STATUS, HABITAT UTILIZATION, THREATS AND CONSERVATION OF MUSK DEER (*Moschus chrysogaster* HODGSON 1839) IN LANGTANG NATIONAL PARK, CENTRAL NEPAL.

By

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A Dissertation Submitted in Partial fulfillment of the Requirement for the Degree of Master's of Science in Zoology (Ecology)

Central Department of Zoology-Ecology Program

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APPROVAL

This dissertation submitted by **Mr. Mitra Panedy** entitled **"Status, habitat utilization, threats and Conservation of musk deer (*Moschus chrysogaster* Hodgson 1839) in Langtang National Park, Central Nepal"** has been accepted as a partial fulfillment of Master's Degree in Zoology Specializing in Ecology

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RECOMMENDATION

It is my pleasure to mention that **Mr. Mitra Pandey** has carried out the Dissertation entitled **"Status, habitat utilization, threats and Conservation of musk deer (*Moschus chrysogaster* Hodgson 1839) in Langtang National Park, Central Nepal"** Under my supervision and guidance. This is the candidate's original work, which brings out important findings essential for biodiversity conservation in remote mountain region. To the best of my knowledge, this dissertation has not bee submitted for any other degree in any institution. I recommend that the dissertation be accepted for the partial fulfillment of the requirement for the Degree of Master's of Science in Zoology Specializing in Ecology.

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On the recommendation of supervisor **Dr. Mukesh Kumar Chalise**, this dissertation submitted by **Mr. Mitra Pandey** entitled **"Status, habitat utilization, threats and Conservation of musk deer (*Moschus chrysogaster* Hodgson 1839) in Langtang National Park, Central Nepal"** is approved for examination.

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ABSTRACTS

"Status, habitat utilization, threats and Conservation of musk deer (*Moschus chrysogaster* Hodgson 1839) in Langtang National Park, Central Nepal" was carried out in Musk Deer Conservation Area of LNP. The study was conducted spending more than 516 hours (16th February 2005 to 4th October 2005).

The study applied the indirect method identifying 5 different blocks in the habitat for the status and habitat utilization of musk deer in LNP. It mainly deals with types of fecal deposits, distribution of those deposits in different topography and forests. The study also deals with other related evidences found in the study area. Questionnaire survey provides the additional information regarding its threats and conservation.

Forty-five different fecal deposits were found and 3 musk deer were sighted. Block B was found to be the appropriate habitat for musk deer. 68.8 percent of fecal deposits were recorded in Block B. Different types of fecal deposits found in Block B were very fresh and fresh (22.5%), old (38.7%) and very old (16.3%).

Thirty-three species of plants were recorded from the quadrates plotted in the study area. Among them *Betula utilis* was found the most dominant species . High percentage of fresh droppings were also recorded in *Betula* forest and maximum old deposits were recorded in mixed forest.

Animal trail was found preferred by musk deer. Forty percent of observed droppings were found on animal trail. Similarly, 8.88 percent of

Relic sites were found in animal trail. High number of bedding sites were recorded in *Betula* and mixed forest.

Questionnaire survey revealed that musk deer in Langtang National Park is in declining state. Seventy percent of the respondents agree about the poaching activity of musk deer in their area. Apart from this, tourists, local people and livestock are the major threats to musk deer in Langtang. High degree of habitat deterioration, livestock grazing, illegal hunting and predator such as Snow Leopard are the major threats in that area. Therefore, these issues have to be addressed for a long term survival of the endangered musk deer species in Langtang National Park.

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1. INTRODUCTION

1.1 General Background

Nepal has been blessed with diverse wildlife biodiversity. It also consists of variety of climatic zones. The country can broadly be divided into three major physical divisions as: 1) The Terai region 2) The mid-mountain region 3) The Himalayan Region. Terai is situated in the south along the border of India. It is low, flat and fertile landscape that is northern extension of Gangatic plain and which varies in width about 25 to more than 32 kilometers in south to north. The northern part is a little more elevated hills up to 1500-2000 m called Churiya. Next comes, mid mountain region, a densely populated area with a complex mountain ranges up to 3,000 m. Himalayan mountain range lies along the northern border with Tibet, China. It contains world's 13 highest peaks including with its highest crest up to 8848 m. Above 5000 m there is permanent snow. This together with the monsoon rainfall along the south facing slopes, has resulted in compacting virtually all climatic zones found on the planet earth (Shrestha 2003).

All of these physical regions are rich in wildlife biodiversity. The term wildlife include animals as well as plants which form part of any habitat in nature. It is the major part of the eco-system. Biodiversity refers to the variety and variability among living organisms and ecological complexes in which they occur. Biodiversity is the rule of nature. In practical terms, biodiversity is expressed as species diversity (weighted for rarity, endemism and taxonomic distinctive if necessary) At the landscape level (Kramer et al. 1997). A species is a product of habitat to which it constantly adopt through evolution and is itself part of the habitat. Therefore best way to preserve the species is to preserve the habitat.

Himalayan region has unique functions and roles as represents one of the world's richest ecosystem in terms of biodiversity. This diversity is a result of the extreme altitudinal differences and associated changes in climate and soil conditions creating a striking characteristic difference in natural vegetation and faunal diversity. The rich biodiversity in ecosystems, species and genetics are found in the Himalayas, is the result of the immense variety of environments found in the mountain ecosystem (ICIMOD 1998). The information on biodiversity such as animal status (abundances, distribution, home range etc.) population and community interactions along with the contribution to the development of ecosystem is essential for the conservation and management of wildlife and protected areas (Basnet 1998). This study is focused on the musk deer (*Moschus chrysogaster*) of Langtang National Park, which has the critical condition from the conservation point of view.

1.2 Objectives

The prime objectives of the study were:

i. To explore the status and distribution of musk deer in the Langtang National Park.
ii. To determine the habitat utilization of musk deer.
iii. To find out the Threats to musk deer.
iv. To provide public awareness education for the conservation of musk deer.

1.3 Justification of the Study

Wildlife conservation is the major problem of today. Many species of wildlife have been extinct from the world and other are reducing day by day. Musk deer is also one of them (Green and Kattel 1997). In Nepal, musk deer are few in number and is native of Asia. Population of musk

deer are reducing because of habitat destruction, poaching, over exploitation of natural resources and lack of knowledge of their conservation and proper management. Very little scientific information is available about them. To learn more about the animal, every aspects of their ecology needs additional investigation.

Habitat is the basic requirement of all living species. Thus the knowledge on habitat utilization is essential to understand the ecology and behaviour of animals to develop effective management for conservation.

Vegetation analysis is often considered as the basic need to understand plant ecology. It helps to develop detailed picture of plant communities. Before any detailed work is commenced in an area, it is necessary to know what species are present. Study in musk deer has been done by Green (1986), Kattel (1992), and few others in Sagarmatha National Park, but no much study has been found to be done in Langtang National Park earlier. Realizing importance and necessity to fill the latest information, present study was done. The present study basically deals with the status and habitat utilization of musk deer in the musk deer conservation area of Langtang National Park (LNP) for the conservation management of this endangered species.

1.4 Limitation of the Study

i. Shy, solitary and crepuscular habit of musk deer limits the study work, that is intended for short period.
ii. Heavy tourist flow and freely wandering domestic animals in the park use to disturb the research work so that our automatic heat censored camera couldn't trap the respective animal in large number.

iii. People hesitate to participate questionnaire survey as it is concerned to a protected animal.

iv. Our study was concentrated only for the partial fulfillment of academic degree for Masters in Zoology (Ecology). Therefore we couldn't spent much time regularly in the field.

1.5 The Musk Deer

Musk deer (*Moschus chrysogaster*) is called 'Kasturi mriga' in Nepali language. It is distributed sporadically throughout the forested, mountainous parts of Asia. The musk deer is best known for its musk, a secretion of the male preputial gland that has been used in traditional oriental medicines and perfumes for many hundreds of years. Despite its popularity renown, little is understood about this small, primitive, deer like animal. It's evolutionary history remains uncertain and its taxonomy is also confused (Green and Kattel 1997).

1.5.1 Taxonomy

For a long period, the taxonomy of musk deer has been under discussion (Flerov 1952, Groves and Feng 1986) Musk deer were originally classified as members of the family Cervidae (Flower 1875), but more recently, they have come to be regarded by most authors as a separate family Moschidae (Flerov 1952, Groves and Feng 1986, Homes 1999). At least four species within the genus *Moschus* are recognized (Green 1996, Groves and Feng 1986). Today, most authors regarded this number as an underestimate (Zhou et al. 2004) and proposed five species of musk deer as follows:

- Forest musk deer (*M. berezovskii*)
- Alpine musk deer (*M. sifanicus*)
- Himalayan musk deer (*M. chrysogaster*)

- Black musk deer (*M. fucus*)
- Siberian musk deer (*M. moschiferus*)

1.5.2 Distribution

The genus *Moschus* is distributed sporadically throughout the forested mountainous parts of Asia, from just north of the Arctic circle south ward to the northern edge of Mongolia and to Korea (Map:1). Further South, avoiding to Gobi desert, the musk deer occur to China, Burma, India (Assam) and the Himalayan region (Flerov 1952). Three species of musk deer are recognized following taxonomic revision of the genus by Groves (1976) and more recently by Grubb (1982). *M. moschiferus* in USSR, Northern China and Korea; *M. berezovskii* in Southern China and Northern Vietnam and *M. chrysogaster* in Western China, Tibet and the Himalayan range. Green (1986) consider Himalayan musk deer to be *M. chrysogaster* and gave its distribution. A fourth species *M. fucus* lives in the eastern Himalayas mainly in Bhutan, China, India, Myanmar and Nepal (CITES 2000). *M. sifanicus* is endemic to China (Zhou et al. 2004).

According to CITES (2001), Shrestha (1989), Sathyakumar (1993), Kattel and Alldredge (1991), *Moschus chrysogaster* lives along the Himalayas in Afghanistan, Pakistan, Northern India, Nepal, Bhutan, and Southern China.

In Nepal, they are found along the northern border and occur in 8 protected areas.

i. Rara National Park
ii. Makalu Barun National Park
iii. Sagarmatha National Park
iv. Shey-Phoksundo National Park

v. Khaptad National Park

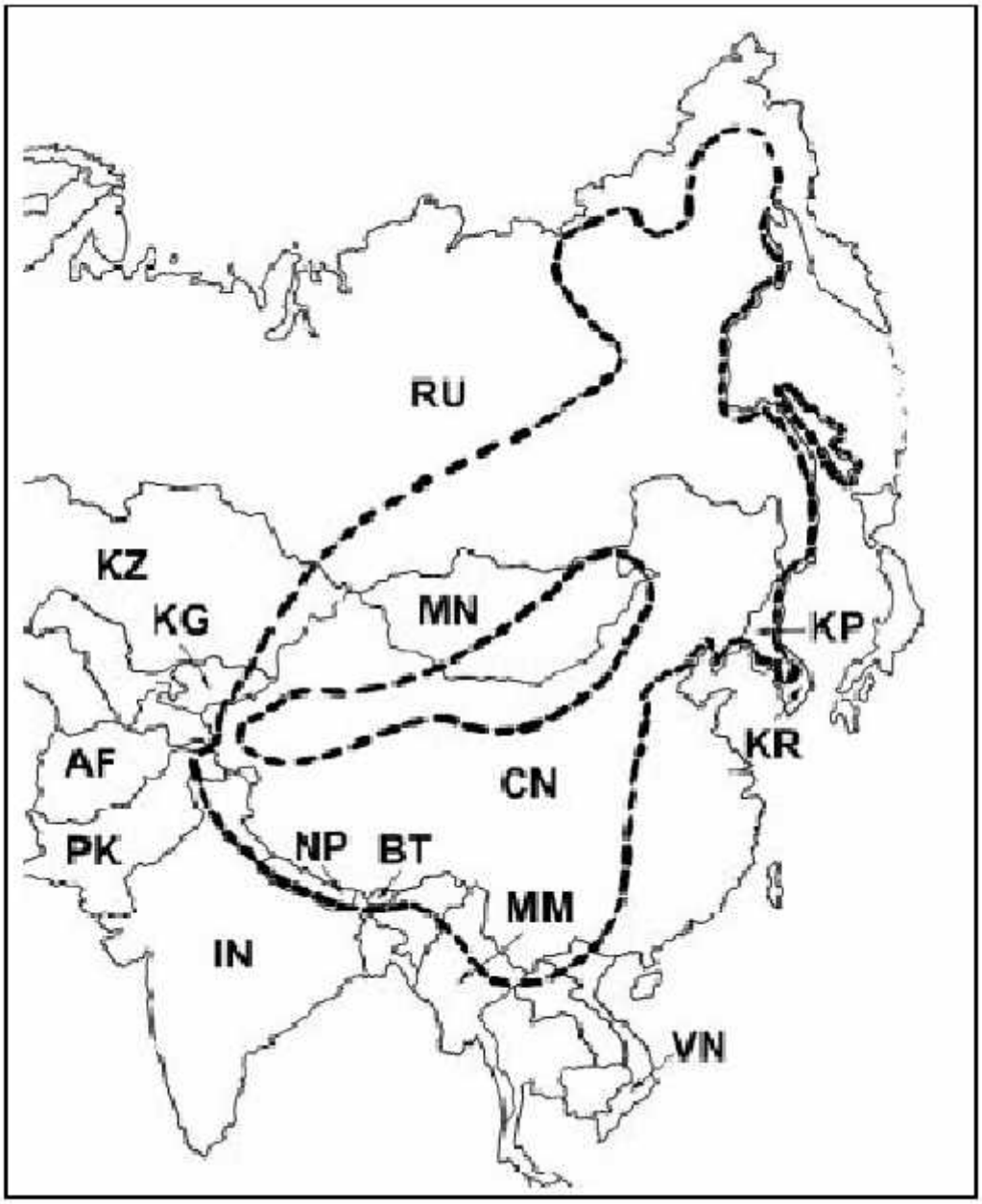
vi. Langtang National Park

vii. Kanchanjunga Conservation Area

viii. Annapurna Conservation Area

Langtang National Park has been supposed to bear large number of musk deer (Chapagain and Dhakal 2005)

Map 1 : Global Distribution of Musk Deer



Credit: Jürgen Matijevic and Alexandra Heyse, WWF Germany

1.5.3 Threat to Musk deer

Musk deer population have declined dramatically during this century as a direct result of widespread illicit hunting of the animal for its musk. Given that a single musk gland or pod, weighting an average 25 g, will provide a pastoralist family with 6-12 months cash income (Jackson 1979, Harris 1991). Hunting is very intense and populations within a given valley may be wiped out within a few years. Hunting traditionally with snares but increasingly with guns, is largely indiscriminate of the age and sex of animals, such that four or five musk deer may be killed for every pod bearing male secured (Jackson 1979, Green 1986).

Habitat destruction, due to increasing human and livestock populations in many Himalayan countries and other mountainous regions, is also a serious threat. This applies particularly to the shrub layer of vegetation which provides musk deer with food and camouflage from predators, including human beings. Expanding pastoralism may also affect musk deer indirectly through predation and harassment by domestic dogs, used to protect livestock (Green 1986, Harris, 1991).

1.5.4 Conservation status

Moschus Chrysogaster is legally protected by HMG/ Nepal under schedule 1 of the National Park and Wildlife Conservation Act, 2029 (1973).

Musk deer and CITES

Concern over the high levels of international trade in parts and products derived from musk deer made all musk deer species *Moschus* species included in the Appendices of the CITES in 1979, with the

purpose of the regulating and monitoring control of international trade in musk deer, so that such trade didn't threaten the survival of these species. Population of musk deer in Afghanistan, Pakistan, Nepal, India, Bhutan, and Myanmar were included in Appendix 1 in 1983, with the effect that population was prohibited to hunt. All other musk deer species were listed in Appendix II, which means that international trade is allowed, but is strictly regulated, according to the provision of convention.

Musk deer and the Red Data List

All species of musk deer are listed in the IUCN Red List of Threatened Species (IUCN 2004). The IUCN red list is an inventory of the global conservation status of plants and animals, which used a set of criteria to evaluate the extinction risk of thousands of species and subspecies. These criteria are relevant to all species and all regions of the world. There are nine categories of Threat in the IUCN Red list system: Extinct, Extinct in the wild, Critically Endangered, Endangered, Vulnerable, Near Threatened, Least Concern, Data Deficient and Not Evaluated. The Siberian musk deer is classified as vulnerable, while Himalayan musk deer, forest musk deer and black musk deer are all listed as Lower Risk/near threatened (a 1994 red list category).

1.5.5 Physical Characteristics

Musk deer are of dark brown colour and their body is covered over with coarse and brittle hair. The fawns are often spotted (Shrestha 1997).

M. chrysogaster looks like a small deer with long upper canines that are visible even when the mouth is closed. It doesn't have antlers. It's tail is hairless except for a small tuff at the end (Shrestha 1989), and it has long "hare-like" ears (Sathyakumar and Prasad 1993). It has an externally visible musk sac that lies between its reproductive organs and umbilicus.

The opening of the sac lies anterior to the urethra. A musk deer is about 60 cm tall and has a shoulder height of 20 cm (Shrestha 1989). Its rearmost pan is slightly elevated to suit its jumping and galloping mode of life (Shrestha 1997). Musk deer are stockly built animals with small heads. The hind legs about 5 cm larger than the forelegs, indicating a tendency to move by leaping. The musk deer posses a gall bladder, which is bovide characteristics and female musk deer have only one pair of teats unlike advanced deer, which have two pairs (Kattel 1992). All these characteristics impress the musk deer is considered to be a very primitive members of the deer family (Shrestha 1997).

1.5.6 Habit and Habitat

Musk deer is a very shy, solitary territorial animal (Green 1986). *M. chrysogaster* is a solitary animal with a bounding gait (Sathyakumar and Prasad 1993).

Musk deer uses latrines for defecation, which may be used by more than two animals. It is crepuscular in habit i.e., active at dusk and dawn. They always squat when urinating or defecating. They scent mark by rubbing the caudal gland located at the base of their tail against plant. This leaves a greasy smear on the plant (Green 1986).

Musk deer breed seasonally. The mating season is November - January. Soon after the first snow fall in November, the female starts to exhibit the sign of heat and this lasts from November to March. On an average the heat period extends up to 48 hours. Approximately, at the age of 2.5 years the male is capable of performing more than three copulations a day (Tiwari and Singh 1999). The gestation period is 160 days. Birth of young (usually single) occurs in June or July.

The Himalayan musk deer doesn't take any seasonal migration, remaining in the same area year - round despite harsh weather conditions (Kattel 1992). Musk deer remain usually above 3000m. (Khalid et al. 1995). Its coveted habitat is the high altitude birch (*Betula utilis*) and rhododendron (*Rhododendron campanulatum*) forest or fir forest. Musk deer in the alpine animal. It leaps and escapes up precipitous cracks and along cliffs. They are sure footed for this reason (Shrestha 1997).

1.5.7 Food Preferences

Musk deer feed on herbaceous and woody plants, leaves, flowers, twigs, shoots, grass, lichen and moss. More than 130 plant species are consumed by musk deer. In the winter, arboreal lichens and some terrestrial bushy lichens make up about 70 percent of the contents of a musk deer's stomach (by weight). In the summer herbaceous plants are the main diet (Green and Kattel 1997, Mac Donald 1995). Himalayan musk deer, existing under extremely harsh climatic conditions, consume a high quality diet during summer, a strategy which is essential for survival through winter (Snider and Asplund 1974). They have a preference for easily digestible nutritious foods that are high in energy content, rich in protein and low in fiber (Green 1986). Musk deer can climb into trees to graze on lichens and leaves otherwise out of reach. The young and adult prefer the leaves of *Persecaria nepalensis,* especially during monsoon season. They relish *Jasminium officinalis, Launea nudicalulis, Bergenia spp., Holloboelia talifolia, Biola serpens, Chrysanthemum spp, Polygonium spp.* (Sathyakumar and Prasad 1993), flowers of *Rhododendron arboreum,* leaves of *Strobilanthes dalhousianus, Pyrus pashia, Prunus domestica, Rubus nutans, Smilax spp., Quercus leucotrichophora, Q. glauca, Arundinaria falcate, Usnea, Agaricus,* etc. Although musk deer rely on wild plants, the farm food they consume that consists of wild as well as agricultural feed. It also prefers juicy fruits like

wild apples, pear, white melon etc. In captivity it is found to take 2-2.5 kg of fodder, however it may be 3 kg in summer and 3.5 kg during monsoon season. It takes 50-60 ml water per intake that ranges 2-6 times daily depending upon the season (Joshi et al. 1993).

1.5.8 Predators

Favorite habitats are sections with rocky places, which provide shelter from predators. In the summer, most of their time is spent in valley of forest rivers, around streams and near fields with good grassy vegetation. Musk deer have a number of natural predators. Depending on the range, their main predators may include the wolverine (*Gulo gulo*), Grey wolf (*Canis lupus*), Leopard (*Panthera pardus*), snow leopard (*Uncia uncia*), lynx (*Lynx lynx*), fox (*Vulpes vulpes)* and yellow throated martin (*Martus flavigula*). The youngs are also attacked by large birds of prey (Green 1987). Musk deer detect approaching danger in part through their sense of hearing (Zhivotshenko 1988).

2. STUDY AREA

2.1 Physical Description

There are 16 protected areas in Nepal and among them 3 conservation areas and 5 National parks lies on northern mountainous zone. Langtang National Park (LNP) is in the Central Himalayan region of Nepal, 132 Km. north of the capital, Kathmandu, bordering in the north-east, Tibet autonomous region of China. Langtang Lirung (7245m) is the highest point in the park while lowest develop drop to about 1000m on the bank of the Bhotekoshi - Trishuli River. Gosainkunda lake (4380m) lies in the south-west and Dorje Lakpa (6,988m) lies in the east (Map:2).

LNP is the most accessible of the mountain national park and can be reached during the monsoon and winter, the park is accessible from Kathmandu by vehicle to Dhunche and Syabrubensi Via Trishuli and then trekking to Langtang valley. Alternate routes are from Gosainkunda or Ganjala, a 5,100 m pass, negotiable during monsoon and autumn months (Khatiwada 2004).

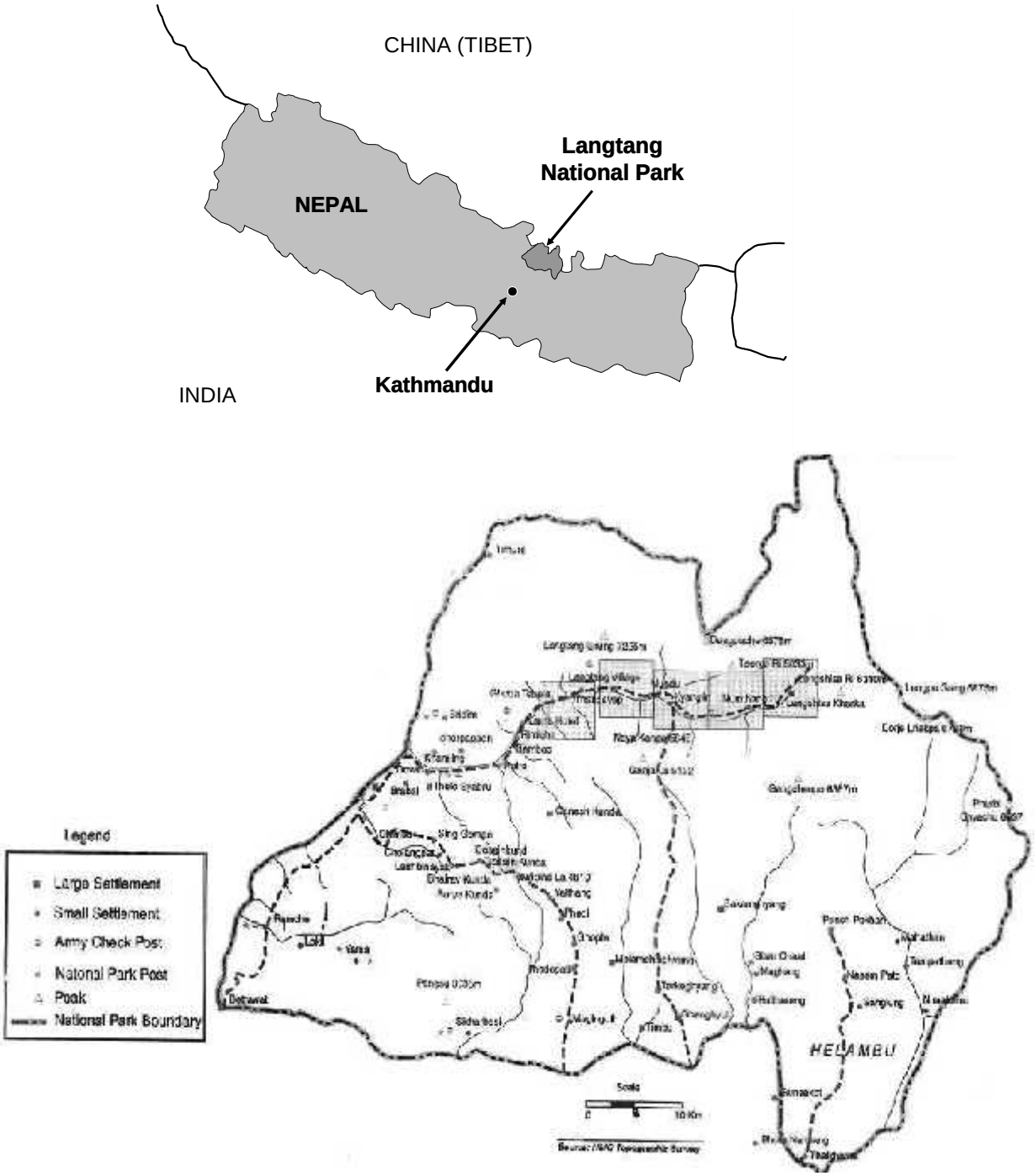
The Langtang National park was established in 1976 by His Majesty's Government of Nepal and in 1998, an area of 420 sq. Km. in and around park is declared as buffer zone (DNPWC 2004). LNP is the second largest Mountain National Park of Nepal, which cover 1710 km^2 in three district: Rasuwa, Nuwakot and Sindhupalchock of Bagmati Zone of Nepal (Chalise 2003).

2.2 Drainge

LNP consists of many springs, Rivers ad Lakes. All the rivers in the park are torrential. Langtang Khola and Bhote Koshi are two major Rivers fed partially by glaciers and those which don't have glacial origins are Trishuli, Phalanga, Tadikhola.

Monsoon climate affects the River discharge and its velocity. Bhote Koshi at Syafrubensi increase by five fold. A seven fold increase in the Langtang Khola at Syafrubensi and twenty four fold in courses in the Trishuli Khola at Dhunche (DNPWC/DUHE 1977).

Map 2: Langtang National Park



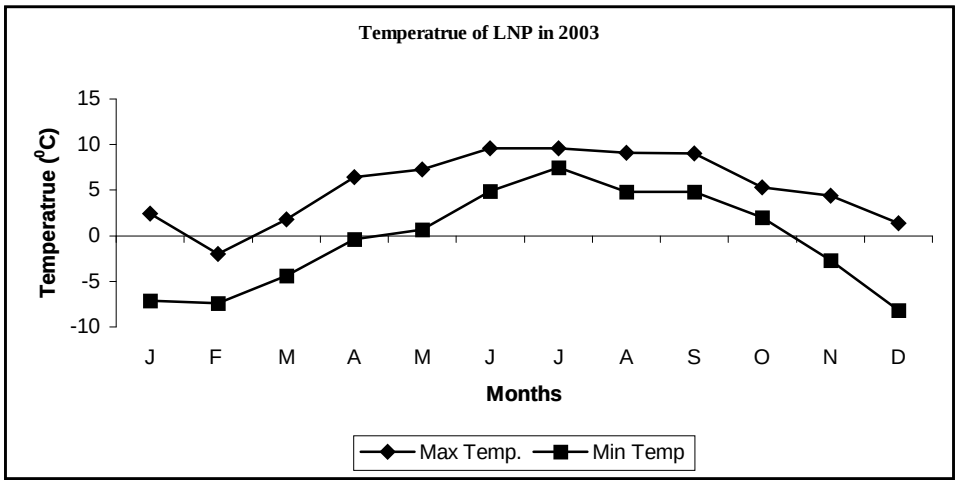
2.3 Climate

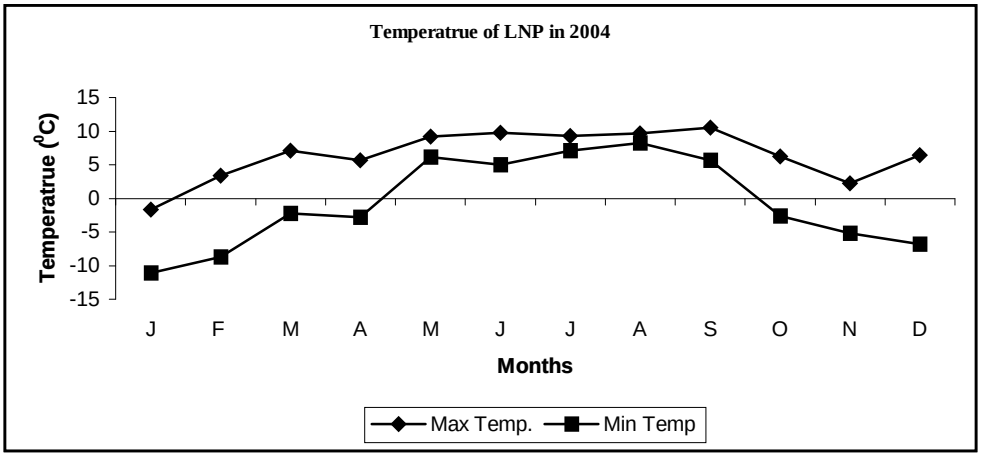
The coldest and driest months are January, February, March, November, December while the warmest and wettest months are May, June, July, August and September. In the summer, the mean maximum temperature recorded was 14^0C in June 1998 and mean minimum annual temperature recorded since 1993 to 2005 was -14^0C in February 2001 (Fig.1).

The seasonal climate is dominated by the southerly monsoon which occurs June to September. The incidence and type of precipitation is mainly related to aspect, altitude and the presence of rain shadow effect. Total annual precipitation is estimated at 526.8 mm to 1041.5 mm, with more than half occurring as rain during the monsoon period (July-September). Data from Langtang, the nearest weather station (which lies inside the study block also), annual precipitation is extremely variable ranging from less than 526.8 mm in 1993 to about 1041.5 mm in 1995 (Fig. 2).

Snowfall rarely remained on the ground for more than a few days on south facing slopes, in contrast to northerly slopes which retain their winter snow cover up to several months. The monsoon usually reaches the study area in late June or early July and lasts until the end of September. June to August tend to be the wettest month but precipitation varies greatly from year to year. The skies are clear early in the morning. After the late of monsoon all the sky is covered by cloud and mist which reduce visibility. For the purpose of this study the seasons were defined as Winter (December-mid March), Spring (mid March-May), Summer (June-September and Autumn (October-November). Detail of 1993 to 2005 meteorological data are attached (Annex. 1).

The data of temperature, clearly shows that December, January and February are very cold months and June, July and August are Warm months (Fig. 1).





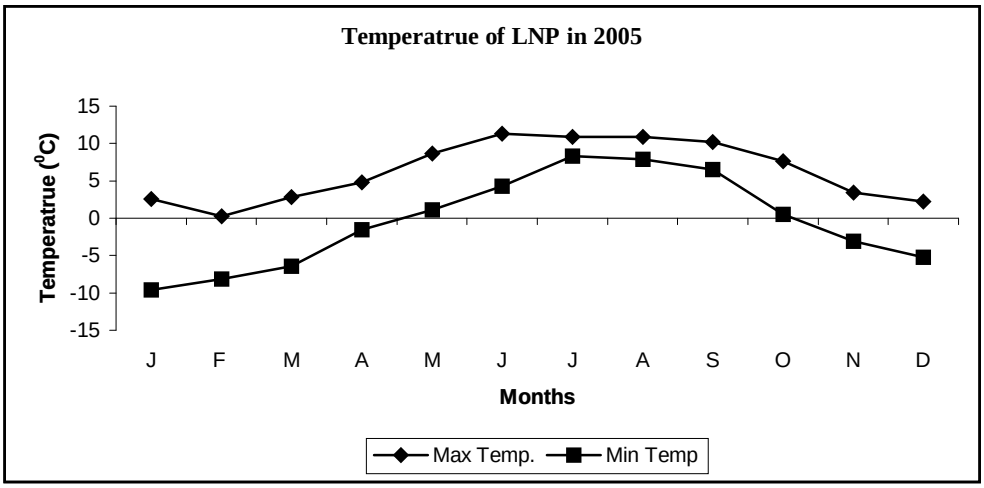


Figure: 1 Monthly Maximum and Minimum temperature (2003-2005) recorded at Kyanjing Gumba, Rasuwa

The study shows that May, June, July, august are rainy months: where precipitation rate is high and less precipitation on October, November, December and January (Fig. 2). From the comparison of Precipitation data, more precipitation was in 1995 (i.e., 1041. 5 mm)

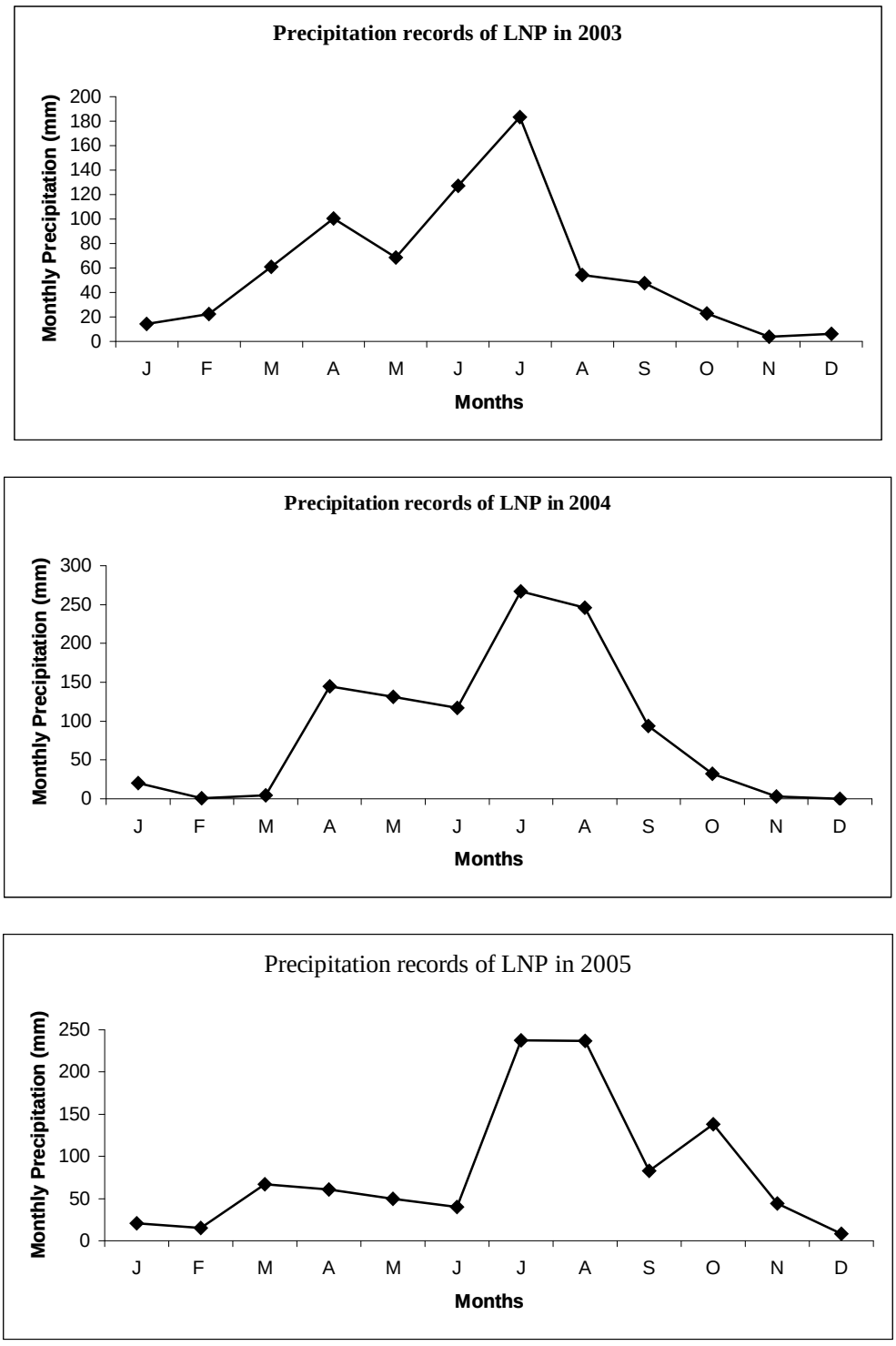


Figure 2: Monthly Precipitation Recorded at Kyanjing Gumba, Rasuwa (2003-2005)

The study shows that the months: June, July August and September are the most humid months in the area (Fig. 3).

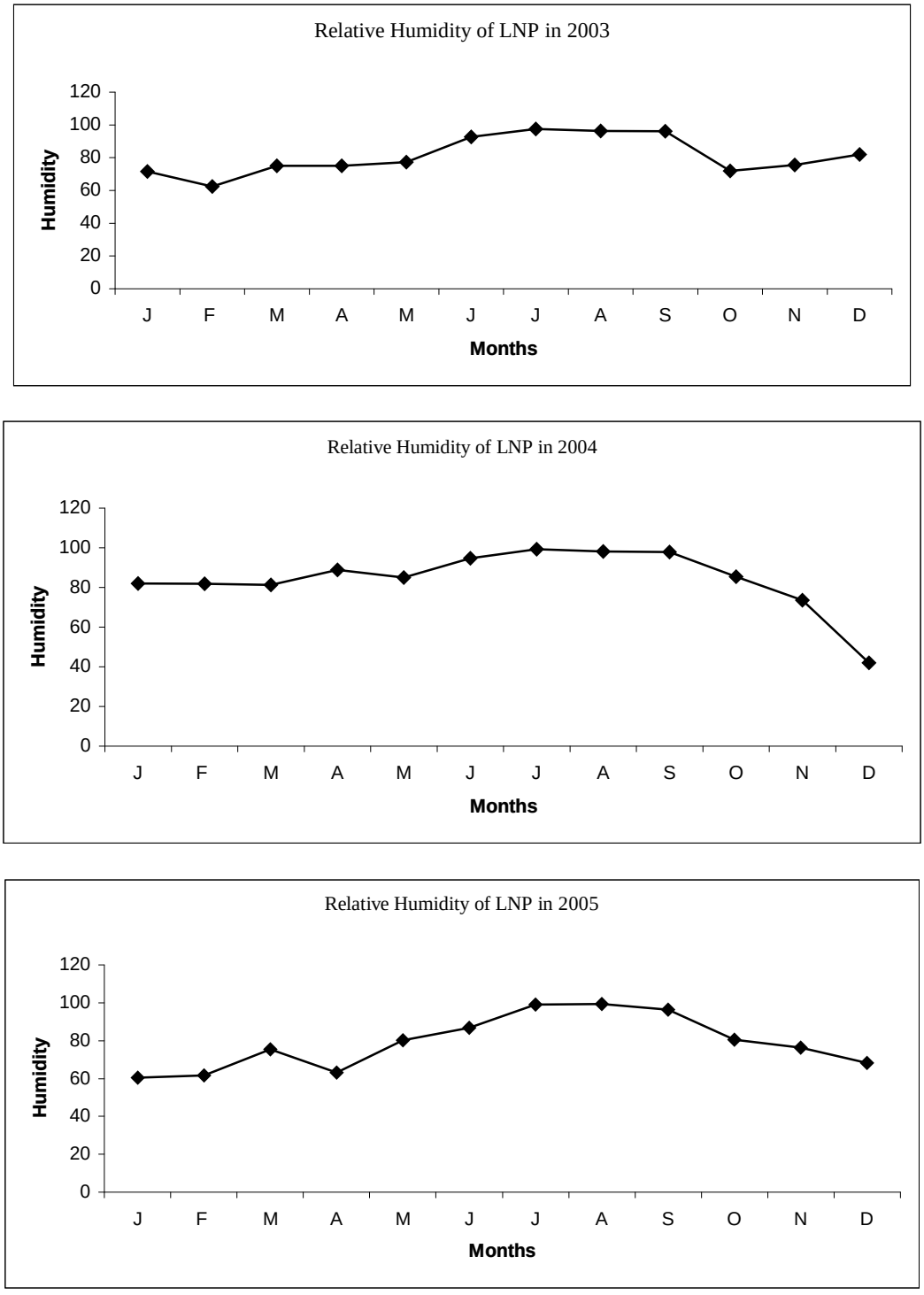


Figure 3: Monthly Relative Humidity (2003-2005)

2.4 Soil

Although no economically viable mineral concentrations are reported to occur in Langtang, the park may be considerably affected, indirectly, once the lead-zinc deposits of Ganesh Himal beings to operate. An Indian company (Hyderbad Asbestos Cement Products Ltd.) has hold the permission of mining rights from the HMG. For this purpose, a road has been constructed to transport ore from the mining site, Ganesh Himal to India.

For such a dissected area, where topography, vegetation and aspect severely affect local soil pattern, it is difficult to generalize. Mature, mainly fertile loams soil occurs in the lower forested regions. In the upper Langtang valley, the most common textural component is sandy-loam with a large proportion of rocks. The mean proportion of sand decreases with elevation and loamy sands become predominant below 2,440 m. Where the practice of pasture burning occurs, the top soil layers often comprise alternating darks and pale horizons due to ash accumulation, and the pH is more homogenous between them. Soils are generally fairly acidic, pH 5-6 (Maire 1973).

A consideration for park management associating all the different aspects of climate, topography, hydrology, geology and soils is the incidence of erosion, both natural and accelerated. The sub and alpine environments are affected by livestock and grazing prevailing shorter growth periods. Cattles, grazing for much of the days of year on the higher slopes, frequently create soil 'baths' in which they rest and roll. Trails suffer from margin collapse each year, particularly at the time of mass transhumance before and after the monsoon. At lower forested elevations foraging and wood-cutting activities, together with heavy rains, high run off and low evaporation during the monsoon, cause

considerable soil transportation. Resultant land, debris and mud slides cover extensive tracts of land in low basins. Gully and land slides erosion was formerly concentrated in Nuwakot District, in area of increasing population pressures and associated deforestation. (Tautscher 1970).

2.5 Vegetation

The greater altitudinal variation has caused the park's climatic and geological variation and consequently the variation in vegetation type. The description and classification of the vegetation in the park has been described in detail in the management plan (DNPWC/DUHE 1997).

Upper Tropical Zone (<1,000 m)

A very small portion of this zone is covered by hill Sal (*Shorea robusta*) and Simal (*Bombax ceiba*) forest. Hill Sal forest is present in the lower Bhote Koshi. Hill Sal is completely different from that of Sal forests of southern plain of the country. This zone is heavily disturbed by human beings.

Subtropical Zone (1,000-2,000 m)

This zone is also under the great anthropogenic pressure. However, small pockets are still untouched due to steep slopes. Mainly, three different kinds of forests can be observed in this zone.

Hydrophilic forest (*Schima wallichii*) occur in the wettest area of the park, e.g. the lower elevations of the Larke, Panch Pokhari and Nasem Khola and the east bank of the Melamchi Khola. This appears to be the only vegetation type of this zone in which small areas have remained reasonably unspoilt in Nepal. Mesohydrophyllic forests (*Schima wallichii, Castanopsis indica*) occurs in the damper areas of the lower

Trishuli, Melamchi, Larke, Panch Pokhari and Balephi Khola and Bhote Koshi.

Xerophyllic forest and heath (specially, species predominated by *Pinus roxburghii*) occurs on drier slopes, mainly in the upper Bhote Koshi Valley, due to rocky terrain and reduced rainfall, *P. roxburghii* is often the only tree present. This vegetation type is frequently exposed to fires and the dense herb layer is poor in species. *Euphorbia royleana* occurs in the dry, rocky habitats along the Bhote Koshi and lower Langtang valley, in association with other strictly xerophyllic plants such as *Agave mexicana*.

Temperate Zone (2000-3000 m)

Agricultural pattern and cattle's grazing has largely affected the forest vegetation within the park in this zone. Intensive collection of fuel wood and fodder has degraded the forest. The forest has stunted sparse tree species present which are species associated with shrub such as *Berberis*, *Rubus* and *Lonicera*.

Hydrophillic *Quercus lamellosa* forest occurs on south side of the park, although it is also present in the wetter part of the Bhote Koshi and Trishuli Khola. Mesophyllic *Quercus lanata* forest on south facing slopes together with *Rhododendron arboreum* and *Lyonia ovalifolia* occur. Mesoxerophyllic *Pinus excelsa* and *Rhodondendron arboreum* forest lies in the upper Bhote Koshi and lower Langtang area.

Temperate zone includes hill zone and montane zone. In montane zone, vegetation varies from the damp, shaded *Q. semecarpifolia* and *Tsuga dumosa* type, to the mesohydrophyllic stands which are almost pure *Q. semecarpifolia*. Other types of forest includes those which have been burnt and now consist mainly of *Q. semecarpifolia*. The further

degeneration of natural forest, due to the presence of livestock in spring and autumn, has resulted in heaths. Community, where *Rhododendron arboreum* is at a selective advantage and ultimately, heath communities, where trees have been removed. This zone corresponds to the Himalayan wet Temperate forest (Champion 1968).

Lower Sub alpine Zone (3000-3600m)

This zone is mainly characterized by the dominance of coniferous and rich variety of associated species. It occupies and almost continuous belt throughout the park, broken in places by burnt areas where dense bamboo (*Himalayacalamus falconeri, Arundinaria sp. and Thamnocalamus aristatus*) stands thrive.

On damper, steep, north-facing slopes *Rhododendron barbatum* is often present in pure stands. At the lower altitude of this region, *Acer* specis are present. These often extend down into gulley of the Upper montane zone. In slightly drier conditions, *T. dumosa* is an important constituent of the zone together with *Abies spectabilis*. The mesophyllic habitats are characteised by *A. spectabilis* and *Larix nepalensis* in the area of less rainfall to the north of Gosaikunda Lake - Dorje Lakpa range. The *L. nepalensis* is peculiar because of its localized distribution in the eastern Himalayas.

Abies spectabilis, the high altitude fir, is common in the upper forest. It is not usually found below 3000 m, but where occasional trees occurs rather below of that altitude, they retain the appearance characteristics of the tree at the higher altitudes. *A. spectabilis* doesn't usually exceeds 24 m in height its branches are widely spreading, and its leaves are much more stuff. Above 3,500 m the *Abies* often is supressed by *Betula utilis*, but in some places it ascends to the tree line. Below 3000 m, it usually gives way to *Tsuga dumosa* forest or to *Acer, Osmanthus*

and *Magnolia* of the upper temperate mixed broad-leaved forest. This fir forest normally has a dense under storey of rhododendron and when seen in spring it create one of the most beautiful sights of high land forest in Nepal. The upper canopy of the forest is composed almost exclusively of the fir, and the straight stemmed trees attain a height of 25-30 m.

The Rhododendron occurring in *Abies* forest are limited to *Rhododendron barbatum, R. campanulatum, R. arboreum* and in a few places the Nepalese endemic *R. cownianum* occur. Broadleaved trees are not common in this *Abies-Rhododendron* forest and mostly confined to clearings. The one most frequently found are *Betula utilis* and species of *Sorbus* and *Acer* where the *Abies* is burnt or the area cleared, dense thickets of bamboo often spring up. The area near Sing Gompa and Thade have dead stand and fire blackened trunks of conifers. This zone corresponds to Alpine Fir-Birch forest, Birch-Rhododendron forest, most temperate deciduous forest and Eastern Oak-Hemlock forest (Champion 1968).

Upper Sub Alpine zone (3,600-4,000 m)

Diversity of flora goes on decreasing on ascending up in alttitude. *Betula utilis* is the characteristic tree species of this zone. Pastures often extends down to areas covered previously by forest. This is largely attributed by overgrazing. On north facing slopes, *B. utilis* is associated with *Rhododendron companulatum*, the latter being scattered and stunted above the tree line. In drier habitats, *B utilis* is absent and *R. campanulatum* is associated with *J. indica* and *J. recurva*. These juniper species are common. *A spectabilis* is still present in small numbers in the damp areas.

Wherever forest is absent, clumps of *R. lepidotum* and *R. anthopogon* develop and are dominant in and around the pastures

(DNPWC/DUHE 1977). This zone corresponds to the Alpine Fir-Birch forest and Birch-Rhododendron forest (Champion 1968).

Lower Alpine Zone (4000-4500 m)

This zone lies above tree line. Bushes of common plant species such as *Rhododendron, Lonicera, Junioperus, Cotoneaster*, depending on climate and humidity, the heaths are dominated by *Rhododendron sp.* (damp) or *Juniperus sp* (dry). Occurrance of *Rhododendron anthopogon* is characteristic of the moist areas. *Salix* species occurs in Langtang Valley often down into sub alpine zone, but are seldom seen in the south of the park. This zone corresponds to dry alpine scrub (Champion 1968).

Upper alpine Zone (4,500-5500m)

Species vary depending on the soil, aspect and degree of shelter. Grasses, herbs and cushion plants occur in the most favorable micro habitats (DNPWC/DUHE 1977).

2.6 Fauna

Because of the altitudinal variation, Langtang National Park has an abundant faunal species. These are recorded more than 46 mammal species, 345 bird species, 11 species of herpeto-fauna, 30 species of fishes, 70 species of butterflies and 10 species of spiders (Khatiwada 2002, Chaudhary 1998, Karki et al. 2002).

Langtang's expansive high meadow provide summer habitat for numbers of ungulate species such as musk deer and Himalayan tahr. Three species of monkeys are also found here - Rhesus monkeys, Hanuman langur and Assamese monkeys (Chalise et al. 2001, Chalise 2003). Some of the endangered species found in the park are: snow leopard (*Uncia uncia*), Clouded leopard (*Neofelis nebulosa*), Musk deer

(*Moschus chryrogaster*), Red panda (*Ailurus fulgens*). The prey species such as the Himalayan tahr (*Hemitragus jemlahicus*), Himalayan Marmot (*Marmota himalayan*), Pika (*Ochotona sp*.), Ghoral (*Nemorhaedas goral*). The park is also well known for the wild dog (*Canis alpinus*), Red fox (*Vulpes vulpes*), common leopard (*Panthera Pardus*), wolf (*Canis lupus*), Himalayan Yellow throated marten (*Martes flavigula*), Himalayan black bear (*Selenarctos thibetanus*), large Indian civet (*Viverra zibetha*), common langur (*Simnopathicus entellus*), Barking deer (*Muntiacus muntjac*) etc. Some of the important bird species in the park are: Impeyan pheasant (*Lophophorus impejanus*), Blood phasant (*Ithaginis cruentus*), Monal pheasant (*Tragopan satyra*). Tibetan snow cock (*Tetraogallus tibetanus*), Snow partridge (*Lerwa lerwa*), long tailed minivets (*Pericrocotus ethologus*), Black-capped sibias (*Heterophasia capistrata*), River chat (*Chimarrornis leucocephalus*), Yellow - billed Blue magpie (*Cissa flavirosteris*), lbisbill (*lbidorhyncha struthersii*) etc. Eagles and vultures are often seen soaring above cliffs and high pastures in search of carrion or prey. White-collared black bird, Himalayan Honey guide, scaly bellied wood pecker, Redstarts, Tits are other birds that can be seen. the Golden Eagle (*Aquila chrysetus*) is also present, although less common.

The most common seen reptiles are the Himalayan rock lizard, Green pit viper, Himalayan matrix, mountain Pit Viper, Large toad Viper are found in the park (Khatiwada 2002).

2.7 Socio-Economy

There are 15 VDCs within the Buffer Zone covering Rasuwa-11, Nuwakot - 3 and Sindhupalchok-1 (Khatiwada 2002). It comprises 10,509 household. Presently study is focused on the Langtang VDC, that consists of 521 total human population with 143 households (CBS 2002). The people from Langtang speak Kerung dialect. It seems that the

Langtang was settled by families from Kerung Tibet (China). However, there is intermingle of local Tamangs and refugees from Tibet. Although, they call themselves Tamangs but don't speak authentic Tamang dialect (Gurung 1988). They also celebrate Tibetan Buddhist festivals such as Loshar.

The inhabitants inside the Langtang National Park depends mainly upon tourism industry and agriculture for their livelihood. Five thousand trekkers some with porters and guides and Nine thousands pilgrims visit the park annually (Shrestha 1988).

The distribution of human population and livestock are governed by vertical stratification of the environment. Vertical strata are characterized by altitude, slope, ecology and availability of water. A general pattern of such utilization is high pasture zone (3,800-4,700 m), forest (2,600-3800 m) and cultivated zone (1600-2600m). Tourism is the primary source of income and agriculture is the secondary in terms of costs and benefits because of low crop production. Most people buy food grains by using earned money from various other activities. Popular crop combination being buckwheat, potato and barley. Cropping pattern is set in alternative way or one crop each year. Rearing of animals is a vary important aspects of the people of Langtang. Livestock is seasonally shifted for the litter fodder and pasture land. They are carried to upper elevation (3000-5000 m) from May-September and they come down to lower elevation at 2,000 m in winter. However, high altitude Yak and Nak don't come below 2,500m. Sheep and goats are grouped into several herds for the summer grazing. These animals usually graze in meadows not accessible by Yaks and in area where there is not enough fodder for larger livestock (Fox 1974).

Animals are allowed to graze freely in the valleys of park. Chauris and Nak are milked once a day and usually in the morning. Dairy Development Corporation opened the first cheese factory in Langtang in 1953. There are two cheese factories which has an ambitious target to produce 20,000 kilograms of cheese a year. Farmers also receives loan from cheese factory. Each cheese factory collects milk from 50 sq km of grazing areas by setting up more than half a dozen collection and processing depots (Gurung 1988).

2.8 Tourism

Tourism industry is the major income source of Langtang people. Langtang trekking is popular tourist destination. With the construction of road to Dhunche and Syafrubensi from Kathmandu, Langtang National Park has become the shortest trek in the Himalayas (Gurung 1988). Panoramic natural scenery of snow claded Himalayas, shrines and unpolluted environment has helped to attract international tourism.

More than 59 hotels and tea stalls are present along the trail from Syafrubensi to Kyanjing Gumba. In the entire Langtang Valley, there are 63 lodges, 19 tea stalls with camping sites and some restaurants run by local people. It indicates that tourism has a positive impact on the economy of the creating various employment opportunities for the local people and providing substantial contribution in improving the local economy. It has been reported unofficially that more than 200 children from the Langtang have been studying in Kathmandu by the donation from the tourists.

The large and increasing number of tourist in a small area might have some negative impact on the local environment. Due to high tourist pressure, the environment could easily degrade. The more trekkers in the valley, the more requirement of energy, which is based on fuel wood

from local forests. The forest deterioration can reduce soil fertility and enhance erosion and ultimately can also be disturbance to wildlife.

2.9 Musk Deer Conservation Area

Musk Deer conservation area (MCA) lies in the forest of north facing mountain of Langtang VDC. It extends from Langtang village (long E 85^0 30.00') to Langsisa Kharka (long. E 85^0 42.169'). The conservation area consists of five different types of forest Betula forest, Willow forest, Rhododendron forest, Mixed forest and Meadow. The area has harboured by various animals and birds specially musk deer. Besides musk deer yellow throated Martin, Pika and birds such as: Impeyan pheasant, Blood pheasant, Monal pheasant are also found in this area.

3. METHODOLOGY

3.1 Preliminary field Survey

A preliminary field investigation was carried out from 17th February 2005 to 29th February 2005 in the musk deer conservation area of Langtang National Park. During this period a general view of habitat and different type of vegetation was made by visual observation. Regular discussion with park wardens, rangers, local villagers and wildlife biologist was done during this period. The field was surveyed on foot. The field work for this study was carried out from 14 April 2005 to 11 June 2005. For the reconfirmation of collected data, field was visited again during September 2005 and worked there for 15 days.

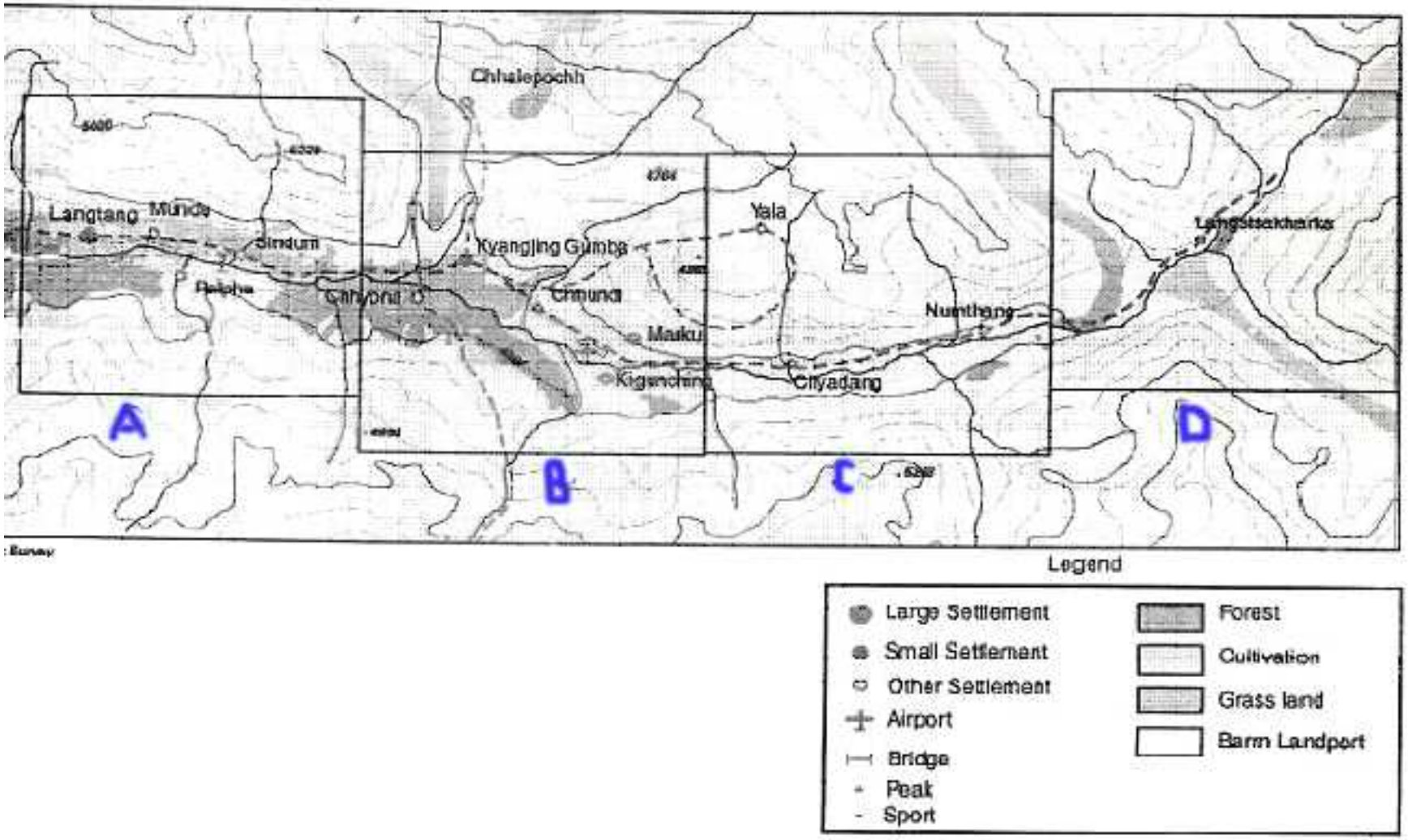
3.2 Survey Block design

The study area was divided into four blocks, having an area of 5 km^2. The study blocks were named as A,B, C and D (Map: 3). The first block A lies in Langtang Village (lat. N 28^0 12.315' to N 28^0 12. 60', long E 85^0 30.00' to E 85^0 32.830' and elevation 3455 m to 5572 m). 'B' lies in Kyanjing Gumba (Lat . N 28^0 12.408' to N 28^0 14.057', long E 85^0 32.972' to E 85^0 35.550' and elevation 3900m to 4983 m). 'C' block lies in Numthang (lat . N 28^0 11. 177' to N 28^0 13. 374', long E 85^0 35.811' to E 85^0 37. 933' and elevation 4000 m to 5163 m) and D block lies in Langsisa Kharka (lat. N 28^0 12.286' to N 28^0 14. 201 Long E 85^0 38.00' to E 85^0 42.169 and elevation 4060m to 5578 m).

3.3 Quadrate Study

Thirty quadrates each of (20x20)m^2 were plotted in the study area, covering all the blocks. They were randomly distributed. There were 11 quadrates present on Block A, 7 quadrates on block B, 8 quadrates on Block C and 4 quadrates on block D. Different plants species, animals and fecal deposits of musk deer inside the quadrate were appropriately listed.

Map 3 : Musk Deer Conservation Area



3.4 Dropping Counts

Droppings were categorized into random droppings, relic sites and bedding sites.

Random droppings: A deposits of feces excreted single time anywhere in the study area.

Relic Site: It is the latrine of musk deer. It contains a huge deposits of feces.

Bedding site: It is the place where musk deer dwells. Deposits are observed scattered in its dwelling place.

All these fecal deposits are further categorized into very Fresh (F1), Fresh (F2), Old (O1) and Very Old (O2)

Very fresh (F1): Shiny black and great amount of moisture content fecal pile.

Fresh (F2): Shiny black but very less amount of moisture content, recent one.

Old (O1): No shine but grayish black; feces have normal shape without moisture content, may be of last season.

Very old (O2): Losing shine at all and also not in normal form and shape.

3.5 Camera Trapping Method

The automatic heat sensor cameras (manufactured by Goodson and Associates, inc. Inc. Lexise, Kansas, USA collaboration with China) were used to photograph the snow leopard on the main project (Chalise et al 2005). Each camera trap unit consists of one Trial Master (TM) - 35 camera (modified Olympus water proof 28 X 80 mm lens containing

compact camera with auto focus). Whenever an animal passes the beam, the TM - 35 camera attached to the system to take photograph of the target animal, records the action with the time and date. The same camera devices were used in this study (on the stone or wooden posts) in strategic locations and trails frequently used by musk deer.

Four cameras were used at a time to photograph the musk deer. The camera traps were placed 2 to 4 days at every trapping station. The colour print films with ASA 200 Kodak were used to take the shots. The camera delay was normally fixed at 1 minute intervals.

3.6 Questionnaire Survey

Hotels, houses and herd sites were visited to take interview with hotel owners, local people and herders. Questionnaire was prepared to know the perspective of villagers about musk deer. Questionnaire, mainly deal about the musk deer sighting, status, threats and conservation issues.

As, the people hesitated to respond, they were briefed about the purpose of the study and then interviews were taken from them. Their free time was used to take interviews without disturbing their working hours. The used format is attached in this thesis (Appendix II).

3.7 Data Analysis

Primary and secondary data were collected for the study from 16th February 2005 to 4th October 2005 spending more than 80 days in the field. The actual study hour in the musk deer study was 516 hours. Primary data were collected by quadrate sampling, questionnaire survey, information from interviews and observations.

Secondary data were collected from VDC offices, different journals, research articles, bulletins published from different offices and departments, newspapers and books.

The collected primary data and secondary data have been processed by using statistical tools. Microsoft excel was used to analyze the data and the results were presented in tables and charts wherever possible.

i. Chi-square test

To examine the significance of data, chi-square test was employed. The 95 percent significance level was used to accept or reject the null hypothesis.

$$\chi^2 = \Sigma \frac{(O-E)^2}{E}$$

Where, O = Observed value

E = Expected Value

ii. F-test (ANOVA)

To examine the significance of difference between the sample means, f-test was also employed. This test is applicable to randomly selected and normally distributed sample which was supported by the collected data. The 95 percent significance level was used to accept or reject the null hypothesis.

3.8 Time Schedule

Table 1: Schedule of field time spent in Langtang Valley study area (2005)

S.N	Field duration	Total working days	Total working hrs.	Remarks
1	16 February to 29 February	13	78	i. Preliminary survey was performed. ii. Block was designed
2	14 April to 11 June	58	348	i. Quadrates were plotted ii. Fixed Camera trappings, fecal deposits counted and habitat studies were done
3	19 September to 4 October	15	90	i. Questionnaire survey and reconfirmation of collected data.
	Total	86	516 hrs	

4. RESULTS

4.1 Status and Distribution of Musk deer

4.1.1 Block wise distribution of fecal deposits of musk deer

Among the 4 different blocks, the highest number of droppings were observed in Block B (Langtang Valley) Block A and Block D have contained the least number of droppings (Figure 4). Out of 45 deposits, 68.8 percent was the highest and 8.8 percent was the lowest deposits found in the study field. On applying the χ^2 - test to the above data, it was found there was significantly difference in the fecal deposits distribution among the blocks (χ^2 = 46.46, at 95 percent level of significance and 3 d.f.) i.e., the deposits weren't evenly distributed in all blocks.

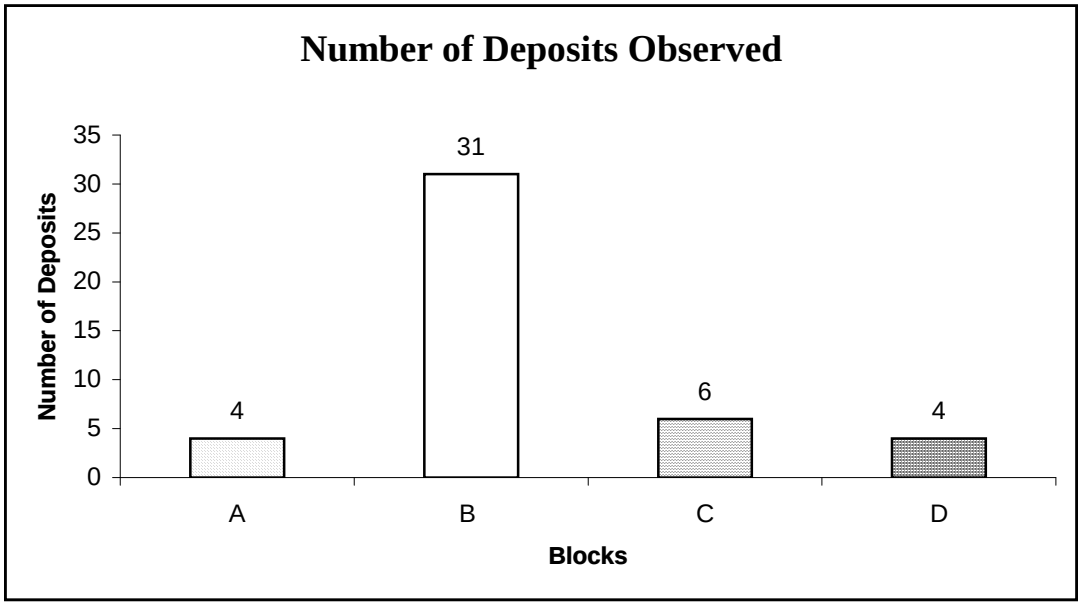


Figure 4: Fecal Deposits distribution according to block

4.1.2 Types of fecal deposits

Out of 45 different types of fecal deposits found in the study area, 40 percent were old (O1) and 13.3 percent were very old (O2). Therefore, the highest and the least number of deposits were old and very old respectively. Fresh and very fresh deposits fell on average.

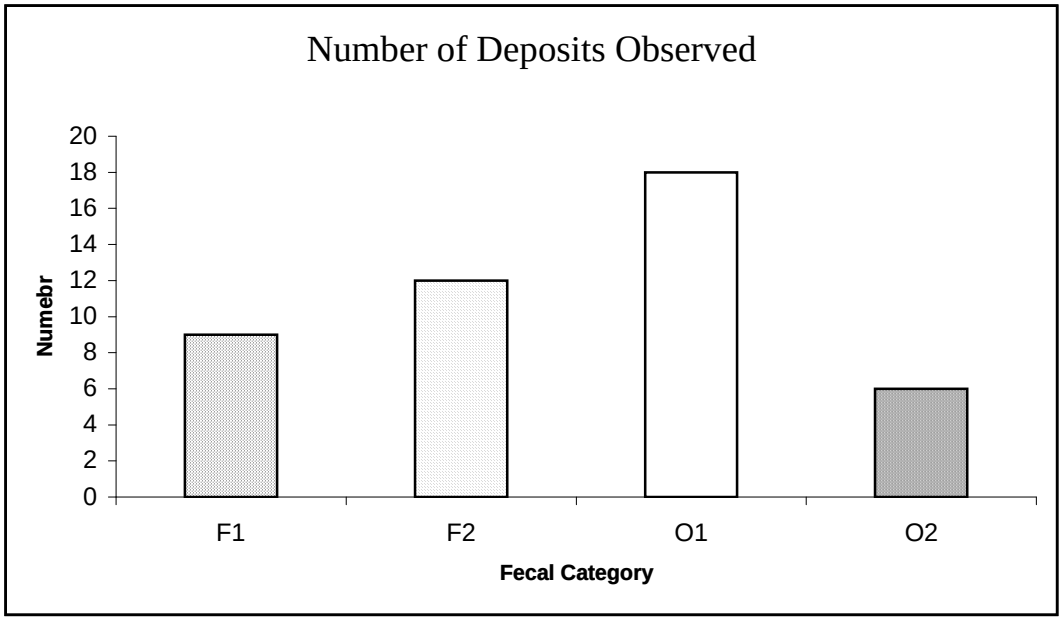


Figure 5: Number of different types of fecal deposits

4.1.3 Occurrence of Different Types of Deposits in Different Blocks.

Block wise distribution of fecal deposit shows that the block B has got the highest number of deposits of different category 22.5 percent of deposits were fresh and very fresh 38.7 percent of deposits were old and 16.3 percent of deposits were very old that were found at Block B. Very old deposits were absent in Block A and D while very fresh deposits were absent in only block D.

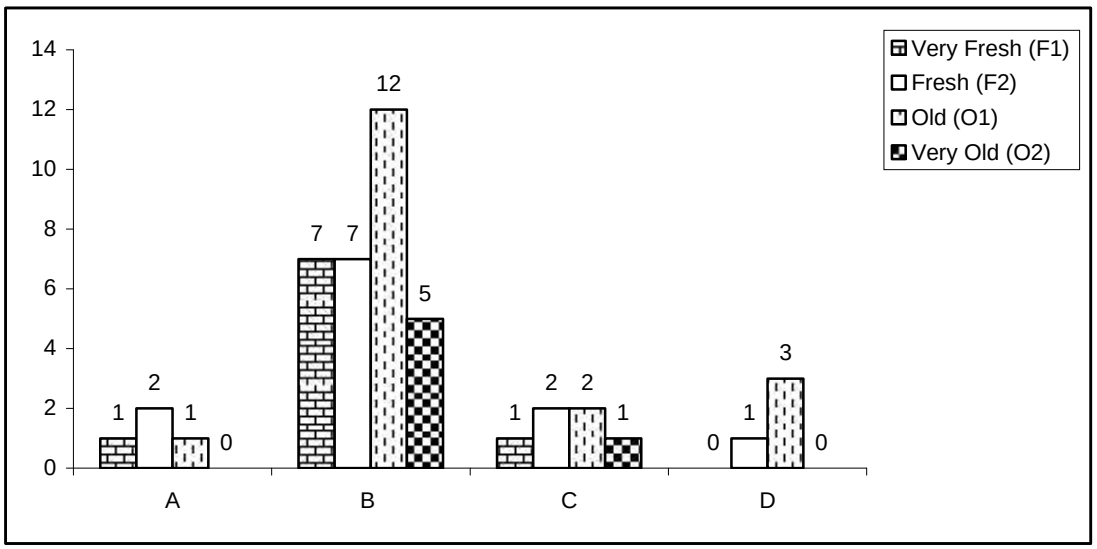


Figure 6: Block wise occurrence of different types of droppings.

Statistically, on applying f-test, there were significant difference in the different types of fecal deposits distribution among blocks (F = 6.99, at 95 percent level of significance and at (3, 9) d.f.) i.e, fecal deposits type weren't evenly distributed in all blocks.

4.1.4 Sign Distribution According to Slope

North facing slope has vegetation rich forest, so, out of 45 fecal deposits 97.7 percent of deposits were recorded in North facing slope and only 2.3 percent were recorded in south facing slope which isn't vegetated and there is human settlement, either.

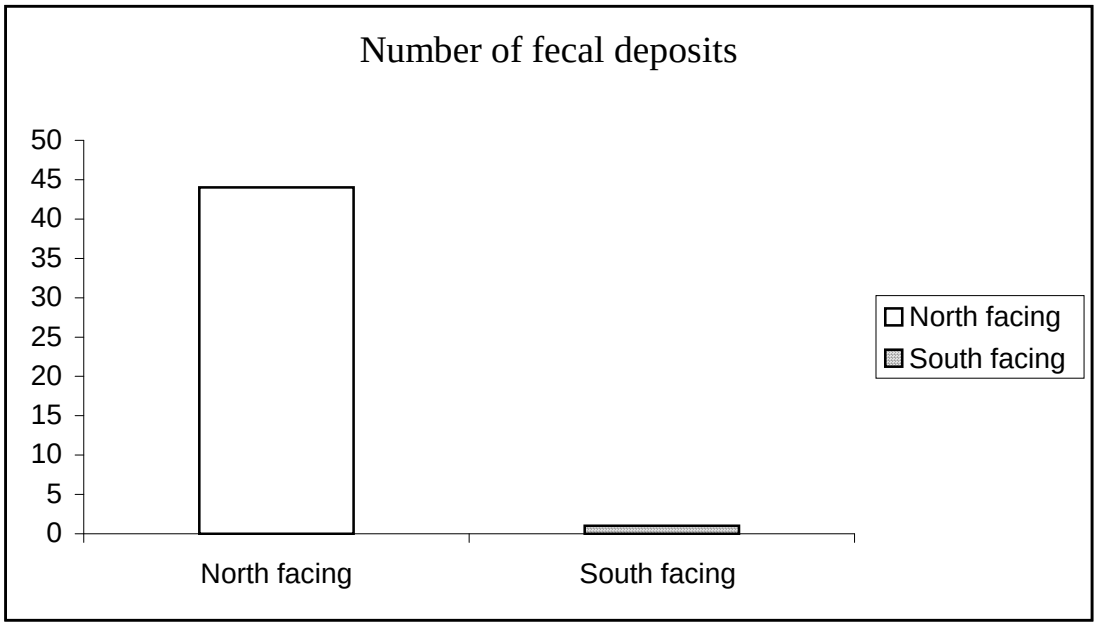


Figure 7 : Droppings distribution on two aspects of mountain

4.1.5 Evidences

Out of 4 types of evidences, the most observed evidence was of fecal deposits. 26 leg snares had been seen in the study area. One hunting snare (loc: N 28^0 12' 28.9" E 085^0 30' 55.9") in Betula forest to the south of Langtang Valley was seen.

During the study period 3 musk deer were sighted. One was found dead (Plate:17) recently intangled in the snare (loc: N 28^0 11' 19.4" E 085^0 34' 54.5") in the Betula forest to the South of airport. Other two were seen alive, one at King-gurchen Kharka (loc: N 28^0 11' 02" E O85^0 34' 37.2") and next to the opposite of Kyanjing (Loc: N 28^0 12' 18.7" E 085^0 33' 44"). They were very shy and passed from observation distance, quickly within a short time.

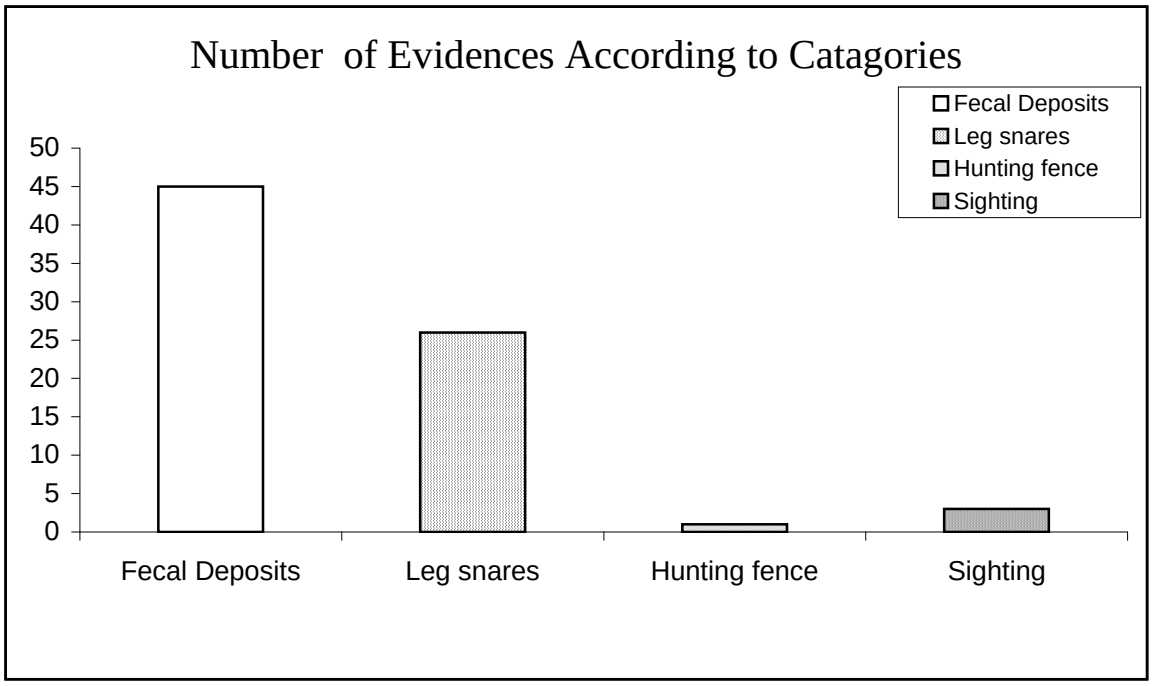


Figure 8: Kinds of evidences recorded

4.1.6 Records of Plant species

Thirty three plant species were found in the study area. Block A was found to contain the heighest number of plant species (69.67 %). *Betula utilis* is highly dominant plant species among the total species found in LNP. The study area is dominated by Betula forest (Table:2, Fig. 9). Other plants species *Abies spectabilis, Rhododendron campanulatum, Salix siklcimensis, R. anthopogan, R. setosum,* are found commonly in the study area.

Table 2: Block wise recorded Plant species within the quadrates

Blocks	Total quadrates taken	Pant species
A	11	*Betula utilis, Abies spectabilis, Rhododendron campanulatum, Salix sikkimensis, R. athopogan, R. setosum, Primula calerana, Cassiope fastigiata, Potentilla cuneat, Iris kemaonensis, Potentilla plurijuga, Cryptothladia polyphylla, Berberis angulosa, Astragalus candollenus, Berberis erythroclada, Euphorbia heliscopia, Leontopodium jacotianum, Cotoneaster microphyllus, R. lepidoton, Artemisia gmelinii*, Mosses, *Lichen usnea*, khar = 23 sps.
B	7	*Betula utilis, Rhododendron campanulatum, Salix sikkimensis, Cupressus torulosa, R. athopogan, R. setosum, Primula denticulate, Astragalus candolleanus, Boschniakis himalaica, Cotoneaster microphyllus, Iris kemaonensis, Primula caldorana, Cassiope fastigiata, Potentilla plurijuga, Orobanche alba,* Mosses, *Lichen usnea =17 sps.*
C	8	*Betula utilis, Salix sikkimensis, Rhododendron campanulatum, R. anthopogan, R. setosum, Lonicera spinosa, Cryptothladia polyphlla, Primula denticulata), Potentilla sps., Iris kemaonensis, Cotoneaster microphyllous, Cassiope fastigiata, Astragalus candolleanus, Primula calderana, Orobanche alba, Boschniakia himalaica, Saxifraga sps., Jumiperus squamata, Ephedra gerardiana, Lichen usnea,* Mosses, Khar =21 sps
D	4	*Betula utilis, Salix sikkimensis, Rhododendron campanulatum, R. anthopogan, R. setosum, Lonicera spinosa, Cryptothladia polyphylla, Cotoneaster microphyllus, Cassiope fastigiata, Ephedra gerrdiana, Lichen usnean, Berberis angulosa, Berberis erythroclada, Iris kemaonensis, Thermopsis barbata, Mosses, khar =17sps.*

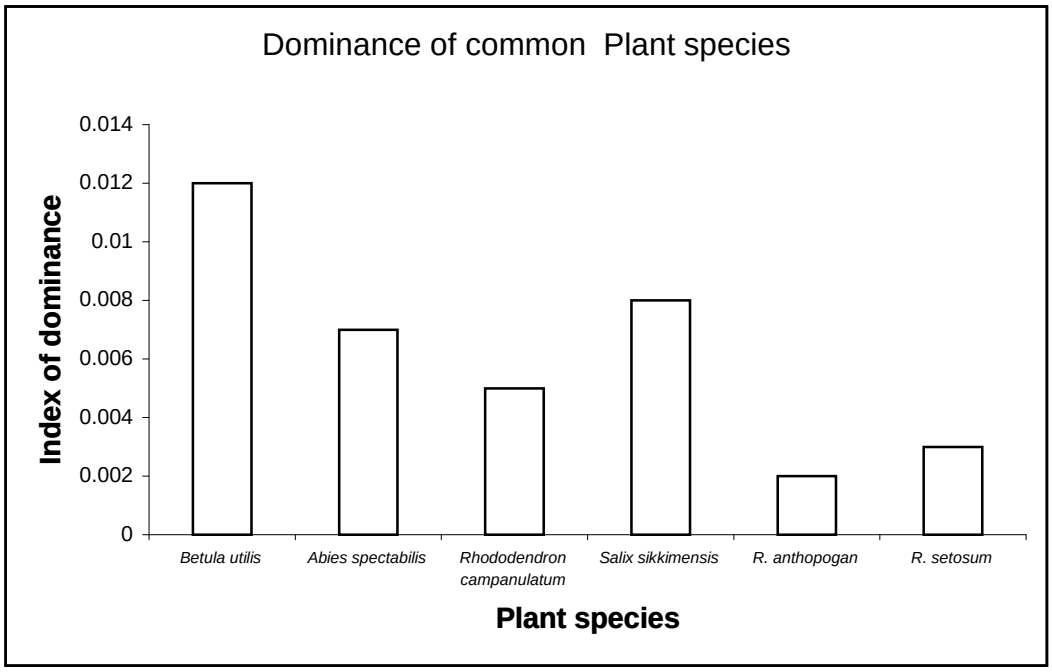


Figure 9: Some common Plant species

4.1.7 Distribution of fecal Deposits According to Forest Types

Study of fecal deposits in different forest habitat shows that, Betula forest has the large number of fecal deposits. Out of 14 deposits found in Betula forest, the highest number (57.1%) were present in Block B and were absent in Block A. willow forest shows the least number of deposits content. Here, fecal deposits were found only in Block B. In total, mixed forest of Block B was found to contain the large number of deposits (24.4%) (Fig.:10).

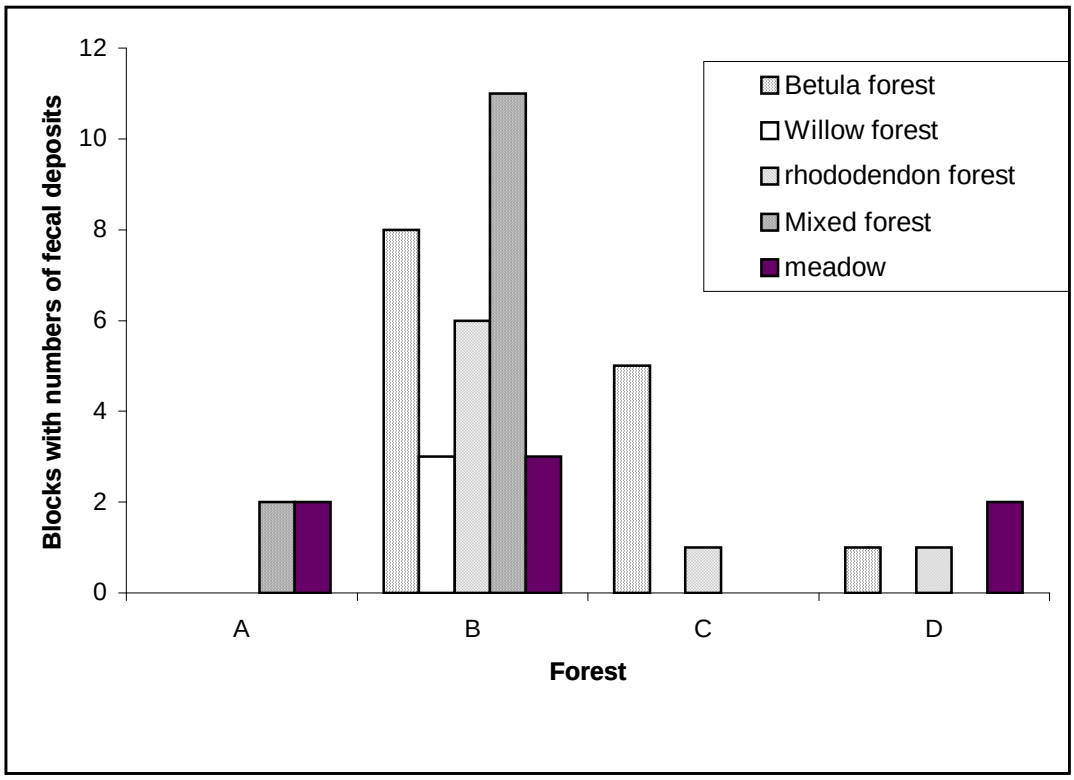


Figure 10: Block wise distribution of fecal deposits in different forest.

During the study period, freshness and oldness of droppings were observed in different forest types. Out of 14 deposits found in Betula forest, 50 percent were fresh and 14.28 percent were very fresh and very old. No any fresh deposits were observed in willow forest. Betula and Rhododendron forest had all types of fecal deposits. In all total, old deposits were in great number (17.7%) found in mixed forest (Fig. : 11).

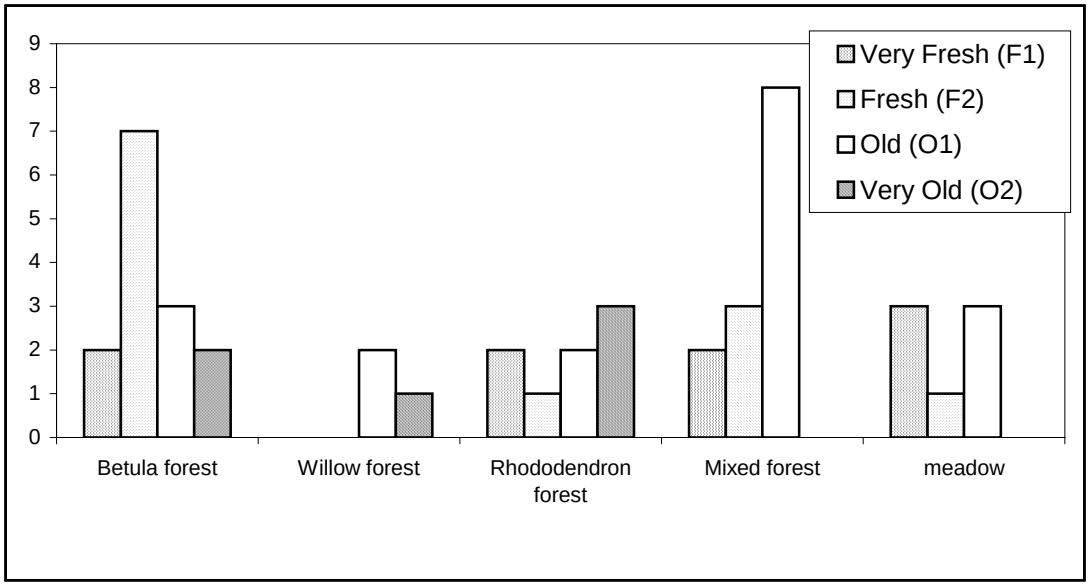


Figure 11: Types of Fecal and their distribution in different forest

4.1.8 Distribution of droppings at different places.

Droppings were observed at different places. 40 percent of the observed droppings were found on animal trial. They were randomly excreted droppings. Similarly, 8.88 percent of relic sites were also found on animal trial. Out of 45 dropping at different places 26.6 percent were at bedding sites. Relic sites and Random droppings were found less, away from human trial. Betula forest and mixed forest were found to contain the bedding sites and random droppings on animal trial (Fig.:12).

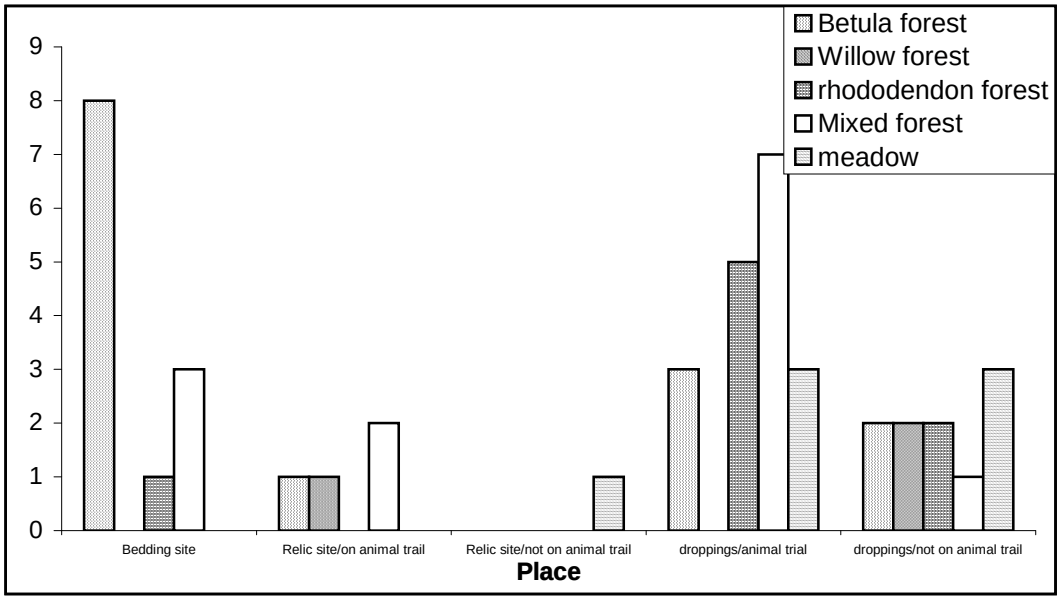


Figure 12: Musk deer droppings at different places

Due to ruggedness and steep terrain, the quadrates were laid in different topography. Randomly placed quadrates had to be shifted due to inaccessibility. so that, more than 45 percent quadrates lied in Hillsides where more than 48 percent of droppings were recorded. Other quadrates lied in plain, ridge line, cliff base and stream bank. The least droppings (2.3%) were present in Ridgeline (Fig.:13).

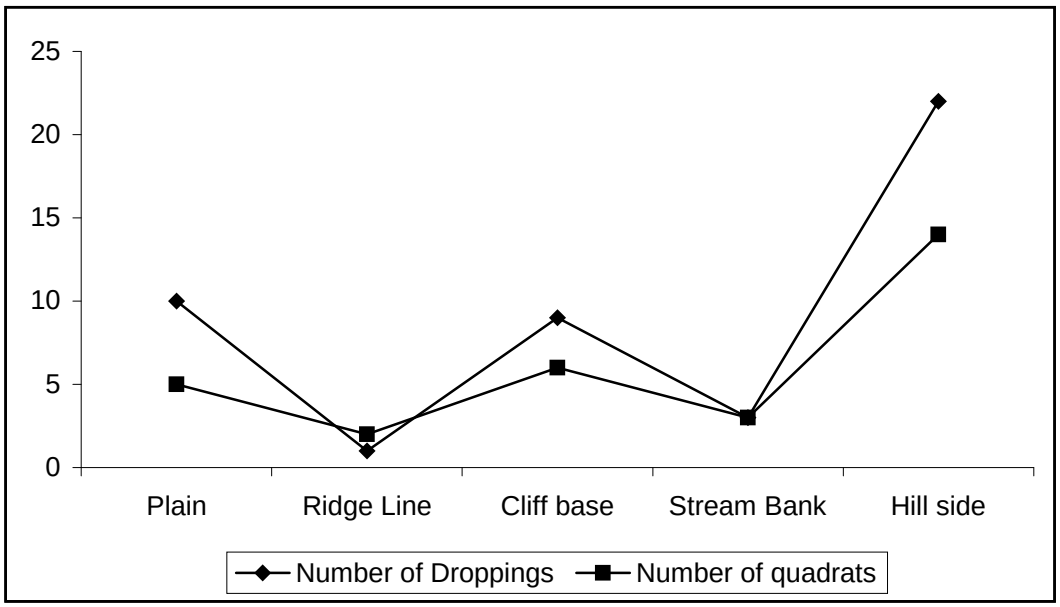


Figure 13: Droppings distribution according to Topography

4.1.9 Animals trapped by automatic camera

During the study period, 4 different automatic cameras traps were fixed to the possible encounter of animals. It will also reveals abundance and density of animal species that are found in the area. They were placed at different places in the forest. They were found disturbed by livestock, and tourists. the camera was able to take only one snap of musk deer while most films were found taking photos of Yaks and other animals (Table : 3).

Table 3: Lists of animals trapped by camera at different places

Animals	Places	Location	Elevation	Number
Yak	Opposite of Kyanjing bridge	N 28^0 12' 28" E 85^0 33' 46.9"	3734 m	8
Yak	opposite of airport	N 28^0 12' 20" E 85^0 34' 19.6"	3824 m	11
Tourist	Way to Yalapeak	N 28^0 11' 03" E 85^0 34' 42.8"	4124 m	4
Musk deer	Opposite of Kyanjing	N 28^0 11' 02" E 85^0 34' 37.2"	3862 m	1
Yak	Opposite of Mundu	N 28^0 12' 30.6" E 85^0 31' 57.2"	3592 m	2
Lammergeier	North of Kyanjing Gumba	N 20^0 13' 11.6" E 85^0 34' 36.2"	3752m	2

4.1.10 Human population statistics of the study area

In the Langtang VDC there are 143 households and population was 521 during study period.

More than 44 percent of lodges, 42 percent of ordinary household and 13 percent of tea shops were recorded during study period in Langtang V.D.C, where 521 people have been dwelling (Fig.:14).

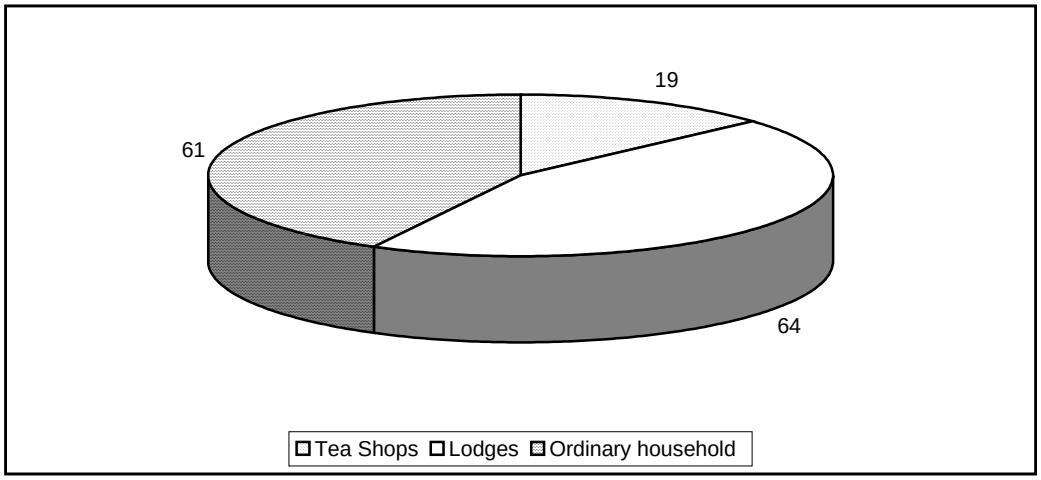


Figure 14 : Number of human residence in LNP.

4.2 Respondent views

4.2.1 Occurrence of musk deer

From the questionnaire survey, among 24 respondents out of 143 households affirmed the occurrence of musk deer in musk deer conservation area of Langtang.

4.2.2 Place of musk deer noticed

More than 33 percent villages had noticed muck deer in Kyanjing's forest. The forest lies to the south of Kyanjing village. The forest is the good habitat of the musk deer which was justified by the respondent's answer. As per the interview result, 16.8 percent of the respondents hadn't seen the musk deer and only 12.5 percent of the respondents had seen the musk deer at Mundu.

Table 4: Place of musk deer sighted by respondents

S.N	Location	Percentage of Respondents
1	Numthang	16.6
2	Kyanjing	33.3
3	Mundu	12.5
4	Langtang	20.8
5	Nowhere	16.8

4.2.3 Time of Sighting

More than 45 percent respondents reported that they had seen musk deer a year ago and only about 8 percent of respondents had seen the musk deer a week ago. Here, recently observed were found the least in comparison to years ago observer.

Table 5: Musk deer, sighted at different times by respondents

S.N	Time	Respondents (%)
1	Never seen	16.8
2	a week ago	8.3
3	a month ago	29.1
4	a year ago	45.8

4.2.4.1 Poaching Activity

More than 70 percent of the respondents agreed about the poaching of musk deer in Langtang. They also informed that the poachers come from Helambu side (the other side of the forested mountain). According to them June to September was the most suitable months for the poacher to poach musk deer. 25 percent of the respondents didn't dare to answer about poaching activity and simply said 'I don't know'. Only 4 percent of the respondents denied about the poaching activity (Fig.:15).

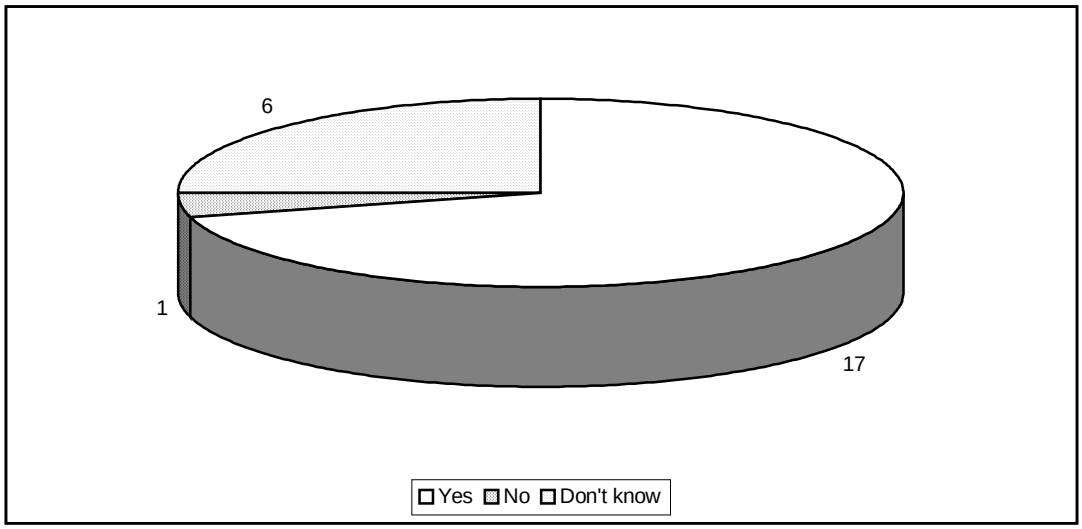


Figure 15: Respondents' view about poaching activity

4.2.5 Attitude towards musk deer

75 percent of the respondents had positive attitude towards musk deer. Musk deer were said to be helpful to enhance tourism and hotel business. A part from this, being a beautiful creature, respondents had good attitude towards, it. No any comments were received from rest of the respondents (Fig.:16).

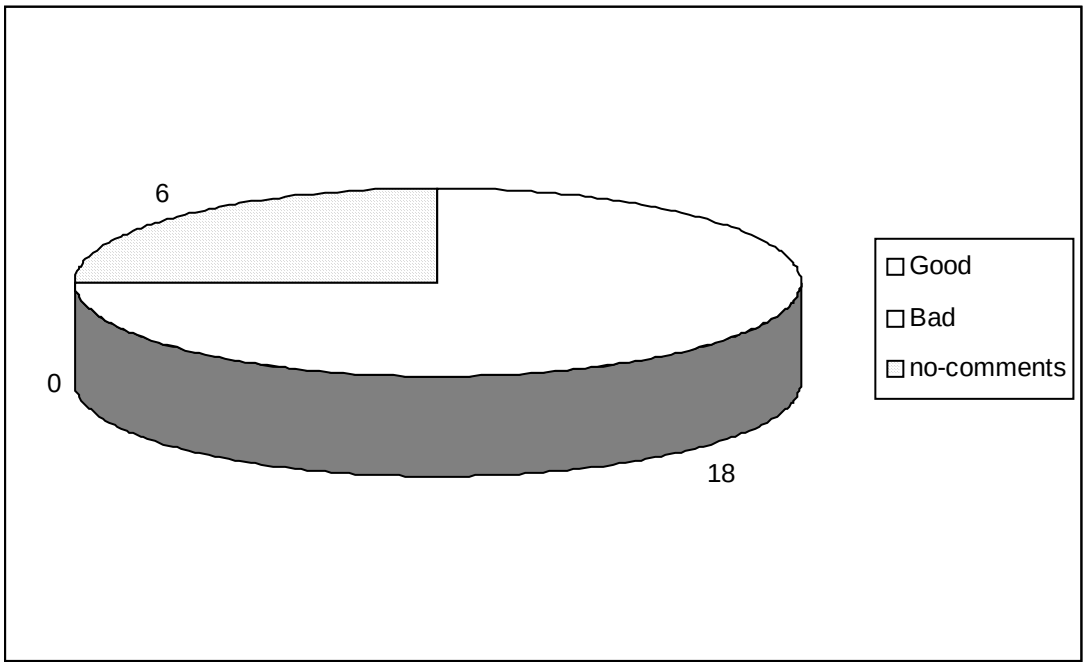


Figure 16: Attitude of Local People towards Musk deer.

4.2.6 Threats to Musk deer

Tourists, local people and livestock are the major threats to musk deer in Langtang. 41.6 percent of respondents reported that livestock were responsible for the musk deer threat. Livestock are let to graze freely in the forest. Increasing number of tourist were the other factor for the musk deer threat. 25 percent of the people blamed themselves for musk deer threat. It is their compulsion to go to forest firewood and timber collection which has caused a serious problem to musk deer.

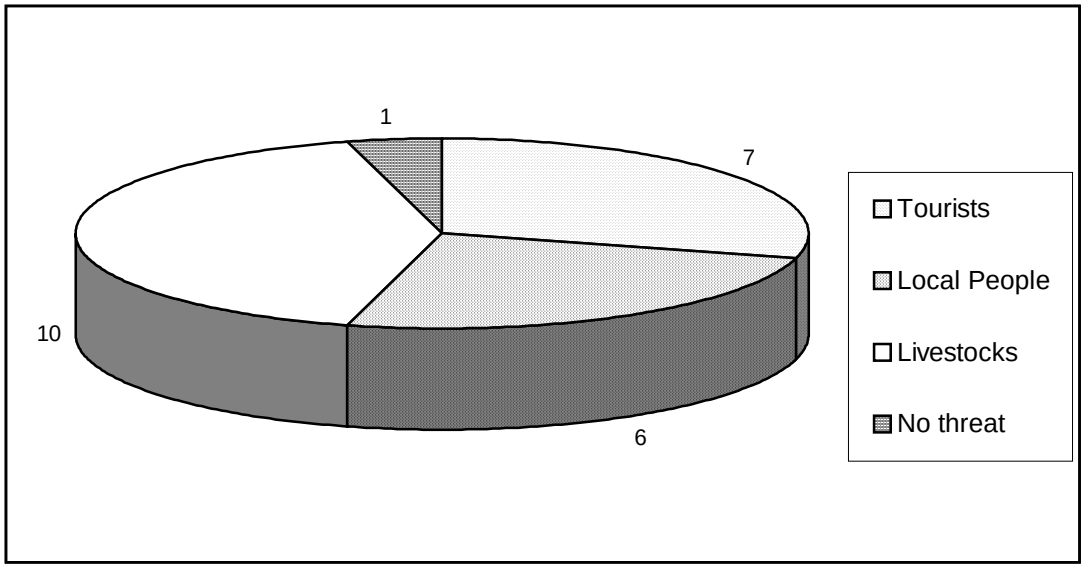


Figure 17: Threats to musk deer by different factors

4.2.7 Conservation of musk deer

Data collected from the interviews with local people showed that they were in favour of the conservation of musk deer. Out of total respondent 25 percent of them wanted it to conserve for their future generation and to enhance tourism industry. More than 20 percent of the respondent's showed their importance from religious point of view. However, around 16 percent of respondents didn't have any idea about the conservation of musk deer.

According to their religious belief, musk pod is used to escalate property and fur of musk deer is used to get rid of evil spirit and ghosts.

Table 6 : Respondents logic conservation of musk deer

Reasons	Respondents (%)
Religious belief	20.8
For future generation	25
For tourist industry	25
Looks good	12.5
don't know	16.7

Photo Plates Showing habitat and area related to Musk Deer Study (2004-05)

Plate 1: A Scene of Kyanjing Village

Plate 2: A Scene of Langtang Village

Plate 3: Musk deer conservation area

Plate 4: Langtang Lirung Mountain

Plate 5: Chhoka Lake in Kyanjing

Plate 6: Langtang Glacier

Plate 7: Mixed forest

Plate 8: Meadow

Plate 9: *Betula* forest

Plate 10: *Rhododendron* bush

Plate 11: Willow forest

Plate 12: Making quadrates

Plate 13: Camping at Langsisa Kharka

Plate 14 : Setting Camera Trap

Plate 15: Observing fecal deposits

Plate 16: Interviewing with locals

Plate 17: A trapped female musk deer

Plate 18: Musk Deer Trapped by Automatic Camera

Plate 19: Relic Site of Musk Deer

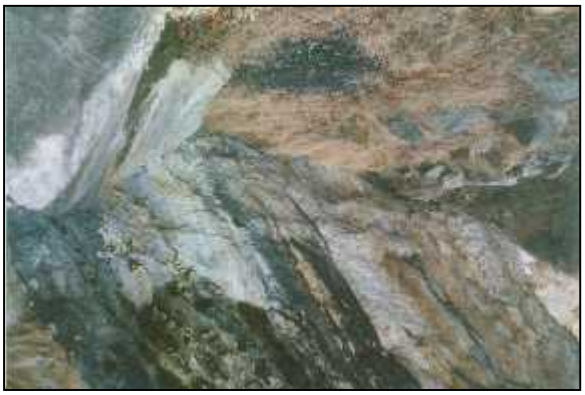


Plate 20: Bedding Site of Musk Deer

Plate 21: Very Fresh Fecal Deposit

Plate 22: Fresh Fecal Deposit

Plate 23: Old Fecal Deposit

Plate 24: Very Old Fecal Deposit

Plate 25: Stack of wood Near Airport

Plate 26: Hunting Fence of Musk Deer

Plate 27: Leg Snares of Musk Deer

Plate 28: Yaks Grazing in Study Area

Plate 29: Human Encroachment in Musk Deer's Habitat in Search of Yarsha Gumba

Plate 30: Conservation education Programme Held in School

5. DISCUSSION

5.1 Status and distribution of musk deer

Musk deer is a very shy, solitary, elusive animal capable of hiding in dense scrub amidst inhospitable terrain (Green and Kattel 1997). So, the direct census of the musk deer is difficult. Kattel (1992) had developed a modified drive net technique to capture Himalayan musk deer. He captured total of 16 individuals for detail study and extracted musk from males. In Langtang National Park, the objective of the study was to show the status and distribution of musk deer. Indirect census method was employed to estimate the rough population status, habitat and distribution of musk deer in the present study area. Sathyakumar (Pers. Comm. 2005) has suggested the best method for the census of musk deer by silent drift count method. As the work is quite expensive and great need of manpower, this technique would not performed in Langtang National Park. Droppings categorization and their count was made. Gurung (1991) collected 41 different pellets to analyze the food preferences of musk deer from Sagarmatha National Park, while in present study 45 droppings were recorded to analyze the status of musk deer in Langtang National Park. They were distributed form 3400 m elevation to 4100 m elevation. According to Kattel (1992), In Sagarmatha National Park, musk deer is distributed between elevation 3000 m to 4200 m throughout the forested area. Musk deer distribution range was found less in LNP.

Bista et al. (1979) has reported that the population in the upper valley of Langtang, Mihinga forest area and in Khola Tal is relatively better protected than in the rest of the park. The population of musk deer is thought to be increasing within the protected areas but declining outside them (Wemmer 1998). But, present study doesn't support these

explanation. Only 21 fresh deposits were found out of which 9 were very fresh. Similarly, 12 bedding sites were recorded. These evidences are too few in comparison to Sagarmatha National Park which shows the total number of observed musk deer as 0.5 in 0.22 km^2 area and sex ratio (adult male/female) being 0.538 (Kattel 1992). In case of Langtang National Park, the occurrence of fecal deposits was found to be 1.8 deposits per sq km, less than that of musk deer occurrence in Sagarmatha National Park.

According to Green (1986), from the observation of their foot marks and other evidences, it was found that musk deer prefer their bedding sites under the big stones, in front area of which has open space and could be viewed to a far distant. It secures the musk deer from it's predator. In the musk deer conservation of LNP, there are huge caved stones under which musk deer dwells. All bedding sites are northwardly faced and open towards the forests and meadows of valleys.

During the study, mixed forest and Betula forest were considered as favourable place for the musk deer as maximum fecal deposits were recorded there. Similar result was reported by Green (1986) who, also reported about the common latrines (relic sites) used by musk deer. Fresh and old pellets were found on the same latrine sites. Pellets were also observed in meadow, below rocks and human trial.

Camera trapping method was also used for estimating the population of the animal. Photo capturing technique are being increasingly used to study solitary animals (Carbon et. al. 2001). During the study period, four camera traps were used to capture the musk deer photographs but among 26 photographs taken by camera, 21 photos were of Yaks, 4 of tourists, 1 of musk deer and remaining were blank. Many biologists use this for tiger and snow leopard census too.

5.2 Habitat utilization by musk deer

Gurung (1991) carried out a survey in 1986 to identity the musk deer habitat, in Sagarmatha National Park. Evidences of musk deer (fecal pellets) were found up to Pheriche above the timberline in brushwood habitat. She made a direct observation of musk deer in the Birch (*Betula utilis*), Rhododendron (*Rhododendron campanulatum*) forests. So, she concluded that as most of the musk deer sightings had been made in Birch-Rhododendron forest above 3000m, it is reasonable to assume that a good population of Himalayan musk deer occurs in Birch-Rhododendron forest. Kattel and Alldredge (1991) identified seven different habitat types in musk deer range. Habitats, most frequently used by musk deer were the 'Birch and Rhododendron forest' and 'Dwarf Rhododendron shrubs' where arboreal lichens were available during winter. In case of LNP, five different types of forest were noticed. Maximum fecal deposits were seen in Betula forest (31.1%) and mixed forest (28.8%). Maximum bedding sites were also recorded in those forest 66.6 percent in Betula forest and 25 percent in mixed forest.. Therefore, these forests were regarded as the favourable forests for musk deer.

Himalayan musk deer is the only ungulates species utilizing the northern aspects of mountainous areas (Kattel and Alldredge 1991). Musk deer generally lives in hilly areas which is covered with mixed forest especially, places where precipitous cliffs. It occurs in the upper temperate and sub-alpine region (Green 1986). In the study conducted in LNP, maximum fecal deposits (48.8%) were recorded in hillside and then in the plain meadow (22.2%). Ridgeline was found the least (2.2%) to occur fecal deposits.

5.3 Threats

Poaching for musk is the main reason of musk deer declination. Given that a single musk gland or pod, weighing on average 25 g, will provide a pastoral family with 6-12 month's cash income (Jackson 1979, Harris 1991). In 1990, alone 26 musk deer were killed by poachers for their musk in LNP (Khatiwada 2004). According to him, other anthropogenic causes such as poisoning and poaching have also played role in decline of this species. Discussion with local revealed that there is maximum poaching activity in LNP. Poachers enter the forest from Helambu route being well -equipped for trapping or Killing the musk deer. During the study period alone 20 leg snares and one hunting fence were noticed. The data collected from respondents regarding their last time sight to musk deer showed sighting record less a week ago while and more, sighting suggested for a year ago. This trend and experiences shows the gradual declination of musk deer in LNP.

Green (1986) has mention that the poachers set up to several hundred snare traps in a forested area and then came back several times over a period of weeks to check at them. The deer stepping through the wire snare get frightens and move randomly and trapped on its legs. A female deer was found trapped in a snare in King-Gurchen kharka of Langtang during study period. Green (1986) has also mentioned that this type of poaching results not only the death of the male deer but also the death of female, juvenile and other wild species.

Sathyakumar and Prasad (1993) has reported the increased livestock grazing and associated impacts have led to low musk deer densities in many areas in Kedarnath Wildlife Sanctuary, India. Owing to the over exploitation of pastures themselves, domestic animals enter the forest to compete for shrubs and undergrowth with musk deer. During the

present study period, 21 yaks were caught in the camera trap showed heavy grazing in musk deer habitat and more than 40 percent respondent told about the role of livestock grazing in declination of musk deer.

Rajchal (2005) has reported landslide, constructions, tourism as other threats to musk deer, which supports the present study on LNP.

5.4 Conservation Awareness Programme

Pandey et al. (2005) has emphasized on conservation education program in order to conserve the declining musk deer species. During the survey of musk deer, such program was organized once in school of syafrubensi (Shyame Wanphel Secondary School) and Thulosyafru (Thulosyafru Lower Secondary School). Students of both the schools were informed about the importance of wild lives. Musk deer's stickers were distributed. The posters of 'Musk Deer Conservation' were pasted in the school's wall. Drawing competition on the subject of 'Nature Conservation' was held. Winner students were encouraged by distributing prizes.

5.5 Other surveyed animals in LNP

Snow leopard (*Uncia uncia*)

During the population survey of the snow leopard in 25 sq. km. study area, two confirmed Snow leopard sightings were made in 2003-2004 study period. (Chalise et al 2005). But during this survey period no animal was directly sighted. A very old skin of snow leopard was expired in possession of one of the hotel owner. Measurement of fresh snow leopard pugmarks suggest at least four different snow leopards individuals presence in the study area. Comparison of observed herd sizes of Himalayan tahr (prey species) indicates decline in average herd size during the two year period from 2003 to 2004 from a mean of 23 to

15 tahr (Chalise et al. 2005). The current study shows that average herd size of tahr depleted to 9 individuals only. This also revealed the declining state of snow leopard a well as other mammals in the area.

Himalayan Tahr (*Hemitragus jemlahicus*)

In the 5 survey blocks measuring 5 sq km each, a total of 218 individuals of different age and sex, Himalayan Tahr were recorded in 8 different herds. Three types of herds were recognized; Adult male - adult female - young (37.5%), Adult female - young (37.5%) and all adult male (25%) survey revealed that 50%) and all adult male (25%). Survey revealed that 50 percent of Tahr herds were observed in 4200-4900m (fourth block) and least (12%) were in 3700-4000m (first block), animals were not located in 3850-4200m (Third, fifth block). Twenty six potential plant species were identified in their habitat (Tiwari et al. 2005).

Birds

A total of 55 bird species (7 orders and 16 families) were identified during the study in upper LNP. An unusual sighting of common house crow was made in the elevation of 3850m, which has to be found below the elevation of 1500m (Khatiwada et al. 2005).

6. CONCLUSION

The musk deer conservation area of Langtang National Park is the prime habitat for musk deer. But at present, human interference has made it as disturbed and inappropriate. Because of difficulty in direct sighting, indirect method (dropping, count and categorization) was applied. Out of total droppings recorded - 20 percent were very fresh, 26.6 percent fresh, 40 percent old and 13.4 percent very old. Mixed forest of block B was found the suitable habitat as more number of deposits were recoded their of different category.

Forest was categorized into five different types-Betula forest, Willow forest, Rhododendron forest, Mixed forest and Meadow. Betula forest and mixed forest were found as the suitable place for musk deer, because of the availability of food whole the year round. Bedding sites are also recorded in these forest. Each bedding sites were under a huge caved store facing northward to the valley floor. It helps musk deer to see it's predator easily and so that it can escape before predators arrival. Most droppings and relic sites were seen in animal trail. Perhaps, it may be easy for musk deer to follow those trial. Maximum droppings were recorded on the hill side in comparision to other sites like plain, ridgeline, cliff base and stream bank. Hillside is the only forested area and suitable habitat for life activities of musk deer.

Poaching is the major problem faced by Musk deer in the musk deer conservation area. Apart from poaching, over grazing, firewood and timber collection, tourism, construction works are other problematic factors faced by musk deer survival.

Out of total interviewed people, 33.3 percent of the respondents told Kyanjing as musk deer rich area. Least people had seen live musk

deer recently. More than 45 percent respondent told that they had seen musk deer a year ago in frequent. Majority of the respondent agreed the musk deer poaching activity is intense in LNP. They were in favour of conserving musk deer, to enhance tourism and for future generation.

During study period, the musk deer population was felt quite low. To satisfy local needs more income generation program is needed and alternatives should be provided to save the musk deer. Conservation education and awareness programmes launched during the study time was appreciated by locals and curious to have more in future.

7. RECOMMENDATION

The information presented in this report relates to status of musk deer along with habitat utilization. The following are the recommendations that would be appropriate for the conservation of musk deer in LNP:

1. Establishment of well equipped and vigilance Anti Poaching Units in the park to control the illegal activities in the park area.

2. Intensive grazing by the domestic livestock in and around the musk deer habitats should be controlled. Grazing should be managed in specific blocks of the park. Plantation of tree and other species is necessary in different open areas to prevent landslides as well as to fulfill the fodder and fuel wood demand of locals.

3. Conservation education, awareness programs training have to be launched in schools, villages and anti-poaching units to inform them about musk deer importance, their role to prevent poaching. These programs at all levels make a critical contribution to peoples ability to participate in caring for the nature.

4. Current firewood collection is haphazard and not sufficient for the local people need. So, an alternative source should be promoted to meet the demand of energy for local households and increased mountain tourism.

5. Alternative Products of Musk

Some other animals and plant species are associated with the musk odour. They produce similar aromas and some have similar properties. The Jagat Pet (*Delphinium trichophorum),* Musk Rose (*Rosa moschata),* Musk Mallow (*Hibiscus abelnmoschus)* are some of them. Studies

regarding status, distribution, availability and use of these plants are necessary that can be used as alternative products of musk demand. It will reduce the pressure in musk deer poaching.

6. The knowledge gained from researches in the area as well as Chinese experience should be incorporated for musk deer farming in the area and appropriate policy should be made for musk deer farming, their harvest and trade for human welfare.

7. Scientific studies of the species in the whole national park should be undertaken urgently to explore their status, habitat evaluation, diet composition and threats.

8. National legislation and conservation policies for musk deer should be strengthened and strictly practiced.

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Annex I

Meteorological data on temperature, relative humidity, precipitation for 1993-2005 recorded at Kyanjing Gumba, Rasuwa. (Soruce: HMG/N Department of Hydrology and Meteorology).

a. Monthly mean Air Maximum Temperature (^{0}C)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1993	-1.3	6.3	-1.5	4.5	7.6	9.3	9.6	9.3	8.0	5.1	3.3	5.1
1994	2.3	-2.3	5.0	1.6	7.0	9.3	10.0	9.3	8.8	7.9	3.0	4.3
1995	0.8	3.0	4.8	6.5	10.8	12.0	11.8	12.0	10.5	7.8	5.8	3.3
1996	3.7	3.5	7.3	9.0	12.2	12.4	13.9	12.9	12.2	9.7	9.3	8.8
1997	3.3	2.0	4.5	6.0	7.8	11.3	12.3	12.0	10.7	7.0	8.3	0.5
1998	2.5	3.5	3.8	7.5	11.8	14.0	11.6	12.3	11.0	8.8	7.5	6.8
1999	2.0	4.5	6.3	9.3	10.8	11.5	12.5	13.3	10.8	8.5	7.0	3.5
2000	3.0	-1.5	6.2	6.5	10.5	11.3	12.0	11.5	9.7	6.8	3.8	1.0
2001	0.5	-2.3	-4.3	-2.3	2.3	0.9	12.3	12.3	11.	11.0	9.0	6.1
2002	0.8	-0.6	-3.2	2.6	7.3	10.2	12.4	12.3	9.2	101	8.3	5.4
2003	2.4	-2	1.8	6.4	7.3	9.6	9.6	9.1	9	5.3	4.4	1.4
2004	-1.7	3.4	7.1	5.7	9.2	9.8	9.3	9.7	10.5	6.2	2.2	6.4
2005	2.6	0.3	2.8	4.8	8.7	11.3	10.9	10.9	10.2	7.6	3.4	2.2

b. Monthly Mean Air Minimum Temperature (^{0}C)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1993	-9.5	-11.6	-8.0	-3.6	-0.5	4.4	6.8	5.8	4.3	-2.5	-2.8	-7.3
1994	-14.3	-10.0	-5.0	-3.3	-3.4	4.3	5.8	5.8	4.5	-2.0	-4.5	-7.5
1995	-9.5	-7.6	-3.5	-1.8	4.5	7.5	8.8	8.5	6.5	3.0	-3.5	-5.3
1996	-7.6	-6.5	-2.4	-0.6	2.9	2.8	8.2	7.3	5.7	1.4	-1.3	-2.5
1997	-10.0	-8.0	-3.4	-4.6	2.8	5.3	9.5	4.5	4.8	-3.8	-4.3	-8.3
1998	-6.8	-7.0	-3.8	0.3	2.3	8.3	8.8	9.3	6.3	3.5	-1.3	-3.5
1999	-7.5	-4.0	-0.8	2.8	3.5	5.8	8.3	7.9	7.9	1.0	-1.0	-5.5
2000	-6.8	-8.0	-4.0	2.8	3.3	7.3	9.0	9.3	3.3	-4.8	-5.0	-9.5
2001	-13.0	-14.0	-10.5	-9.6	-4.9	-4.3	-2.0	8.8	8.3	5.0	1.3	-13.0
2002	-14.1	-10.2	-8.3	-9.1	-5.1	-0.3	-2.0	3.3	2.8	-1.6	-27	-11.3
2003	-7.1	-7.4	-4.4	-0.4	0.7	4.9	7.5	4.8	4.8	2	-2.7	-8.2
2004	-11.1	-8.7	-2.2	-2.8	6.1	5	7.1	8.2	5.7	-2.6	-5.2	-6.8
2005	-9.6	-8.1	-6.4	-1.5	1.1	4.3	8.3	7.9	6.5	0.5	-3.1	-5.2

c. Monthly Mean Relative Humidity (^{0}C)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1993	36	43	40	43	49	64	64	66	62	41	28	27
1994	32	38	42	44	54	60	60	62	64	47	47	30
1995	36	43	40	43	49	64	64	66	62	41	28	27
1996	63	68	70	68	74	88	88	91	90	74	55	48
1997	21	29	28	37	34	40	40	47	45	32	23	-
1998	70	81	81	67	73	70	70	81	81	66	47	38
1999	47	51	46	47	92	91	91	87	82	60	46	47
2000	59	44	59	54	67	79	79	79	79	57	50	41
2001	49	63	63	72	88	94	94	96	97	80	57	46
2002	55	59	63	67	69	82	82	91	93	76	61	53
2003	71.5	62.4	75	75	77.3	92.6	97.6	96.3	96.2	72	75.5	82
2004	82	81.8	81.3	88.8	85	94.7	99.3	98.2	97.8	85.4	73.6	42
2005	60.4	61.7	75.3	63	80.3	86.8	99	99.4	96.5	80.5	76.3	68.2

d. Monthly Precipitation (mm)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Yearly
1993	13.0	22.5	27.4	36.0	73.8	28.8	74.0	124.3	127.0	0.0	0.0	0.0	526.8
1994	5.6	5.9	13.2	15.1	32.5	26.7	-	141.7	87.7	-	-	-	-
1995	42.7	53.0	65.0	40.6	29.3	82.7	124.8	139.3	87.1	0.0	5.7	5.9	1041.5
1996	25.7	9.2	0.0	18.1	17.7	84.7	140.6	175.3	67.8	66.7	0.0	0.0	605.8
1997	6.9	11.3	21.5	24.5	29.6	119.7	153.7	111.7	65.2	17	35.7	0.0	596.7
1998	0.0	38.4	40.8	14.9	35.5	97.7	149.0	183.6	43.1	21.0	4.2	0.0	628.2
1999	6.9	4.0	21.8	27.0	59.3	147.8	232.4	145.6	6.3	26.7	4.2	0.0	682
2000	0.0	8.9	13.0	22.6	54.5	125.9	216.6	172.1	115.8	0.0	1.2	0.0	730.6
2001	3.5	7.5	15.7	52.3	57.1	149.3	158.9	142.1	48.1	6.5	0.0	0.0	641
2002	5.1	6.3	13.2	56.1	73.1	139.7	168.8	98.4	59.2	73.1	0.0	0.9	693.9
2003	14.2	22.6	60.8	100.4	68.8	127.2	183.2	54.1	47.8	23	4	6.4	712.5
2004	20.4	1	4.4	144.8	131.2	117	266.8	245.8	93.6	32	2.8	0	1059.8
2005	20.6	15.2	66.8	60.6	49.4	40	237.6	237.2	82.6	138	44.3	8	1000.3

Annex II

Musk Deer Survey Questionnaire

(For interviewing local residents about Musk deer in LNP)

1. Name of Interviewer :
2. Interview Date :
3. Village Name :

   GPS reading

   Elevation (m) :
4. Respondent's Gender : 5 Age : 6 : Occupation :

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7. Do Musk deer occur here or in nearby area ?
8. If so, where ? (list places, where seen in past year)
9. When was the evidence seen last time ?
10. Indicate kinds of evidence found with tick below.

    a. Faces b. Sighting c. Foot marks d. other
11. Describe the place where the sign found.
12. What habitat types ?
13. Describe distinctive physical features ?
14. What is your opinion about musk deer ?

    a. good b. bad c. no comments
15. Do local people have any kind of belief or some interesting tales about musk deer ?
16. What are the predators of musk deer ?
17. Should musk deer be protected or not ?
18. It there any poaching in your areas ?

    a. Yes b. No c. Don't know
19. If yes, which wild life species ?
20. What kind of weapons /methods used for poaching ?
21. Who are the persons responsible for poaching ?

22 For what reasons, musk deer are poached ?

23. Are local people interested in conserving musk deer ?

24. What are the reasons for conserving musk deer ?

25. Are they used locally or exported ?

26. If exported, where do they go ?

27. Which month is regarded favourable to poach musk deer ?

28. What are the threats to musk deer apart for poaching ?

29. What other animals occur in M.C.A. ?

30. Do their predators occur there ?

31. How often you see other species there ?

Sps.	Frequently	Rarely	Sometime	Of ten

32. Have musk deer's number declined over the past 5-10 years ?

Annex : III

Floral Species Found in Musk Deer Habitat

S.N.	Species	English Name	Nepali Name
1.	*Abies spectabilis*	Silver fir	Talis patra
2.	*Acer cacium*	Maple	Firfirey
3.	*Aconitum spp.*	Aconitum	Bikh
4.	*Aconogonum companulatum*		Rapre ghans
5.	*Anemone rivularis*		Kangarate
6.	*Artemisia gmelinii*		Titepati
7.	*Arundinaria spp.*		Nigalo
8.	*Asplenium spp.*		
9.	*Astragalus candollenus*		Thomja
10.	*Berberis erythroclada*		Lake chutro
11.	*Berberis angulosa*		Chutre kanda
12.	*Betula utilis*	Birch	Bhojpatra
13.	*Bistorata vivipara*		Khalti
14.	*Boschniakis himalaica*		
15.	*Cassiope fastigiata*		Phursan
16.	*Clematis montana*		Junge lahara
17.	*Clematis Montana*		Junge lahara
18.	*Cryptothladia Polyphylla*		
19.	*Cupressus torulosa*	Himalayan cypress	Raj salla
20.	*Ephedra geraradiana*		Kagcharo
21.	*Euphorbia heliscopia*		
22.	*Iris kemaonensis*	Nepal iris	Padampuskar
23.	*Juglans regia*	Walnut	Okhar
24.	*Juniperus wallichina*		
25.	*Juniperus recurva*		Dhupi
26.	*Leontopodium jacotianum*		Buke

27.	*Lichen usnea*		
28.	*Lonicera spinosa*		
29.	*Orobanche alba*		
30.	*Picea smithiana*	West Himalayan spruce	Jure salla
31.	*Pinus wallichina*	Blue pine	Gobre salla
32.	*Polygonatum spp.*		Khiraunala
33.	*Potentilla plurijuga*		
34.	*Potentilla cuneata*		
35.	*Primula calerana*		Medosero
36.	*Princepia utilis*		Bhekali
37.	*Prunus spp.*	Prunus	Painyu
38.	*Rhododendron athopogan*		Sunpate
39.	*Rhododendron campylocarpum*		Chimal
40.	*Rhododendron setosum*	Jhusey	Sunpati
41.	*Rhododendron campanulatum*		Nilo chimal
42.	*Rhododendron lepidoton*		Bhaley sunpati
43.	*Rosa moschata*	Musk rose	Pahadi gurans
44.	*Rosa sericea*	Himalayan rose	Amlong Kada
45.	*Salix sikkimensis*	willow	Bains
46.	*Solamum tuberosum*	Patato	Alu
47.	*Sorbus spp.*		Najhil
48.	*Taxus beccata*	Himalayan Yew	Louth salla
49.	*Thalictrum spp.*	Meadow rue	Dampate
50.	*Themeda tiandra*	Rui grass	Khar
51.	*Thermopsis barbata*		
52.	*Usnea spp.*	Lichen	Jhyau