	85°33'7.8"	1498	2.2	12.5	around 5 new scratches and burrow in Y shape after 0.3m
11	27°32'51.5"	85°33'7.4"	1492	3.5	22.5	
12	27°32'50.7"	85°33'6.9"	1471	1.2	20.0	
13	27°32'50.5"	85°33'7.4"	1476	>5	20.0	
14	27°32'52.8"	85°33'8.3"	1513	0.8	20.0	
15	27°32'52.7"	85°33'9.1"	1529	0.6	17.5	
16	27°32'52.8"	85°33'9.4"	1533	1.4	17.5	
17	27°32'53.9"	85°33'8.9"	1532	0.4	17.5	2m above 1 scratch
18	27°32'53.7"	85°33'8.7"	1528	0.4	17.5	near 3 scratches
19	27°32'53.9"	85°33'8.5"	1522	0.6	20.0	

S.N.	North (Latitude)	East (Longitude)	Elevation (m)	Depth (m)	Diameter (cm)	Remarks
20	27°32'53.6"	85°33'8.7"	1515	2.9	17.5	
21	27°32'53.8"	85°33'8.4"	1511	1.1	20.0	
22	27°32'53.9"	85°33'8.4"	1509	2.1	20.0	
23	27°32'53.8"	85°33'8.2"	1506	0.8	20.0	white ant (termites) at burrows
24	27°32'53.4"	85°33'8.6"	1496	0.8	20.0	
25	27°32'53.5"	85°33'8.4"	1494	1.4	17.5	2 scratches nearer
26	27°32'53.5"	85°33'8.2"			0.0	scratch
27	27°32'54.6"	85°33'7.6"	1501	0.9	15.0	3 burrows nearer and 1 is at rock
28	27°32'56.5"	85°33'8.2"	1483	1.8	20.0	near 1m 3 scratches and 5 fresh scratches
29	27°32'56.0"	85°33'8.2"	1464	0.7	20.0	
30	27°32'55.5"	85°33'8.1"	1473	0.6	15.0	near 1 fresh scratch
31	27°32'55.3"	85°33'7.7"	1463	0.6	15.0	near 2 fresh scratches
32	27°32'55.5"	85°33'8.2"	1460	2.3	25.0	
33	27°32'55.6"	85°33'8.4"	1477	0.9	22.5	nearby 5 scratch
34	27°32'55.5"	85°33'8.1"	1478	0.9	17.5	
35	27°32'56.2"	85°33'9.5"	1514	0.8	17.5	white ant (termites) at cone of pine
36	27°32'56.8"	85°33'9.3"	1518	1.8	15.0	
37	27°32'55.2"	85°33'9.9"	1525	1.7	17.5	At stone bed and near by 4 scratches
38	27°32'55.4"	85°33'10.1"	1527	1.3	20.0	burrow in Y shape starting branches 1.2m and 1.3m
39	27°32'55.4"	85°33'10.1"	1529		20.0	burrow in Y shape starting branches 0.2m and 1.2m
40	27°32'55.4"	85°33'10.1"	1531	1.1	17.5	
41	27°32'55.5"	85°33'10.0"	1532	4.2	17.5	

S.N.	North (Latitude)	East (Longitude)	Elevation (m)	Depth (m)	Diameter (cm)	Remarks
42	27°32'55.6"	85°33'10.1"	1531	1	15.0	
43	27°32'55.9"	85°33'10.0"	1521	4.1	15.0	
44	27°32'56.8"	85°33'9.5"	1521	1.1	17.5	
45	27°32'56.7"	85°33'9.6"	1520	0.8	20.0	
46	27°32'57.3"	85°33'8.8"	1494	0.5	17.5	
47	27°32'57.5"	85°33'8.9"	1493	1.2	17.5	
48	27°32'57.6"	85°33'8.8"	1491	0.6	17.5	
49	27°32'57.7"	85°33'8.8"	1486	0.7	17.5	
50	27°32'57.4"	85°33'8.5"	1479	1.1	30.0	used at old one
51	27°32'57.3"	85°33'8.1"	1471	1.7	20.0	
52	27°32'57.4"	85°33'8.1"	1471	0.6	17.5	
53	27°32'58.3"	85°33'7.5"	1454	2.3	17.5	
54	27°32'58.2"	85°33'7.7"	1458	0.8	17.5	
55	27°32'59.2"	85°33'9.4"	1457	0.8	17.5	

**Plot - B**

S.N.	North (Latitude)	East (Longitude)	Elevation (m)	Depth (m)	Diameter (cm)	Remarks
1	27°32'59.4"	85°33'12.0"	1459	0.7	15.0	
2	27°32'59.4"	85°33'12.4"	1470	0.3	12.5	Fresh scratches
3	27°32'59.1"	85°33'12.5"	1471	2.2	20.0	seems permanent habitat burrow
4	27°32'58.5"	85°33'11.8"	1475	1.0	17.5	nearby 3 old burrows

S.N.	North (Latitude)	East (Longitude)	Elevation (m)	Depth (m)	Diameter (cm)	Remarks
5	27°32'57.6"	85°33'12.1"	1499	0.6	15.0	
6	27°32'56.9"	85°33'11.2"	1501		17.5	fresh scratch
7	27°32'57.2"	85°33'11.9"	1512	0.6	17.5	nearby 1m right 1 old burrow
8	27°32'56.7"	85°33'11.3"	1508	0.3	20.0	
9	27°32'56.3"	85°33'11.0"	1516	1.0	20.0	stick shown photo
10	27°32'56.5"	85°33'11.5"	1516	0.3	20.0	
11	27°32'56.5"	85°33'10.0"	1520	2.4	30.0	2 stick shown photo
12	27°32'56.7"	85°33'10.0"	1520	0.4	15.0	
13	27°32'56.6"	85°33'10.0"	1521	1.0	20.0	
14	27°32'56.6"	85°33'10.0"	1521	1.0	17.5	
15	27°32'57.1"	85°33'9.9"	1520	0.5	20.0	nearby 3 burrows
16	27°32'57.3"	85°33'9.2"	1500	1.0	17.5	newly fresh
17	27°32'57.5"	85°33'9.1"	1489	1.2	20.0	newly fresh
18	27°32'57.6"	85°33'9.0"	1491	0.5	20.0	newly fresh and nearby 1 old
19	27°32'57.5"	85°33'9.0"	1489	1.1	25.0	nearby 1 old and 1 scratch
20	27°32'58.3"	85°33'12.8"	1493	0.4	15.0	fresh scratch
21	27°32'57.3"	85°33'12.6"	1497	0.6	17.5	
22	27°32'57.1"	85°33'13.3"	1480	0.6	17.5	newly fresh
23	27°32'55.9"	85°33'13.1"	1488	0.2	25.0	fresh 3 scratches nearby
24	27°32'55.4"	85°33'12.7"	1493	1.0	20.0	newly fresh and nearby 4old burrows
25	27°32'55.5"	85°33'12.6"	1500	0.4	17.5	newly fresh and nearby 2 old burrows, also 6 fresh scratches
26	27°32'55.7"	85°33'12.5"	1505	0.6	20.0	nearby 6 old scratches

S.N.	North (Latitude)	East (Longitude)	Elevation (m)	Depth (m)	Diameter (cm)	Remarks
27	27°32'55.6"	85°33'12.5"	1505	0.9	17.5	nearby north side 6 scratches
28	27°32'55.3"	85°33'12.6"	1497	0.6	20.0	
29	27°32'55.3"	85°33'12.8"	1495	1.0	20.0	newly fresh & villagers saw pangolin entered then dug to catch (photo with GPS and measuring tape)
30	27°32'55.5"	85°33'12.9"	1487		17.5	nearby 4 scratches
31	27°32'55.5"	85°33'13.0"	1481	1.2	17.5	
32	27°32'56.0"	85°33'12.6"	1503	0.6	15.0	newly fresh 2 new burrows below 1m
33	27°32'56.5"	85°33'12.6"	1493	3.3	20.0	newly fresh below cultivated land (photo with GPS and Pen)
34	27°32'56.9"	85°33'12.5"	1509	0.3	12.5	newly fresh and 1m above 1 old scratch
35	27°32'56.9"	85°33'12.4"	1510	0.3	17.5	
36	27°32'56.9"	85°33'12.3"	1511	0.6	15.0	nearby 1m south 1 scratch and 1 old burrows
37	27°32'56.9"	85°33'12.3"	1513	1.2	17.5	nearby 2m north side 4 old burrows
38	27°32'56.1"	85°33'11.7"	1511	0.4	10.0	
39	27°32'56.0"	85°33'11.7"	1514		0.0	nearby 0.5m interval 6 scratches
40	27°32'56.2"	85°33'11.8"	1518	0.5	10.0	nearby at tree root at 3m distance 1 fresh burrows
41	27°32'56.1"	85°33'11.9"	1519	0.6	25.0	nearby at 2m distance 2 burrows
42	27°32'54.4"	85°33'11.8"	1528	0.4	17.5	scratch
43	27°32'54.4"	85°33'11.6"	1536	0.6	15.0	nearby 3 scratches

S.N.	North (Latitude)	East (Longitude)	Elevation (m)	Depth (m)	Diameter (cm)	Remarks
44	27°32'53.9"	85°33'11.4"	1540	0.8	20.0	newly fresh (photo with file) and direction change north to east
45	27°32'58.6"	85°33'13.0"	1489	1.4	20.0	newly fresh 1 old burrow at 1m north
46	27°32'58.5"	85°33'13.1"	1486	0.9	17.5	
47	27°32'58.6"	85°33'13.1"	1485	2.4	22.5	2 fresh scratches
48	27°32'59.1"	85°33'13.1"	1484		17.5	nearby 5 fresh scratch
49	27°32'54.5"	85°33'13.3"	1506	0.6	20.0	3m south 1 burrows
50	27°32'54.5"	85°33'13.1"	1507	2.1	20.0	nearby 2 old burrows
51	27°32'53.3"	85°33'12.3"	1520	2.5	15.0	nearby 4 scratch and at south down and up 2, 2 burrows
52	27°32'53.1"	85°33'12.6"	1510	0.6	20.0	
53	27°32'53.0"	85°33'12.8"	1506	1.0	20.0	nearby 1 fresh burrow at 1m north
54	27°32'52.7"	85°33'13.0"	1499	0.7	20.0	freshly new and surrounding 3 burrows, at south 4 scratches
55	27°32'52.5"	85°33'13.1"	1498	1.5	20.0	burrow straight inclined down and surround 4 scratch
56	27°32'51.1"	85°33'12.8"	1511	1.5	20.0	at tree below, 18 fresh foot print, movie also taken
57	27°32'50.9"	85°33'13.0"	1513	1.7	20.0	newly fresh
58	27°32'51.0"	85°33'13.4"	1508	0.3	20.0	newly fresh and at north at 3m dist scratch
59	27°32'51.1"	85°33'13.5"	1507	0.8	17.5	newly fresh

S.N.	North (Latitude)	Easti (Longitude)	Elevation (m)	Depth (m)	Diameter (cm)	Remarks
60	27°32'50.2"	85°33'13.3"	1510	1.1	17.5	newly fresh and at 4m dist in north 1 scratch
61	27°32'50.3"	85°33'13.4"	1505	3.5	17.5	newly fresh and at 1m dist in north 1 scratch
62	27°32'50.1"	85°33'12.3"	1533	3.3	20.0	newly fresh and 1 scratch also
63	27°32'50.1"	85°33'12.3"	1532	2.2	17.5	newly fresh at bushes (jhadi)
64	27°32'50.1"	85°33'11.6"	1538		0.0	
65	27°32'49.5"	85°33'11.8"	1540	0.9	17.5	
66	27°32'48.2"	85°33'15.1"	1538	0.6	15.0	
67	27°32'49.0"	85°33'13.8"	1521	0.3	17.5	newly fresh
68	27°32'47.9"	85°33'12.7"	1528	1.2	17.5	
69	27°32'48.1"	85°33'12.9"	1539	0.3	20.0	
70	27°32'48.4"	85°33'11.0"	1570	1.5	17.5	
71	27°32'47.9"	85°33'11.1"	1575	0.4	20.0	fresh scratch thin pine trees
72	27°32'47.9"	85°33'11.2"	1572	0.8	17.5	newly fresh
73	27°32'48.0"	85°33'10.7"	1579	0.6	17.5	ridge line
74	27°32'49.9"	85°33'11.2"	1565	0.9	12.5	
75	27°32'50.1"	85°33'11.3"	1551	3.2	20.0	newly fresh
76	27°32'50.0"	85°33'11.6"	1550	0.5	15.0	3m north 2 scratches
77	27°32'50.4"	85°33'11.5"	1552	0.9	17.5	corn cultivated land
78	27°32'50.3"	85°33'11.5"	1553	2.1	17.5	corn cultivated land
79	27°32'50.8"	85°33'11.0"	1554	1.5	17.5	corn cultivated land
80	27°32'51.7"	85°33'10.8"	1548	0.3	17.5	corn cultivated land
81	27°32'51.5"	85°33'11.1"	1544	0.4	17.5	2-4m south 7 scratches

S.N.	North (Latitude)	East (Longitude)	Elevation (m)	Depth (m)	Diameter (cm)	Remarks
82	27°32'51.6"	85°33'11.4"	1536	1.1	17.5	2m north 1 scratch
83	27°32'52.8"	85°33'11.7"	1524	2.9	15.0	
84	27°32'53.1"	85°33'11.7"	1531	0.3	15.0	
85	27°32'52.3"	85°33'11.9"	1524	0.6	17.5	newly fresh
86	27°32'51.2"	85°33'13.6"	1501	0.3	15.0	
87	27°32'53.2"	85°33'13.5"	1450	2.3	20.0	
88	27°32'47.9"	85°33'14.4"	1516	1.5	15.0	
89	27°32'46.3"	85°33'12.1"	1527	0.3	15.0	

**ANNEX – V**

**Data for IVI**

**Plot - A**

S.N.	Species	Sample quadrates															Total	Total circumference (m )	No. of Quadrates species present
		Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Q 10	Q 11	Q 12	Q 13	Q 14	Q 15			
1	<i>Betula alnoides</i>	1	1	-	-	-	-	-	-	-	-	5	1	-	-	-	8	3.78	4
2	<i>Alnus nepalensis</i>	-	1	2	2	-	-	-	-	3	-	-	-	-	-	-	8	4.72	4
3	<i>Pyrus pashia</i>	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	3	2.28	1
4	<i>Prunus cerasoides</i>	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	4	1.68	2
5	<i>Ficus auriculate</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	0.72	1
6	<i>Rhododendron arborium</i>	1	2	-	-	-	-	-	-	-	-	3	-	-	-	-	6	2.22	3
7	<i>Lyonia avalifolia</i>	3	-	-	2	-	-	-	-	-	-	-	-	-	-	-	5	3.4	2
8	<i>Albizia chinensis</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	0.55	1
9	<i>Quercus lamellosa</i>	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2	0.63	1
10	<i>Schima wallichii</i>	1	-	-	-	-	-	-	-	-	-	2	-	-	-	-	3	1.86	2
11	<i>Pinus roxburghii</i>	-	-	19	21	20	17	19	7	8	-	-	15	13	7	21	167	150.3	11
12	<i>Choerospondias axillaris</i>	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	1.06	1
13	<i>Juglans regia</i>	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	2	0.86	1
14	<i>Cinnamomum tamala</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	0.42	1
15	<i>Boehmeria rugolusa</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2	0.84	2
16	<i>Grevelia robusta</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	3	1.68	1
<b>Total no. of species =</b>																	<b>217</b>		

**Plot - B**

S.N.	Species	Sample Quadrates																		Total	Total circumference (m)	No. of Quadrates species present
		Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Q 10	Q 11	Q 12	Q 13	Q 14	Q 15	Q 16	Q 17	Q 18			
1	<i>Betula alnoides</i>	-	-	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	4	1.88	3
2	<i>Alnus nepalensis</i>	-	-	-	-	-	-	-	-	2	-	-	3	-	-	-	-	-	-	5	4.72	2
3	<i>Pyrus pashia</i>	-	5	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	8.38	2
4	<i>Prunus cerasoides</i>	-	-	2	1	-	-	-	-	-	-	-	2	1	-	-	-	-	-	6	2.72	4
5	<i>Ficus auriculate</i>	-	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	3	2.26	2
6	<i>Rhododendron arborium</i>	3	-	1	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	6	3.22	3
7	<i>Lyonia avalifolia</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	4	2.83	3
8	<i>Albizia chinensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	2	-	5	2.57	2
9	<i>Quercus lamellosa</i>	1	6	-	-	-	-	-	-	-	-	-	1	2	-	-	1	-	-	11	3.56	5
10	<i>Schima wallichii</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1	-	-	4	2.28	2
11	<i>Pinus roxburghii</i>	-	-	-	8	20	17	19	19	13	-	-	-	-	-	2	5	2	1	106	95.93	10
12	<i>Choerospondias axillaris</i>	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	3	2.89	3
13	<i>Juglans regia</i>	-	-	-	-	-	-	-	-	-	-	-	2	-	1	2	-	-	-	5	3.15	3
14	<i>Cinnamomum tamala</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	2	0.83	1
15	<i>Boehmeria rugolusa</i>	-	1	1	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	4	1.72	4
16	<i>Grevelia robusta</i>	-	1	-	1	-	-	-	-	-	3	-	-	-	-	-	-	-	1	6	2.93	4
17	<i>Ficus sps.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	0.47	1
<b>Total no. of species =</b>																			<b>186</b>			

**Plot - C**

S.N.	Species	Sample quadrates										Total	Total circumference (m )	No. of Quadrates species present
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10			
1	Schima wallichii	1	-	-	1	-	-	-	-	-	-	2	1.39	2
2	Alnus nepalensis	2	-	-	-	-	-	-	-	-	-	2	1.22	1
3	Pyrus pashia	1	-	-	-	-	-	-	-	-	-	1	0.42	1
4	Pinus roxburghii	7	9	17	15	23	21	20	20	17	16	165	96.5	10
5	Cinnamomum tamala	-	1	-	-	-	-	-	-	-	-	1	0.39	1
6	Boehmeria rugolusa	-	3	-	-	-	-	-	-	-	-	3	1.87	1
<b>Total no. of species =</b>											<b>174</b>			