A Report on

"Status and distribution of Himalayan Musk deer *'Moschus chrysogaster'* in Annapurna Conservation Area of Manang District, Nepal"

Researcher:

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A Report submitted to ITNC, UK

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Cover photo: Musk deer: provide by DNPWC/Dhorpatan hunting reserve

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Acknowledgements:

I would like to take the opportunity to offer my cordial thanks and sincere gratitude to my respected advisors Suresh K. Shrestha and Santosh Rayamajhi (Lecture of Wildlife, Institute of Forestry, Pokhara, Nepal), Jhamak B. Karki (Warden, DNPWC/ Nepal), Dr Michael J.B. Green (Director of Research & Strategy, Broads Authority, United Kingdom) and Marcus Cotton (Trustee ITNC) who provided remarkable guidance, creative comments and suggestions in all stages of this study. I am highly indebted to International Trust for Nature Conservation (ITNC) UK for providing funding for this research.

I wish to extend sincere thanks to Dr. Siddhartha Bajracharya (Programme Director, KMTNC) for his encouragement, guidance and suggestions; similarly Gehendra Gurung, (former Project Director, ACAP), Roshan Sherchan (Project Coordinator, ACAP) for granting me the permission to conduct the study in ACA and Nawaraj Chapagai (GIS officer, ACAP) for proving GIS map and guidance . Thanks are extended to Raj Kumar Gurung (OIC, Manang) and Kriti Nath Paudel for their generous support. Special thanks are extended to Kamal Thapa, Raj kumar Gupta, Shree Krishna Neupane, Bishnu Pandey (Rangers- ACAP), Hira Malla and other all staffs of UCO Manang for their generous support. Bharat B. Shrestha (PhD student, TU, Kirtipur), Bhupendra Yadav, Hari M. Chhetri, Anjala Pyakurel, Babu Ram Upreti and Santosh Aryal, deserve special thanks for their cooperation and encouragement.

CAMCs of Manang, Tanki Manang and Pisang VDCs and the Musk deer Conservation joint sub Committee deserve thanks for their cooperation during surveys. Dev Chiri Gurung, Kanchha Gurung, Maila Gurung, Palte Gurung, Gyanu Chhetri, Phonje Gurung, Korto Gurung, Kanchha Gurung (Lure), Aakheaching Gurung, Bhujung Gurung, Woagel Gurung, Jeet B. Lama, Satya Lama, Manilal Gurung, Megmar Tenjing Sherpa, Bikash Gurung and Raju Gurung also deserve special thanks for their cooperation during survey work. All other informants are thanked for sharing their information.

Finally, my greatest recognition goes to my beloved parents for their inspiration and moral support for this study.

Achyut Aryal
September. 2005

Abstract:

The study on Musk deer '*Moschus chrysogaster*' was carried out during the October-November, 2004 and July, 2005 in Humde (Manang VDC) and Pisang VDC of Manang district**. The research was entitle "Status and distribution of Himalayan Musk deer** *'Moschus chrysogaster'* **in Annapurna Conservation Area of Manang district, Nepal"** Study was carried out by using direct field inventory, population/pellet count and questionnaire survey. Pellet count was done in transect line in both study areas and silent drive count method were done in one study area (Humde). Approximately 30 days' pellets groups were counted in transect line with the help of local people. Both silent drive count and pellet group count were done in Humde area and regression model was developed to predict musk deer population density from pellet group density. Vegetation analysis was carried out in musk deer habitat, using sample plots of 10m X 10m for tree layer, 4m X 4m for all woody undergrowth up to 3m in height, and 1m X 1m for the herb layer.

Musk deer is distributed throughout VDC of Manang District expects Phu VDC and Ghyaru VDC, with high densities present in Nyeshang Valley. Potential musk deer habitat totals 7.82 km2 in Pisang VDC and 5.1 km2 in the Humde study site, where as 8 and 12 forest site of Humde and Pisang area was most potential site where we can see musk deer frequently.

The Humde area supported an estimated 23 musk deer at a mean density of 4.5 individuals/Km^2; the Pisang area supported an estimated 27 musk deer at 3.4 individuals/Km^2. The relationship between population density and pellet group density can be described by the regression equation:

$$(X) = 0.59+0.003Y$$

where X is population density/km^2 and Y is pellet group density/Km^2. Musk deer populations have been declining at a high rate in all VDC of Manang District, except Manang and Tanki Manang VDC.

Musk deer prefer altitudes of 3300 - 3700m in the study area, on 36-45% slopes with N-NW aspects and dense vegetation (forest) cover. Frequency of encounter of pellet groups

in descending order was: forests (most frequent), scrub, pasture and open land (least frequent). High encounter rates were recorded in areas with 50-75% of crown cover and 50-75% of ground cover. In Humde, *Betula utilis* (IVI=138.89) was the most prominent tree species in musk deer habitat, followed by *Cupressus tortulosa* (IVI=46.62), *Abies* spp. (IVI=44.69), *Juniperus* spp. (IVI=41.39) and *Pinus wallichi* (IVI=31.39). In Pisang VDC, *Abies* spp. (IVI=133.86) was the most prominent tree species, followed by *Betula utilis* (IVI=61.87), *Juniperus* spp. (IVI=31.39), Cupressus spp. (IVI=31.09), *Pinus wallichiana* (IVI=21.08) and *Rhododendron campanulatum* (IVI=20.76).

Snares are currently used by poachers to kill musk deer, whereas in the past they used guns, poison and dogs. The other major threat to musk deer is habitat degradation and loss, due to overgrazing, forest fires, timber production and collection of other forest products. Urgent action is required to establish Trans-boundary co-operation between Nepal-India-China to minimize illegal trade of wildlife products from the study area and other border areas. Awareness raising programs are essential for school students, herder, villagers and the general public to improve their understanding of threats to musk deer and other wildlife species and, thereby, engage their support in conservation efforts. Nature conservation awards should be provided to Musk deer conservation joint sub-committee of Manang and Tanki Manang CAMC and CAMC Pisang of Manag District.

Table of Contents:

ACRONYMS

ACA	:	Annapurna Conservation Area
ACAP	:	Annapurna Conservation Area Project
CITES	:	Convention on International Trade of Endangered Species of Wild Flora and Fauna
CAMC	:	Conservation Area Management Committee
NTFPs	:	Non-Timber Forest Products
cm	:	centimetres
GPS	:	Global Positioning System
ha	:	Hectare
Km2	:	Square kilometre
HMG/N	:	His Majesty's Government of Nepal
IOF	:	Institute of Forestry
IUCN	:	International Union for Conservation of Nature and Natural Resources
IVI	:	Importance Value Index
m	:	meters
OIC	:	Office-in-Charge
pers. comm.	:	personal communication
RD	:	Relative Density
Rdom	:	Relative Dominance
RF	:	Relative Frequency
UCO	:	Unite Conservation Office
VDC	:	Village Development Committee

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Chapter: One

Introduction:

Nepal is situated on the southern slopes of the central Himalaya and occupies a total area 147,181km^2. The country is well known for its biodiversity. Nepal's rich biodiversity is a reflection of this unique geographic position as well as its altitudinal and climatic variations. It incorporates Palaearctic and Indo-Malayan bio-geographical regions and major floristic provinces of Asia, creating a unique and rich diversity of life. Altitude varies from some 60m above sea level in the Terai to Mount Everest (Sagarmatha) at 8,848m, the highest point in the world.

Musk deer '*Moschus chrysogaster*' is one of six deer species of Nepal, belongs to order-Artiodactyla, family-Moschidae and in Asia, it is distributed in Afghanistan, Bhutan, China, India, Myanmar, Nepal, and Pakistan. In Nepal, it is found in the Annapurna Conservation Area (ACA), Kanchenjunga Conservation Area (KCA), Sagarmatha, Langtang, Shey Phoksundo, Rara, Khaptad and Makalu Barun National Parks and Manaslu Conservation Area, where a major problem is poaching (NBS, 2002). In these areas, they are distributed in Alpine forest and the vegetation is oak, fir, rhododendron, blue pine, juniper, grass, lichens and scrub between elevations of 2,200 to 4,300 meters (7,250-14,200 feet) on the eastern and southern edge of Tibet and the southern slopes of the Himalayas. *M. chrysogaster* usually lives in forests with moderate to steep slopes (Green, 1987, Kattel, 1991).

Himalayan Musk deer are essentially solitary animals having 12-20 year life span. The male is highly territorial. But females appear to be noticeably tolerant of other individuals. Average home range of males is larger than that of females (Kattel, 1992). The presence of the musk gland (pod) is one of the characteristics features of the species, which is present only in the male (Shrestha, 1989).

Musk deer is reported to face predator pressure from Leopard (*Panthera pardus),* Clouded leopard *(Neofelis nebulosa*), Snow leopard (*Uncia uncia*), Lynx (*Felis lynx*), Wolf (*Canis lupus*) and Wild dog (*Cuon alpinus*) (Shrestha, 1981).

Musk deer is a protected mammal and listed as an endangered species by the National Parks and Wildlife Conservation Act 1973 in Nepal. It is listed in Appendix I for Afghanistan, India, Nepal and Pakistan, and in Appendix II for Bhutan and China under CITES.

Populations of musk deer are poached for the musk gland that fetches enormous amounts of money through illegal international trade. Population of Musk deer is decline due to poaching, high human and domestic livestock pressure, consequent degradation of habitat and, in respect of poaching, it has been estimated that for every male deer that yields one musk pod, four deer are killed. (Green, 1986; HMG/Nepal, 2002).

The musk produced by this genus of primitive deer is highly esteemed for its cosmetic and alleged pharmaceutical properties and can fetch US$ 45,000 per kilogram (2.2 pounds) on the international market. Although this musk, produced in a gland of the males, can be extracted from live animals, most "musk-gatherers" kill the animals to remove the entire sac, which yields only about 25 grams (1/40 of a kilogram) of the brown waxy substance (Green, 1986; Knowler, 2000).

The aim of this study on "**Status (population, poaching and habitat) of Musk deer *'Moschus chrysogaster'* in Annapurna Conservation Area of Manang district"** was to examine the current status and structure of the musk deer population and its habitat in the previously unstudied Manang District of the Annapurna Conservation Area, Nepal, including an assessment of poaching activities.

Chapter: Two

[This chapter is based mainly on Homes, V. (1999), Green and Kattel, 1998]

Musk deer

Taxonomy

Musk deer have been classified with deer in the Cervidae family (Flower, 1875 and Heptner and Naumov, 1961), but today they are grouped together by many scientists into their own separate family, the Moschidae (Brooke, 1878; Flerov, 1952; Groves and Grubb, 1987 and Whitehead, 1972). Thus Musk deer taxonomy remains debatable. While it was previously assumed that one to three species existed (Green, 1986; Groves, 1975 and Grubb, 1982), there are now thought to be at least four and possibly six or more species (Green, 1998; Groves and Grubb, 1987 and Groves *et al*., 1995). There is, however, broad agreement over the distinctions made for the following four species and their distribution (Green in Wemmer, 1998):

- Siberian Musk deer *Moschus moschiferus* (Russia, Kazakhstan, Kyrgyzstan, China, Korea and Mongolia).
- Forest Musk deer *M. berezovskii* (China and Vietnam).
- Himalayan Musk deer *M. chrysogaster* (Afghanistan, China, India, Nepal and Pakistan).
- Black Musk deer *M. fuscus* (Bhutan, China, India, Myanmar and Nepal). Some maintain that this is a subspecies of *M. chrysogaster*.

Morphology

Musk deer are of dark brown colour and their over with coarse and brittle hair. They are known to attain a height of 40 to 50 cm at shoulder having head to body length of 86-100 cm, a weight of 13-18 kg (Zhivotshenko, 1988, Shrestha, 1997). Musk deer do not have antlers, but males and females possess clearly elongated upper canine teeth that project far below the lower lip. The length of male canines usually reaches six to eight centimetres, and in rare instances as much as 10 cm, and they are used in displays and fights between rivals. The rear part of the body is more powerfully built than the forequarters, with the back being curved and hind legs longer than the forelegs. Musk

deer movement appears more like jumping than running. Their toes are large for their body size and can be spread to find secure footing in mountains and on snow. Their coat is thick and includes brittle guard hairs. Individual hairs contain air-filled cells for better insulation (Green, 1985).

Musk deer is considered to be a very primitive member of the deer family. A fully mature male deer bears a musk 'pod' between the genitalia and umbilicus, which exudes a strong smelling, dark brown semi fluid substance for attraction of females during the onset of the rut. The active chemical substance in musk is known as muscone and finds use in perfumes or in medicines or as aphrodisiacs and fertility drugs (Green, 1985; Shrestha, 1997).

Habitat and ranging behaviour

The characteristic landscape for Musk deer constitutes mountains covered with mixed forest especially places where precipitous cliffs abound. Himalayan Musk deer occur at an altitude of 3,000 to 4,500 metres where temperate climate prevails (Green, 1986; Shrestha, 1997). Musk deer inhabit steep, forested or shrub-covered slopes, mainly in the sub-alpine zones of mountain regions. Dense undergrowth of rhododendron, bamboo and other shrubs form the typical habitat (Bannikov *et al*., 1978; Green, 1987a). Use of the habitat depends upon the availability of cover, food and other factors: Musk deer are very shy and solitary animals that may not become active until dusk.

Male Musk deer are highly territorial, tolerating only female musk deer within their home ranges and defending their home range against other males of the species, while female territories may overlap (Green, 1998). In studies in Nepal it was found that, in regions where the population density of musk deer is high (23 individuals to 50 ha), the home range of one male overlaps with parts of the home ranges of five females but not with parts of the home range of another male (Kattel, 1992). However, in studies in northern India (Green, 1995 and 1998) it was found that in cases where the population density was low (five to six individuals / km2) the home ranges did not overlap as much as when densities were high.

Communication between animals: Solitary behaviour is typical for small forest ruminants, such as Musk deer, which are guided primarily by their olfactory sense. Olfactory signalling between Musk deer is highly developed (Lai and Sheng, 1993). So-called “latrine sites” (areas of droppings), urine markings and the musk scent of males, as well as scent from other glands found around the hoof and tail areas, are used for marking (Green, 1987c and Sokolov and Prikhod‘ko, 1979 and 1983). The function of the musk scent in chemical communication is not entirely understood. Observations of red or pink-stained and sweet-smelling patches of urine in snow indicate that the musk of the male is probably emitted in the urine, while the urine of females, by contrast, is amber-coloured and does not have any noticeable smell to humans (Green, 1987c). The scents could be used for territorial marking by animals and at the same time express something about the individual status of animals. Fights between rivals would in this way be kept to a minimum and females would learn more about potential reproductive partners.

Reproduction

Musk deer breed seasonally. The rut extends from November to early January and the young are born from May to June after a gestation period of 178-198 days. The period of gestation increases with the size of the species, from the Forest Musk deer, the smallest species, to the Siberian Musk deer, to the Himalayan Musk deer, the largest species and with the longest gestation period (Green, 1989). Litter size ranges from one to three young. Twin births predominate in Forest Musk deer and Siberian Musk deer, while single births are most common in Himalayan Musk deer.

The birth weight of Musk deer varies between about 400g and 600g, depending on the species. In their first two months, the young Musk deer, like all deer species, are “nursed offspring” concealed in the undergrowth and suckled by their mothers. At the age of about two months they begin to follow their mothers and are weaned (Green, 1987a).

The young grow rapidly, become independent of their mothers by the age of six months, and reach sexual maturity at 18 months of age. Female Musk deer are capable of breeding after their first year (Green, 1987a and 1989). This fact is conducive to quick growth of a population of Musk deer, relative to other large mammals, given suitable environmental conditions. The Musk deer populations of Russia were brought to the brink of extinction

through over-hunting in the early part of the twentieth century and were subsequently able to recover within a few decades.

Food

The food of Musk deer consists primarily of leaves of trees, shrubs and forbs. They have a preference for easily digestible nutritious foods that are high in energy content, rich in protein and low in fibre (Green, 1987b and Kholodova and Prikhod'ko, 1984). In northern India, forbs and parts of trees and woody shrubs form the main part of the diet in summer and winter. In winter the Musk deer can also survive on poorer quality diets, for example, mainly lichens *Usnea sp.* which, while low in proteins, are very high in energy and easily digested (Green, 1987b and Negi, 1996). When the snow is deep, arboreal lichens and evergreen rhododendrons may constitute the only available sources of nourishment. Musk deer can climb trees to graze on lichens and leaves otherwise out of reach.

Predators

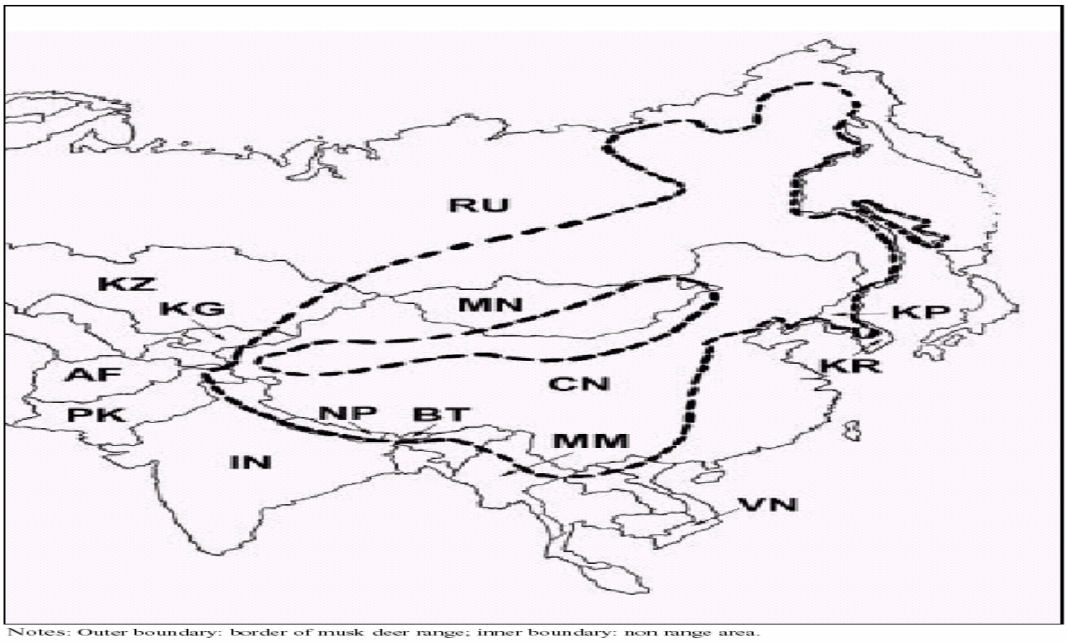
Musk deer have a number of natural predators. Depending on the range, their main predators may include the Wolverine *Gulo gulo*, Grey Wolf *Canis lupus*, Tiger *Panthera tigris,* Leopard *Panthera pardus*, Clouded leopard *Neofelis nebulosa*, Snow Leopard *Uncia uncia*, Lynx *Lynx lynx*, Fox *Vulpes vulpes* and Yellow-throated Marten *Martes flavigula*. The young are also attacked by large birds of prey (Green, 1987a, Kozhechkin, 1994 and Zhivotshenko,
1988). Predators do not, however, have a significant impact on the size of the Musk deer population. In the region of the Altai and Eastern Sayans in Russia, Musk deer form up to 50% of the diet of the Yellow-throated Marten but, nevertheless, the martens in these regions remove only about 8-12% of the overall population of Musk deer (Bannikov *et al*., 1978 and Prikhod'ko, 1997). Musk deer detect approaching danger in part though their sense of hearing (Zhivotshenko, 1988).

Distribution and population

The distribution of Musk deer extends through the forested mountains of eastern Asia, from the Arctic Circle in Siberia in the north, to the north-eastern edge of Mongolia and Korea and further southward across China, away from the Gobi Desert, to Vietnam, and Myanmar continuing as far as the southern Himalaya in Afghanistan, Pakistan, India and Nepal (see **Figure 1**). In Central Asia, Musk deer occur in Kazakhstan, possibly in Kyrgyzstan, and the south of Russia (Dao, 1977; Flerov, 1952; Green, 1986 and Whitehead, 1972). Musk deer mainly inhabit altitudes of above 1000m. In the Himalayas, the animals range extends in parts up to the tree line at an altitude of 4200 m, but in the northern parts of their range, Musk deer may occur at much lower altitudes.

The accuracy of the estimates of the size of Musk deer populations varies greatly in the different regions (Wemmer, 1998). Only in very few countries are population estimates based, at least in part, on systematic counts carried out in selected areas and extrapolated to larger distribution ranges: this method of estimating population sizes was used in the Soviet Union. Overall the population of all Musk deer species may be estimated to be between 400 000 and 800 000 individuals.

Figure 1: Range of Musk deer (*Moschus* sp.) according to Corbet and Hill (1992); Dao (1977); Flerov (1952); Green (1986); Wemmer (1998) and Whitehead (1972).



Notes: Outer boundary: border of musk deer range; inner boundary: non range area.

AF: Afghanistan; BT: Bhutan; CN: China; IN: India; KG: Kyrgystan; KP: North Korea; KR: South Korea; KZ: Kazakhstan; MM: Myanmar; MN: Mongolia; NP: Nepal; PK: Pakistan; RU: Russia; VN: Vietnam

Credit: Jürgen Mallyon and Alexandra Heyne, WWF Germany

Distribution of Musk deer in Nepal

M. chrysogaster is widely but discontinuously distributed throughout the Himalaya from about 3,000m to 4,400m (Green, 1985). The population is thought to be increasing within protected areas but declining outside them. Sagarmatha National Park has an estimated 600-800 animals, with up to 45 per sq. km. Elsewhere, there are an estimated 500 animals in Langtang National Park, 20 in Rara National Park and >1000 in Shey-Phoksundo National Park (B. Kattel, pers. comm., 1990 by Green).The habitat of Musk deer in upper Langtang Valley, the vicinity of Thyangboche monastery in Khumbu and in upper Budi Gandaki Valley is better protected than other parts of country. According to Jamwal (1972) areas where Musk deer are more commonly found in Nepal are Bajhang, Doti, Simikot, Markhor Lake, Dhorpatan, and Langtang in west and central region. In eastern Nepal, Musk deer are known to occur in Jatapokhari, Taplejung, Chipuwa, Arun and Wallangchung Gola. It is present also in Dhorpatan Hunting Reserve, Khaptad National Park and Makalu-Barun National Park (IUCN, 1993).

M. fuscus, considered by some authorities to be a subspecies of *M. chrysogaster*, occurs in the Everest region.

Conservation status and protection

The conservation status of species of Musk deer is recorded as follows in the *IUCN Red List of Threatened Animals* (IUCN, 1996):

Siberian Musk deer: Vulnerable (VU)

Forest Musk deer: Lower Risk (nt)

Himalayan Musk deer: Lower Risk (nt)

Black Musk deer: Lower Risk (nt)

Global conservation and trade status of musk deer

Taxa	Global conservation status[1]	Global status under CITES[3]
Musk deer *Moschus* spp.	LR/nt ver 2.3 (1994)	Appendix II (1979) [5]
Forest musk deer *Moschus berezovskii*	LR/nt ver 2.3 (1994)	Appendix II (1979) [5]

Alpine musk deer *Moschus chrysogaster*	LR/nt ver 2.3 (1994)	Appendix II (1979) [5]
Black musk deer *Moschus fuscus*	LR/nt ver 2.3 (1994)	Appendix II (1979) [5]
Siberian musk deer *Moschus moschiferus*	VU A1acd ver 2.3 (1994)	Appendix II (1979) [5]
Anhui musk deer[6] *Moschus anhuiensis*	not recognised	Appendix II (1979) [5]

[1] Global conservation status is based on the IUCN Red List. The **bold symbol** indicates the population trend: declining for tiger and uncertain for Asiatic black bear. Ver refers to the version of the Red List Categories and Criteria used to classify a taxon, but not the year in which it was classified.

[3] Global protection status in based on the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES). The year of listing is in brackets.

[5] All species of musk deer are listed in CITES Appendix II, except Himalayan populations of Afghanistan, Bhutan, India, Myanmar, Nepal and Pakistan, which are listed in Appendix I (1983).

[6] This species is not recognised in the IUCN Red List. Some authorities consider it to be the same as *M. fuscus*.

Vulnerable (= VU) means: threatened because of an observed, estimated or anticipated reduction in population in the past or future. Lower Risk signifies that the species is not included in the three categories of "threat" but "nt" (= near threatened) classifies them as approaching a threatened level. All Musk deer species have been included in the Appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) since 1979. Populations of Siberian Musk deer *Moschus moschiferus* occurring in the countries of the Himalayan region (Afghanistan, Bhutan, India, Myanmar, Nepal and Pakistan) were included in Appendix I (although Green (1998) considers these populations to be of Himalayan Musk deer *Moschus chrysogaster* and Black Musk deer *M. fuscus*), while all other Musk deer species are listed in Appendix II. Musk deer is a protected mammal and listed as endangered species by the National Parks and Wildlife Conservation Act 1973 in Nepal.

Chapter: Three

Annapurna Conservation Area Project

Annapurna Conservation Area (ACA), the first conservation area and the largest protected area in Nepal, has adopted a new approach and concept in protected area management. It is managed by the King Mahendra Trust For Nature Conservation (KMTNC) as the Annapurna Conservation Area Project (ACAP). The underlying principle of the project is to strengthen the linkages between ethics and environment taking local communities as both principal actors and beneficiaries of the conservation undertakings. Unlike the conventional protected area management approach where people are viewed as the undermining agents of the environmental degradation, ACAP strongly considers local people as the masters of environment conservation. KMTNC has been successful in integrated conservation and development programmes in ACAP. This made ACAP the most successful integrated Conservation and Development Project (ICDP) in the world (ACAP, 2002). Annapurna Conservation Area is a land of extremes located in the north central part of Nepal. The ACA covers a landmass 7,629km^2 with altitudes ranging from Sub-tropical region to 8,000m within a short horizontal distance of less then 35km. The southern sector of ACA is humid and warm with a subtropical climate, while the northern sector is cold and semi-desert. The ACA has an extremely diverse floral and faunal kingdom in a variety of interrelated ecosystems from subtropical to alpine grass lands exist in the ACA. The ACA harbours a recorded total of 1226 species of plants, 38 species of orchids, 9 species of rhododendrons, 101 species of mammals 474 species of birds, 39 species of reptiles and 22 species of amphibians. More than 10 ethnic groups inhabit in region. Some of the ethnic groups are Gurung, Thakali, Manangi, Bhotia, Tibetan, Magar, Tamang, Brahmin, Chhetri and lower cast (Kami, Damai, and Sarki). (ACAP, 2002).

The KMTNC established its first field office in Ghandruk in December 1986 to run ACAP's pilot phase which covered only the Ghandruk Village Development Committee (VDC) an area of about 290 Sq. km, After successful indicators in Ghandruk, ACAP began Stage-1 expansion in 1990 to cover 19 VDCs in the southern Annapurna

region covering approximately a total of 1,748 sq. km, In 1992, The HMG/N opened Upper Mustang to foreign tourists (it was previously a restricted zone) and in July HMG/Nepal assigned the entire resource conservation responsibility of the area to the KMTNC for 10 years to 2002. In 2002, HMG/Nepal extended the arrangement for a further 8 years to 2010. The project now covers 55 VDCs with 55 CAMCs (Conservation Area Management Committee) in 5 districts of Nepal – Kaski, Lamjung, Mygadi, Mustang and Manang. The CAMC is the main body of ACAP through which it implements all programmes & provides support for biodiversity conservation through people participation.

Chapter: Four

Objectives:

1. To determine the population Status of Musk deer in study area.
2. To assess the present habitat structure.
3. To assess past and present the poaching activities of Musk deer in study area.
4. To map out distribution and potential poaching area in ACAP area.
5. To find out current threats to Musk deer population and their habitats.

Problems /Justification

Musk deer are native to Asia but that natural musk and products containing musk are used and traded worldwide and, therefore, that conservation of musk deer is a global concern. Government of Nepal is protecting endanger flora and fauna. Out of them the musk deer is a one of the protected animals of Nepal, which is reported in the different parts of alpine region of Nepal. Government of Nepal has established Department of National park and wildlife Conservation area for the conservation of endanger flora and fauna. These flora and fauna are being depleting day by day due to over exploitation, pollution, habitat destruction, poaching and human and livestock pressure in the its habitat (HMG/Nepal,2002). The population of musk deer is declining from Nepal and the Himalayan area due to poaching, habitat destructions (Sathyakumar, 1993; HMG/Nepal, 2002) but there are lack of researches to understand population decline. The only one research in Nepal which was carried by Kattel in 1992 about its ecology in Sagarmatha National Park of Nepal. ACAP is one of the potential areas of the musk deer which is found in the Manang district where no research has been carried out up to data in ACA region, present this research is first research in this species of ACA region of Nepal.

Manang is one of potential habitat area of Nepal for the Musk deer, where good number of population of musk deer is present (Nerndra lama,[1] pers. comm., 2004). In Manang district, musk deer is present in Pisang village development committee (VDC), Manang

[1] who is former officer In-Charge of Unit conservation office, ACAP/KMTNC, Manang, Nepal

VDC, Khangshar VDC, Nar and Pho VDC and Humde area out of 12 VDCs of Manang district.

People in the Himalayas have hunted the musk deer for commercial purpose .In Manang, this remains the sole reason for the decline in the musk deer population (HMG/Nepal, 2002). There are high pressures on Musk deer population due to heavy pressure of poaching, habitat use by livestock, grazing and Non-timber forest product collection in its habitats.

In Nyeshang valley (which is largest valley of Manang from Pisang VDC to Throng Phedi and lies in Pisang VDC, Bhraka VDC, Tanki Manang VDC, Manang VDC, Khangsar VDC, Ghyaru VDC) harbors good population, Out of them Pisang VDC is potential habitat of Musk deer (ACAP,2002). In 1992, people of Nyeshang cleared 310 snares. These snares are placed at different intervals of the fencing constructed to block the path of the deer. One such fencing in Humde forest was 1500m long. ACAP Staff themselves clears more than 200 snares made of nylon rope every year (pres.com. K. Marshani and S. K Naupane, rangers of ACAP, ACAP, 2002) Poaching activities is high in this study area (Per. comm. N. Lama,2004). In 2001/2002, ACAP Staff and Pisang Conservation Area Management Committee (CAMC) went to Pisang jungle on 2001/12/17 for the patrolling and they were found 1 Male musk deer on trap, 2 Musk deer's head, 8 legs of Musk deer and 335 snares (ACAP, 2002).This shows the scale of poaching by very capable snare hunters..

Initially, data must necessary for the proper management of musk deer in this region. Therefore, this study has found out the population of musk deer in the study area, its past and present poaching activities, potential poaching area and present habitat structure and its distribution and outline current threats to Musk deer population and their habitats in the study area. The out put of this research is useful for not only to ACAP but also to Government of Nepal for the proper management of it population in other part of Nepal and provide management prescription to ensure long-term survival in its natural habitat

Chapter: Five

Study Area

Manang District

The **s**tudy area is in Manang District of Western Development Region of Nepal, which lies in the north-central part of Nepal. Though it is an area delimited primarily according to administrative policy, it is also, from the natural point of view, sharply delimited from the surroundings by high mountain chains. To the south it is bounded by the main chain of the Himalayan range, formed by Annapurna and Lamjung Himal, to the west by mountain range of Damodar and Muktinath Himal, to the east Manaslu Himal, while in the north Peri, Himlung and Chyo Himal at the same time form the border to Tibet. The territory of the district is not only surrounded by high mountain chains more than two thirds of the surface area of approximately 2,200km^2 is occupied by high mountains. These are interrupted only by the main valley of the Marsyangdi khola, which together with its tributaries the Nar and Dudh khola, drains the entire area to the south. In doing so the Marsyangdi flows through the area north of Annapurna and Lamjung Himal in a longitudinal valley, extending from NW to SE, before it turns directly south near the village of Thonje and subsequently breaks through the main chain of the Himalaya between Lamjung and Manaslu Himal in a steep and narrow gorge. Due to the different geological and geo-morphological conditions, various valley forms have been created along the river's course and these have had a decisive influence on the settlement pattern and economic activities within the area. Thus in its upper reaches, in Nyeshang Valley, the relatively soft sediments of the Tibetan marginal synclinorim have been swept by glacial erosion into the form of a broad U-Shaped valley, favourable to settlement and agriculture. With the onset of the crystalline roots of the main chain of the Himalaya in Gyasumdo, however, the Marsyangdi cuts deep into the harder rock formations. Manang is a trans-himalayan district of Nepal. It covers an area of 2,246km^2. It lies between 28° 27′ and 28° 54′ N and 83° 40′ and 84° 34′ E. The elevation ranges from 1,600m (Tal) to 8,156m (Manaslu I). Altitudinal variation has resulted in diverse climatic conditions. The land use pattern of this district is not suitable for agriculture that represents only about 0.5% of the total land usage. About 9% is covered with forest and rest is grazing and other (Anonymous).

Climate – Rainfall

Nepal has a great variation of topography, which has impact on the diversity of weather and climate. It experiences sub-tropical, mesothermal, taiga and tundra types of climate (HMG/Nepal, 1994). In general, Manang has temperate and alpine type of climate. The high mountain ranges shield the monsoon, causing a dry atmosphere in the Manang Valley. The mean annual precipitation is 959.5mm. Manang Bhot comparatively is drier has an annual precipitation of only 476mm (Shrestha et al., 1995). The amount of rainfall declines from east towards west in the Himalayan region (Singh and Singh, 1992). The maximum rainfall occurs in July and August (121.8mm and 146.4mm respectively). Minimum rainfall occurs in November (3.0mm in Manang District) as shown in Table 2.

Table 2: Annual Rainfall of Manang District (2001)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	6.2	28.6	23.8	23.0	25.2	112.6	121.8	146.4	34.0	6.2	3.0	0.0

Source: Department of Meteorology

Temperature

Temperature varies not only from east to west but also at the local level and depends upon exposure of the sun. The highest maximum temperature (Tmax) of the district is in May (20.1°C). Similarly, the minimum temperature (Tmin) is in December (-1.4°C) as shown in the Table 3. This data not represent more than 3300m of altitude.

Table 3: Annual Temperature of Manang District (2001)

Month		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature (^{0}C)	Tmax	9.9	14.0	17.1	19.3	20.1	19.7	19.3	19.0	19.8	18.2	17.4	14.5
	Tmin	-1.2	1.2	5.0	8.3	9.2	7.2	7.6	7.1	7.9	5.6	5.2	-1.4

Source: Department of Meteorology

Vegetation

Vegetation is the term used to designate the plant cover of a region. It is generally made up of one or more plant communities or aggregation of plants usually forming a complex.

It is a geographic feature of great importance, as it determines the appearance and general characters of most land areas (Forsberg, 1961).

Negi (1994) has divided the forest of Nepal into four forest regions:

a) Outer or Siwalik region
b) Lower Himalayan or Midland region
c) Main Himalayan region
d) Arid or trans-Himalayan region

The arid or trans-Himalayan region of Nepal lies to the north of the main Himalayan axis. This region receives very little rainfall, as the southwest monsoon is unable to cross the high mountains. Manang is categorized as the prominent arid zone (Stainton, 1972).
Manang is rich in variety of vegetation in hills, valleys, riverbeds and high Himalayan pastures in different climatic zones. Corresponding to the climatic condition, there is a change in vegetation type from subtropical to temperate, xerophilous and alpine formations. The forest vegetation includes Oak (*Quercus sp*.) and Rhododendron forest in a lower belt and Conifers (*Pinus wallichiana, Picea smithiana, Taxus wallichiana, Tsuga dumosa* and *Abies spectabilis*) and Birch (*Betula utilis*) in the upper belt. The vegetation above the timberline is enriched by steppe communities mostly *Berberis sp., Caragana sp., Rosa sp., Juniperus sp., and Lonicera sp*. (Pohle, 1990).

Population

Manang District has a total population of 9,587 which is about 0.04% of the total population of the country. The population density of Manang district is only 4 person/km^2 and the average family size is 5.4 people per household. The total population of Chame and Tachi Bagarchhap VDCs are 1,204 and 554 respectively (HMG/Nepal, 2002). The main ethnic groups are Gurungs and Sherpas (Bhotias). Gurungs are culturally oriented partly towards Tibetan Buddhist traditions and partly Nepali Hinduism. The Sherpas in contrast are firmly rooted in the religious tradition of Buddhism and cultural tradition of Tibet, though they differ significantly in their forms of economic activity. The Sherpas and Gurungs draw their main income from animal husbandry (yaks, goats, sheep and

cattle) but they also cultivate barley and potatoes and carry out small scale trade in the lower altitude during winter. Due to severe winter climate, the population migrates with its herds in December to winter quarters. Some people, predominantly the young, set off from there towards the south to exchange their trading products such as yak, wool, dried cheese, spices (jimbu) and medicinal herbs for rice and other foodstuff.

Intensive study area: Study area was lies in Manang VDC i.e. Humde area and Pisang VDC.

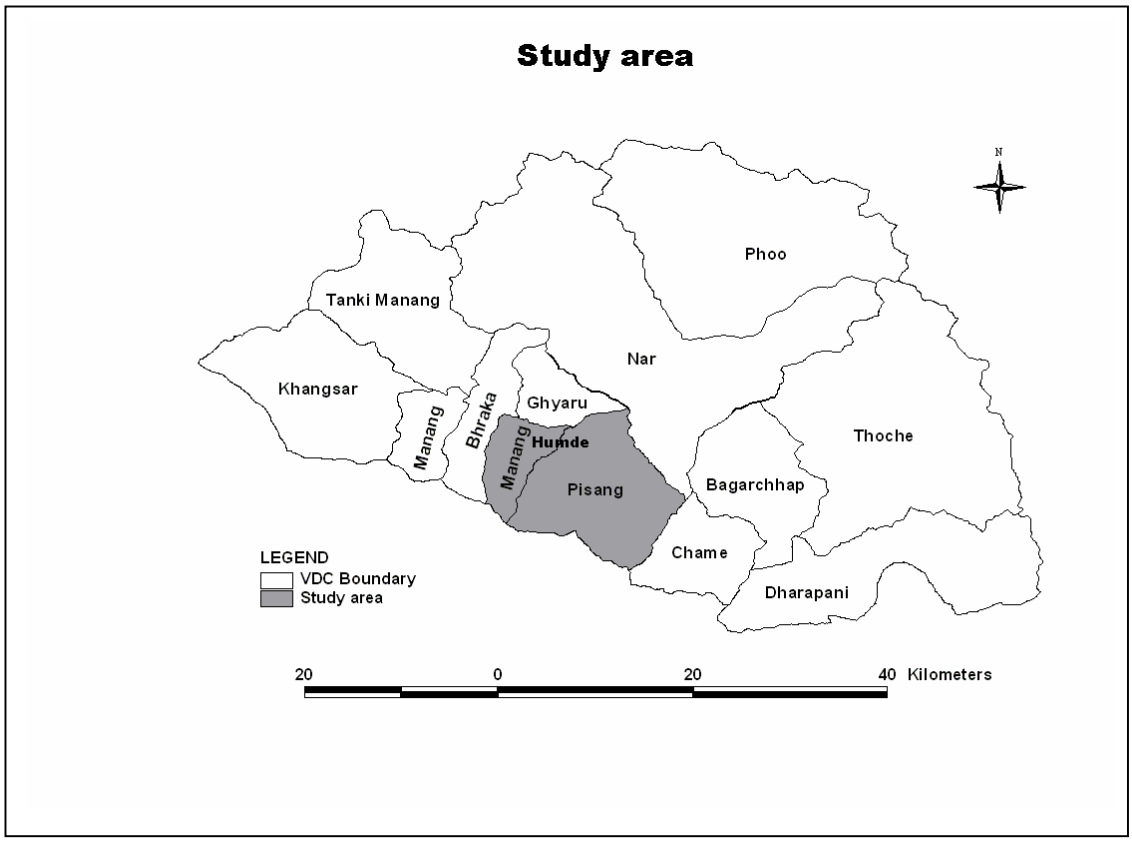


Figure: Study area (Humde and Pisang)

Chapter: Six

Methodology

A preliminary survey of the study area was carried out to find out Musk deer habitat before the actual field work started. This was done by questionnaire and discussion with concerned and knowledgeable people: villagers, herders, local leaders, district forest staff and Annapurna Conservation Area staff.

Distribution Pattern

Distribution pattern was identified on the basis of direct observation, presence and absence of pellets and tracks and from interviews with local herders and other key informants.

Population status

Pellet count was done in transect line in both study areas and silent drive count method was done in one study area (Humde). Approximately 30 days pellets groups were counted in transect line with the help of local people (It was on the bases on past experience of local people on musk deer habitat patrolling).

Both silent drive and pellet group count were done in Humde area. It was done to predict population density by pellet group in other sites by reference to the Humde area result. Only pellet group count in transect line was done in Pisang area.

SILENT DRIVE COUNTS METHOD for Musk deer:

(After Green, 1985; Sathyakumar 1994)

Green (1985) was the first to use this density estimation technique for mammals such as the Musk deer and Serow followed by Kattel (1992); Sathyakumar (1994) and Vinod & Sathyakumar (1999).

It is similar to the block drive census method. It involves more time, manpower, funds and so is not repeatable frequently. In this method, the area of interest identified within a habitat (usually sub-alpine forests at tree line) is divided into small blocks or patches using features such as ridges, streams and foot paths as boundaries. A base line is identified and 10 to 12 men are spaced at intervals of 30 to 40m. All these men should have some knowledge of the block or patch in which the drive is to be conducted and their line of travel. They are instructed to move quietly through the patch and record ungulates sighted. Three to five men called 'observers' are placed strategically above the forest level and other vantage points to spot and record ungulates which otherwise might have got flushed undetected from the block. All men have watches that are set to the watch of the drive count coordinator. Data on time, species, number and location with reference to the line of travel and direction of movement of the ungulate are recorded. It is ideal to conduct drives in early mornings or late afternoons. Duplicate records arising from the same animal being sighted in adjacent blocks or patches is minimized by conducting drives in a direction that would flush them outside the study area rather than towards adjacent blocks or patches. This technique not only helps in obtaining absolute density estimates for Musk deer and Serow but also helps in monitoring their numbers for a given area over the years.

Pellet density was also recorded for pellets up to approximately 30 days old along 500 m long transects of 10 m width between altitudes of 3,500m and 4,000m. Both pellet group density and silent drive count method were used in Humde area. In Pisang area only pellet density was observed. In Humde area pellet density survey and silent drive count method was conducted twice (summer and autumn). Musk deer drop pellet repeatedly the in same place, so it is possible to distinguish between older and newer layers of pellets; when the lower layer and upper layer are less than 30 days old, then it was counted as

two pellet groups. It was on the bases on past experience of local people on musk deer habitat patrolling.

Pellet density: $\frac{\text{Total pellet numbers}}{\text{Transect area X Transect Number}}$

Regression model for the predication of population density/Km^2 of Musk deer through data pellet density/km^2 was developed on the basis of two time data collection from Humde area; both times the same area was used for pellet density survey and silent drive count. Present equation is developed through the very small sample size and needs to be repeated in a number of different study areas through future research.

Regression equation: X = a + bY

Where X= Population density/Km^2 (dependent variable)
Y= Pellet density/Km^2 (Independent variable)
$a = X - b\,Y$
$b = \frac{N \sum XY - (\sum X \,.\, \sum Y)}{N \sum Y^2 - (\sum Y)^2}$

Poaching activities (Past and Present)

To meet the objective, direct observation and questionnaire surveys were used. Formal and informal interviews were done to determine hunting practices, poaching areas, wildlife knowledge and hunting equipment and its threats.

Habitat Structure analysis

Vegetation analysis

Vegetation analysis was carried out in Musk deer habitat. Floristic survey was conducted with random sampling methods in all representative areas. Sample plots were laid where encounter with pellets occurred and also plots were laid where pellets were absent. Sample plot size for plants were used as suggested by Schemnitz, D.S, 1980: that is 10m X 10m for tree layer, 4m X 4m for all woody undergrowth to 3m in height, and 1m X 1m for the herb layer in composite plot.

For calculating plant density, frequency, abundance etc., following formulas are used:

1. Density and Relative density (RD):

$$\text{Density of species A} = \frac{\text{Total no. of individuals of species A}}{\text{Total no. of plots sampled} \times \text{area of a plot}}$$

$$\text{Relative density of species A} = \frac{\text{Density of species A}}{\text{Total density}} \times 100$$

2. Frequency and Relative frequency (RF)

$$\text{Frequency of species A} = \frac{\text{No. of plots in which species A occurs}}{\text{Total no of plots sampled}} \times 100$$

3. Relative Dominance:

$$\text{Relative Frequency of species A} = \frac{\text{Frequency value of species A}}{\text{Total frequency value of all species}} \times 100$$

$$\text{Relative dominance of species A} = \frac{\text{Total basal area of species A}}{\text{Total basal area of all species}} \times 100$$

Basal area of a species was a sum of basal area of individual trees of that species which will be calculated using the formula:

Basal area = $\pi (d / 2)^2$
Where, d= diameter of tree at breast height

Importance Value Index (IVI):

IVI of a tree species was obtained by the summation of relative density, relative frequency and relative dominance.

IVI = relative density + relative frequency + relative dominance

Physical feature Analysis in its habitat

Other features of habitat such as cover, ground morphology (broken, unbroken, smooth, boulder or small rock) and erosion, cliffs, caves, water sources was noted as was slope, elevation and aspect by directed observation by using appropriate instruments.

Map out the poaching and distribution areas

After completion of the field visit, data was plotted on the original map to show the poaching and distribution.

Chapter: Seven

Result and discussion:

Present distribution of Musk deer in ACAP region:

Manang and Mustang districts have provided prime habitat for Musk deer. In Manang district they are distributed in Thoche, Tache Bagarchap, Dharapani, Chame, Manang, Tanki Manang, Khansar, and Nar VDCs. Nyeshang valley (which is the largest valley of Manang and starts from Pisang VDC to Throng Phedi and covers the six VDCs) harbours high density of Musk deer population. Similarly, in Mustang district Musk deer is found in Tukuchhe, Jomsom (higher altitude), Marpha, Muktinath, Kobang, VDCs (per. comm. Ghan Br thapamagar, 2005). In 2000, an ACAP patrolling team led by Ajay Pandey (Officer-ACAP) and Rajesh Gupta (Ranger-ACAP) encountered Musk deer in Parche and Namarjung VDCs of Kaski district as well.

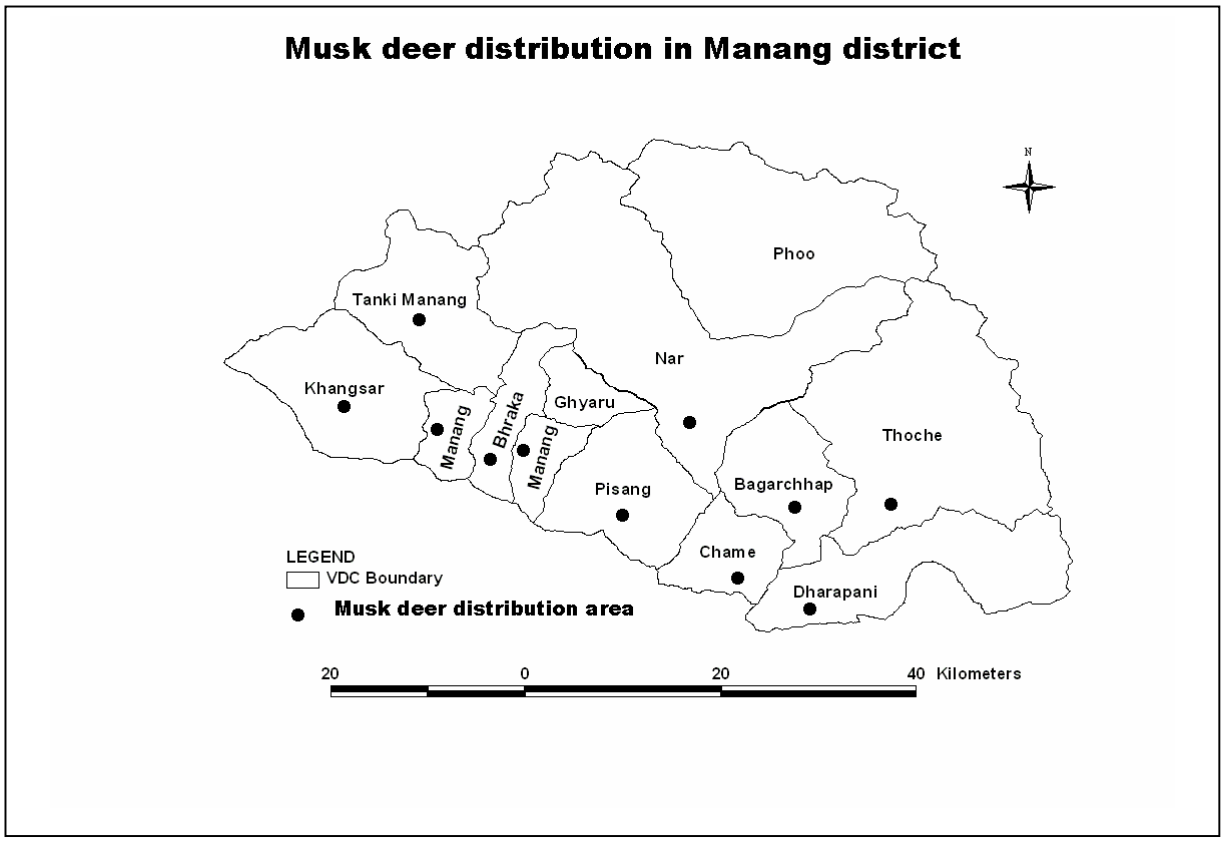


Figure: Musk deer distribution in Manang district.

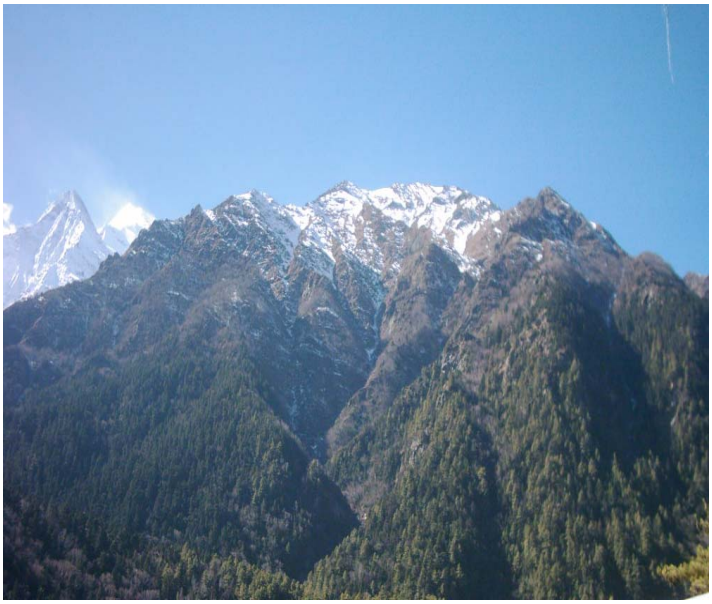
Musk deer distribution and potential area of Humde and Pisang

The potential area of Musk deer in Pisang covered 7.82 Km^2 and in Humde area, 5.1 Km^2. The following sites in Humde area are potential for Musk deer habitat:

1. Nagyu
2. Tendemlo
3. Pharsigrama
4. Pangkang
5. Pyahu
6. Sakyo
7. Tengla
8. Rachpi

Potential Musk deer habitat areas of Pisang VDC are:

1. Padibu Pakha
2. Kyothopa Pakha
3. Kyadi
4. Kyaudi Pakha
5. Cheranma Pakha
6. Kuchura Pakha
7. Kesar khola
8. Nalago
9. Maraka Danda
10. Namche
11. Yaka Danda
12. Dhukur Pokhari



Musk deer habitat in Pisang (forest above Dhukur Pokhari)

Musk deer habitat in Humde area (Nagyu area) with researcher

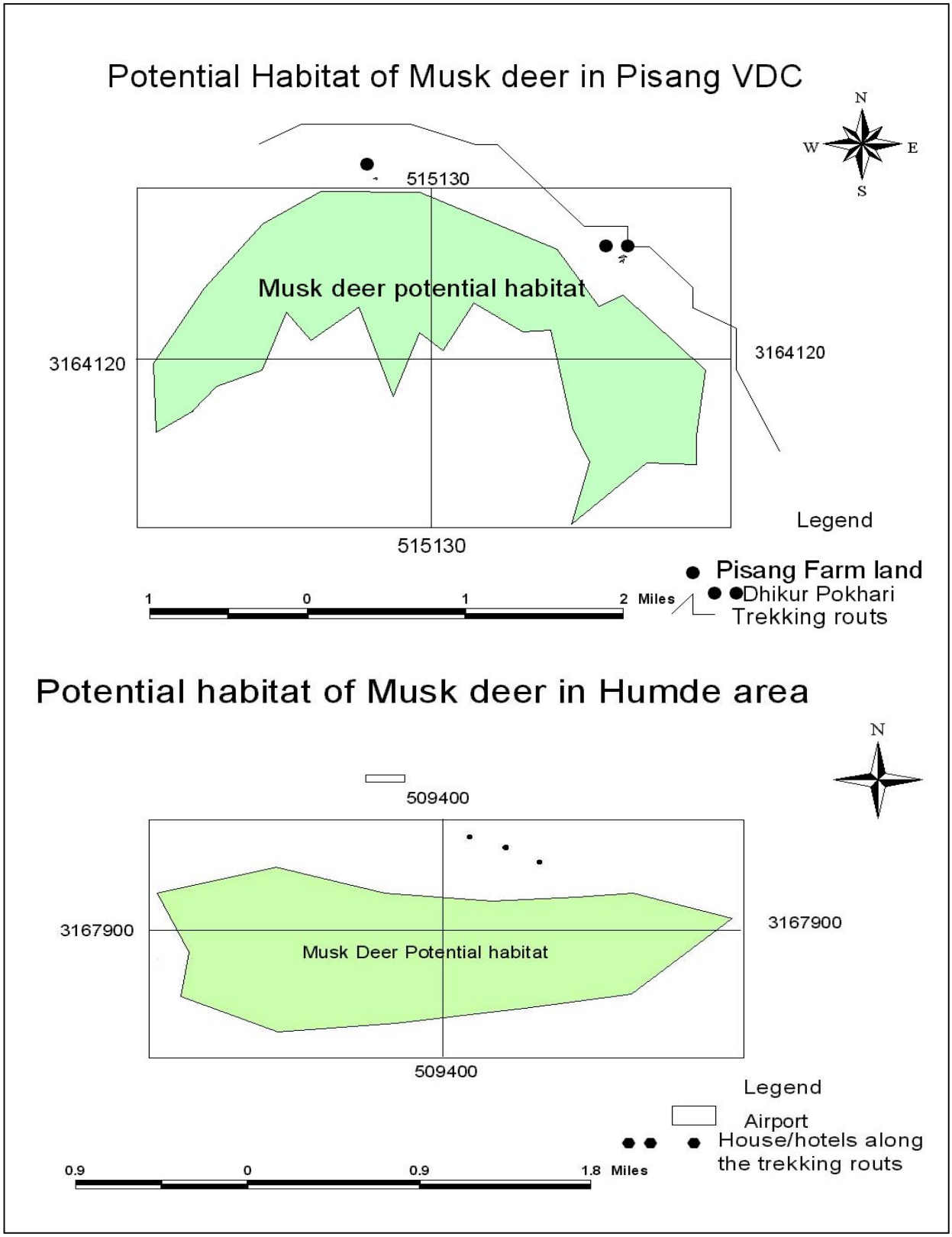


Figure: Musk deer potential habitat in study area.

Potential area of musk deer map was prepared by the help of GPS point taken in the boundary of the potential habitat of musk deer. It was based on musk deer pellet distribution range, altitude, ridge, and other natural boundaries.

Population Status

Pellet density was also observed approximately up to 30 days old in a transect line of 10m with X 500m from altitude of 3,500m to 4,000m. Both pellet density and silent drive count method were use in Humde area. In Pisang area only pellet density was observed. Generally, Musk deer uses the same place for defecation, so layer has formed and distinct in older and new, when lower layer and upper layer are less than 30 old, then it was counted as two pellet groups. Silent drive count was used in Humde area in September, 2004 and June, 2005 (summer and autumn).

Pellet density: $\frac{\text{Total pellet numbers}}{\text{Transect area X Transect Number}}$

Pellet group density in Humde area: 11.33/ha and 17.45/ha (summer and autumn survey respectively)

Pellet group density in Pisang area: 9.33/ha

Number of Musk deer records in the Humde area in September, 2004, and June, 2005 using silent drive methods of census.

S.N.	*Adult*			Juvenile	Total
	Male	Female	Unclassified		
Summer	3	-	7	1	11
Autumn	5	6	5	-	16

The study area of Humde was approximately 3Km^2. Pellet density of Musk deer in Humde area were recorded 11.33/ha in summer and 11 Musk deer were counted. While 17.45/ha was recorded in autumn and 16 Musk deer were recorded using silent drive count method. On the basis on silent drive count method average population density of Musk deer was 4.5 individual/Km^2 in Humde area. The potential habitat of Musk deer in Humde forest is 5.1Km^2 so we can estimate there are approximately 23 individual Musk deer present.

Regression model for the predication of population density/Km^2 of Musk deer through data pellet density/km^2 was developed on the basis of two time data collection from Humde area. Both times the same area was used for pellet density survey and silent drive count.

Regression equation: $X = a + bY$

Where X= Population density/Km2 (dependent variable)

Y= Pellet density/Km2 (Independent variable)

$a = X - b\,Y$

$$b = \frac{N \sum XY - (\sum X \,.\, \sum Y)}{N \sum Y^2 - (\sum Y)^2}$$

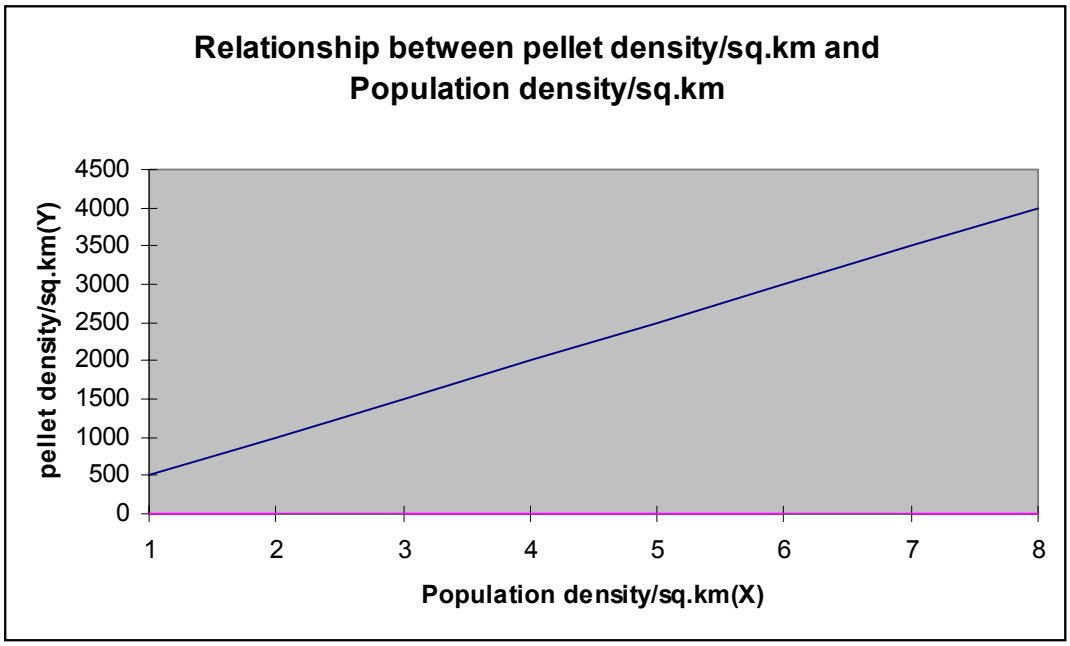
Regression equation for the estimation of Population density/km2 (X) is

(X) = 0.59+0.003Y

Where a = 0.59

b = 0.003

On the basis of this equation following relationship can develop.



On the basis on this equation the population density of Musk deer in Pisang forest covered 3.4 individual/Km^2 and there is 7.82Km^2 area which provides potential habitat for Musk deer therefore it is estimated that at least 27 individual Musk deer may be in Pisang forest.

There was high poaching pressure in Pisang forest but in the Humde area there has been no recorded of death of Musk deer since last 3 year due to poacher/hunter. Therefore the population density of Musk deer is low in Pisang forest compared to Humde forest.

Population trend:

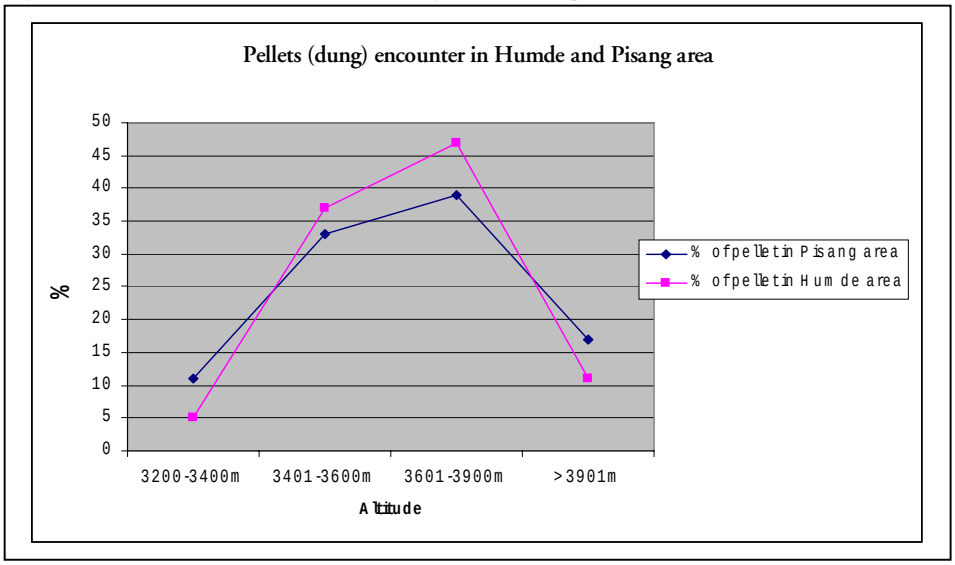
According to local people, the population of Musk deer is low compared to the past 10 years. Heavy poaching occurred in Pisang VDC compared to Humde area. Interviews were taken from herders and other local people of the study area. According to them, in Pisang area there is high poaching pressure on Musk deer, and about 90% of respondents agreed that the population was gradually decreasing; only 10% of respondents were not sure if the population was decreasing or increasing. (N=123)

In both study area, before the 2048BS (1991), there was a high population and from 2048 to 2055BS (1998), there was high poaching pressure. A older person (a former herder) said that the population has changed drastically as compared before 1991, at that time there were more than 200 Musk deer in Pisang area and more than 100 Musk deer in Humde area but now it may be that there remain only around 50 in Pisang area and only about 25 in Manang VDC. Most of the respondents of Pisang area indicated that the population of Musk deer was declining gradually, while but respondents of Humde area indicated that the population of Musk deer is also declining gradually but less than Pisang area because the influence of poachers is less in Humde than Pisang. Many respondents blamed poaching, killing by predators, human and livestock disturbance in its habitat as the main cause of population decline.

Habitat preference

Altitude

Figure: Pellet encounter in Humde and Pisang area with respect to altitude



Total 110 (Pisang 63+ Humde 47) sample plot were taken in study area. Sample were taken in both in latrine site and non-latrine site (foot print area, resting area and possible grazing area) but about 80% of sample plot were taken in latrine site. Musk deer frequented lower altitude during snow. Pellets of Musk deer were found between 3,200m and 4,100m in the study areas. Pellets groups were encountered from 3,300m in Pisang area and from 3,350m in Humde area.

Only 5% of pellets were encountered in altitude span of 3,200 to 3,400m in Humde area and 11% was encountered in same altitude range of Pisang area. In altitude range of 3,401m to 3,600m 33% and 37% of pellets in Pisang and Humde area respectively were encountered. Between 3,601m and 3,900m 39% and 47% of pellets in Pisang and Humde area were encountered respectively. Only 17% and 11% of the pellet were encounter in Pisang and Humde area respectively.

In conclusion, the preferable altitude of the Musk deer in Pisang area is 3,800m (±300m) and 3,700m (±200m) in Humde area.

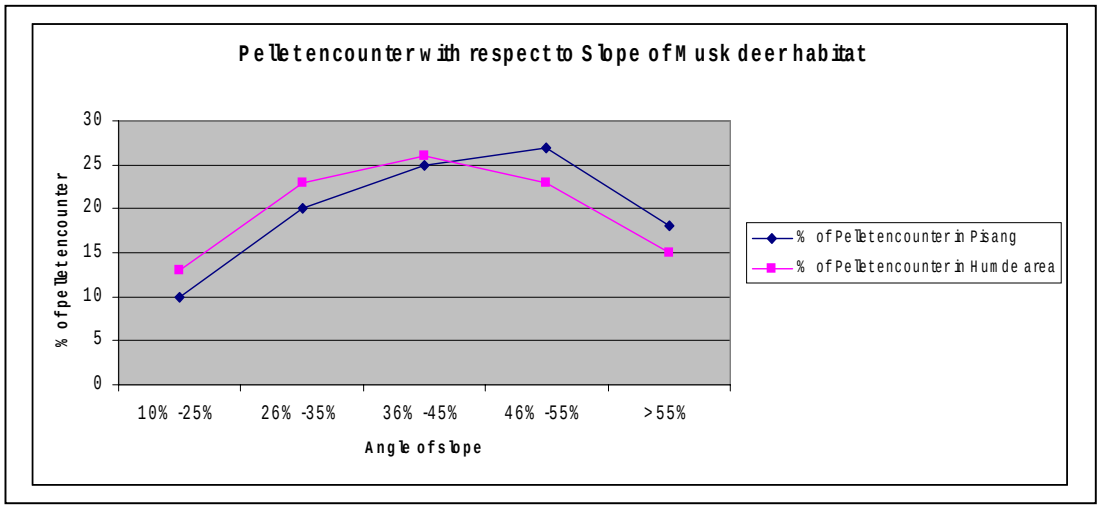
Slope/Aspect:

The highest rate of encounter with Musk deer pellet was 36° to 45° angle of slope in both study areas. There was increasing encounter rate of pellet 10° to 45° of angle of slope in Humde area then gradually decreasing same a way in Pisang area, there was also

increasing the encounter rate of the pellet up to 55° angle of slope of the habitat then gradually decreasing. It was due to snow fall that occurred in the higher altitude of the study area so that old deposited pellet were covered by snow and fresh (about 15 to 30 days old) pellet were encounter in the snow covered area. Most part of the Humde area above 3,800m was roughly covered with snow.

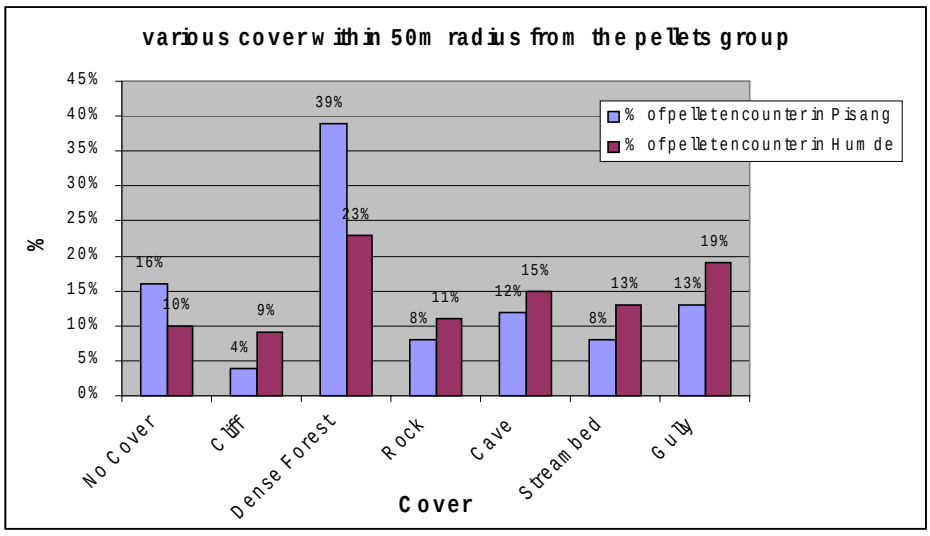
In Pisang area high number of pellet were found in the NW aspect as compare to other aspect and Humde area almost pellets were found on northern slopes. It may be due to pressure of human activities (timber / fuel wood collection) and livestock grazing was high in other aspect more than NW aspect in Pisang area. Humde study site was faced in the totally northern slope. It may also be due to Musk deer being more active on northern slopes whereas they rested more on southern slopes. Northern slopes may be warmer at night because they are probably the more sheltered (Green, 1987).

Figure: Pellet encounter with respect to slope of Musk deer habitat.

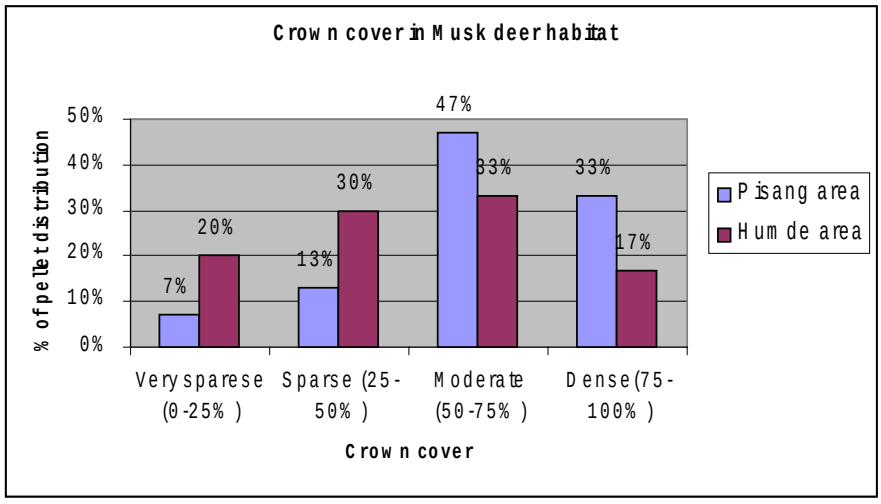


Cover within 50m radius from the Dung and Crown/ground Cover (110 Sample plots)

Any structure providing cover to Musk deer that occurred within 50m radius from the dung or pellet groups was recorded. 84% of the total pellet groups were found close to the structure providing cover and only 16% were found where there was no cover (open area) in Pisang area. 90% of pellet groups were found where such structure provided cover and only 10% where there was no cover in Humde area. In a few sites there was cover beyond 50m. Maximum of such cover was provided by dense forest in both study site 39% and 23% in Pisang and Humde areas respectively. In Pisang dense forest occurred with Nigalo (bamboo) while it was not present in Humde forest.



86% and 81% of the pellet groups were found in forest land in Pisang and Humde area respectively. This implies that Musk deer prefer forest compared to shrub land, grass and other for resting and



latrine. Humde area has more shrub land, grassland and open land compared to Pisang. In Humde 3% pellet groups were found in open land similarly 3% in grass land, 13% in shrub land. In Pisang areas, 8% and 6% of pellets group were found in shrub and grass land respectively but no pellet groups were found on open land. Pisang forest covered the highest numbers of pellet groups (47% and 33%) were encounter in both area (Pisang and Humde area) with Moderate (50-75%) crown cover. 7% and 20% of pellet group were found in Pisang and Humde area respectively.

During the study period almost all ground layer vegetation was dry. The ground level was covered with litter and part with snow. Highest (34%) pellet groups were found in very sparse (0-25%) ground cover in Pisang area while highest 34% of pellet groups were encountered in moderate (50-75%) ground cover. It was due to the Pisang forest being dense and so light could not reach ground level. Therefore, there was no undergrowth and some part is covered with snow. While the Humde forest was not so dense compared to Pisang and herbs and shrub were thus higher in Humde.

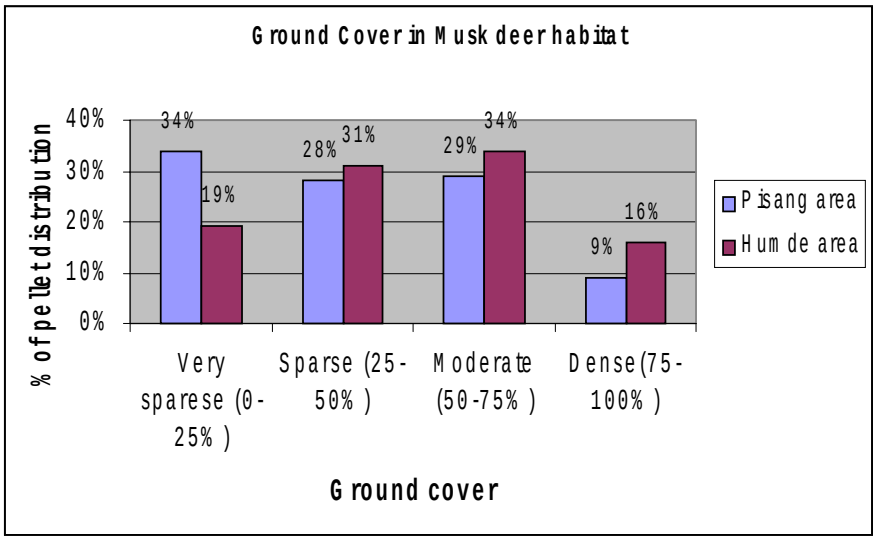


Photo by Aryal, A :Musk deer habitat in Humde area (Betula utilis forest)

Musk deer habitat in Pisang was dominated by *Abies sp.* Forest and Musk deer habitat of Humde area was dominated by *Betula sp.* Forest.

Vegetation types of Musk deer habitat:

Study area	Dominant species
Humde area 3,100-3,400m 3,400-4,000m	 *Pinus wallichiana* *Betula utilis*
Pisang area 3,200-3,400m 3,400-4,000m	 *Pinus wallichiana / Cupressus sp.* *Abies sp.*

Tree/Shrub/Herb Status in Musk deer Habitat

In Pisang, total 6 species of tree, 9 species of shrub and 11 species of herb were recorded. While 5 species of tree, 4 species of shrub and 7 species of herb were record in a sample plot of Humde.

In Humde, *Betula utilis* (IVI=138.89) was the most prominent tree species of Musk deer habitat while in Pisang, *Abies sp.* (IVI=133.86) was most prominent followed by *Betula utilis* (IVI=61.87), *Juniperus sp.* (IVI=31.39), *Cupressus torulosa* (IVI=31.09), *Pinus wallichiana* (IVI=21.08) and *Rhododendron campanulatum* (IVI=20.76). Similarly in Humde area, important species were *Betula utilis* followed by *Cupressus torulosa* (IVI=46.62), *Abies sp.* (IVI=44.69), *Juniperus sp.* (IVI=41.39) and *Pinus wallichiana* (IVI=31.39).

Table: Important Value Index (IVI) of tree species recorded in Musk deer habitat in Humde

Tree Scientific name	**Relative density**	**Relative Dominance**	**Relative frequency**	**IVI**
Pinus wallichiana	10.86	8.41	12.12	31.39
Abies sp.	14.13	18.44	9.1	44.69
Betula utilis	50	55.56	33.33	138.89
Cupressus torulosa	13.04	9.34	24.24	46.62
Juniperus sp.	11.95	8.23	21.21	41.39

Table: Important Value Index (IVI) of tree species recorded in Musk deer habitat in Pisang.

Tree Scientific name	**Relative density**	**Relative dominance**	**Relative frequency**	**IVI**
Betula utilis	25.43	17.39	19.05	61.87
Rhododendron campanulatum	4.62	1.85	14.29	20.76
Abies sp.	39.88	60.65	33.33	133.86
Cupressus torulosa	8.67	10.42	12	31.09
Juniperus sp	12.139	4.97	14.29	31.39
Pinus wallichiana	9.25	4.69	7.14	21.08

Table: Tree species status in Musk deer habitat of Pisang.

Tree Scientific name	**Relative density**	**Frequency**	**Relative frequency**
Betula utilis	25.43	50	19.05
Rhododendron campanulatum	4.62	37.5	14.29
Abies sp	39.88	87.5	33.33

Cupressus torulosa	8.67	31.25	12
Juniperus sp	12.139	37.5	14.29
Pinus wallichiana	9.25	18.75	7.14

Table: Shrub species status in Musk deer habitat of Pisang.

Shrub **Local name**	**Scientific name**	**Relative density**	**Frequency**	**Relative frequency**
Amlong Kada	*Rosa sericea*	3.33	25	7.54
Nigalo		66.66	50	15.09
Chorchung (Chhad)		4.33	56.25	15.09
Maru		6	37.5	16.98
Kishing		5.33	31.25	11.98
Chutro	*Berberis sp*	5	25	9.43
Dyakar		2	37.5	7.55
Yacha		3.33	37.5	11.32
Unknown		4	18.75	5.66

Table: Herb species status in Musk deer habitat of Pisang.

Herb **Local name**	**Scientific name**	**relative density**	**Frequency**	**Relative frequency**
Anemia		10.12	75	13.19
Buke	*Leontopodium jacotianum*	12.34	50	8.79
Khar		14.24	68.75	12.08
Jyau	Permilia spps.	6.64	81.25	14.28
	Thalitrium sp.	3.16	37.5	6.6
Ban Kaphal	Fragaria spps.	4.43	25	4.4
	Aconitum spps.	3.79	31.25	5.4
	Rhododendron anthopogan	19.62	43.75	7.6
Chharchakeya		6.33	18.75	3.2
	Primula sp.	14.24	81.25	14.28
Tinpate Sano Grass		5.06	56.25	9.8

Table: Tree species status in Musk deer habitat of Humde.

Tree: **Scientific name**	**Relative density**	**Frequency**	**Relative frequency**
Pinus wallichiana	10.86	30.76	12.12
Abies sp.	14.13	23.07	9.1

Betula utilis	50	84.61	33.33
Cupressus torulosa	13.04	61.54	24.24
Juniperus sp.	11.95	53.85	21.21

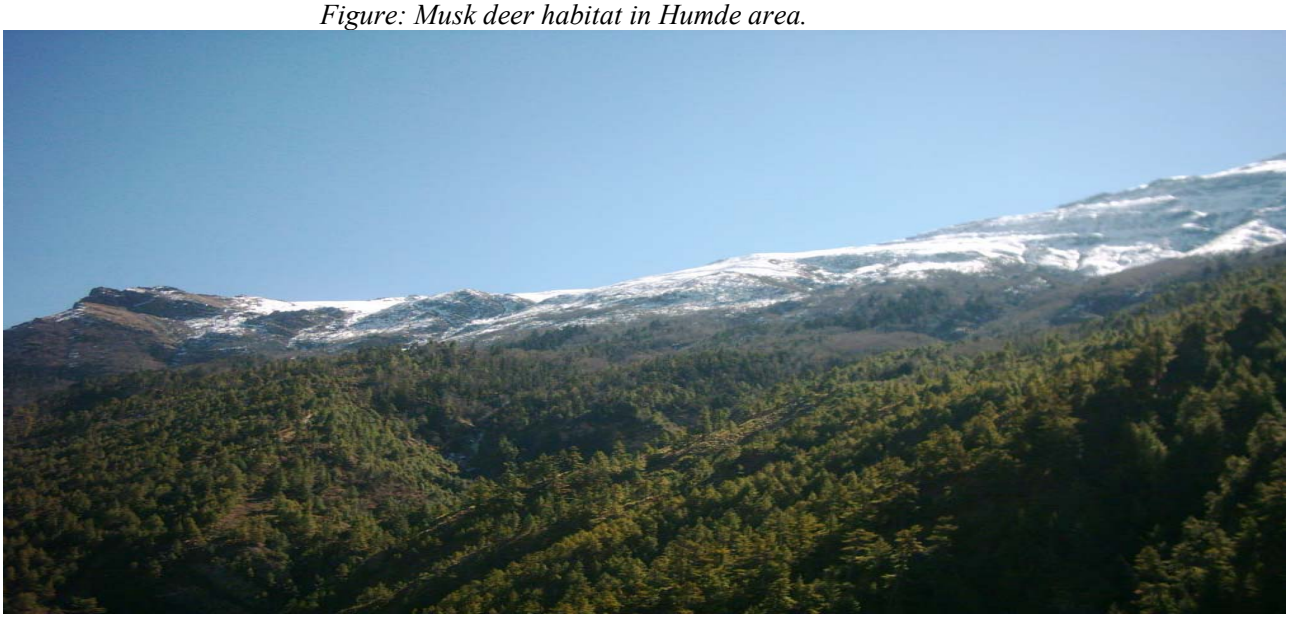
Table: Shrub species status in Musk deer habitat of Humde

Shrub Local name	**Scientific name**	**Relative density**	**Frequency**	**Relative frequency**
Chutro	*Berberis sp*	20.22	30.76	20
Nigalo		71.9	69.2	44.99
Amlong Kada	*Rosa sericea*	5.62	38.46	25
Chhorchung		2.2	15.38	10

Table: Herb species status in Musk deer habitat of Humde area

Herb Local name	**Scientific name**	**relative density**	**Frequency**	**Relative frequency**
Buke		14.28	46.15	11.32
	Anemone sp.	16.67	76.92	18.86
	Primula sp.	12.69	84.61	20.75
Khar		20.6	69.23	16.98
	Thalitrium sp	6.34	38.46	9.43
	Rhododendron anthopogan	26.19	30.76	7.54
	Aconitum sp.	3.17	61.53	15.09

Figure: Musk deer habitat in Humde area.



Past and present poaching activities:

Hunters use a variety of techniques to kill Musk deer, which include snaring and shooting, the latter sometimes aided by dogs. In the past hunters usually used guns and dogs but now due to security situation in the country shooting is replaces by snaring.

Present Hunting technique

There are a few well established methods of hunting and killing Musk deer by poachers. The most commonly practiced method is snaring and trapping. Musk deer usually follow a fixed trail (e.g., defecating place or grazing ground). Such trail is always well marked in the mountain spur. The poachers are aware of this habit and construct fence lines usually along a mountain spur, encircling a large habitat of Musk deer, leaving gaps in frequently used paths. Occasionally, the snare line runs from the top of the mountain to the river valley with more than 50 individual traps. For setting the snare, a small hole measuring about 20 to 25cm and 10cm deep is dug and two small pencil-like pegs with inner side made flat are fixed about 15cm apart inside the hole. After this, a stick of about one inch is bent and strongly fixed with both ends making an arch over it for fixing a trigger. The trigger is pulled further by the pressure of a bent over pole. A small horizontal stick with one side is fixed in the pegs. Just above it a wooden platform is built and a wire snare is set with one end attached to the bent over pole. When Musk deer treads on the hidden platform, the horizontal stick falls down by the weight of the Musk deer, the trigger is released with force and as a result the pole straightens, the noose is pulled tight around the animal's leg and the creature is jerked in the air. This is a most wasteful method of

Photos: Snares found in Pisang area *Photo By: Aryal, A*

killing the deer for musk, as this often kills young and females which do not yield musk.

Past techniques

Another technique used is baying by hunting dogs. These dogs area trained to track the Musk deer by its scent. When the dogs locate the Musk deer, they start chasing without overtaking it till the animal becomes totally exhausted. The dog barks aloud to announce baying of the victim to its master. The poacher arrives at the spot quickly to kill the deer. Another method is killing the animal using poison. Musk deer is very found of the leaves of alpine area. Musk hunters apply the local poison (*Skimmia laureola*) on the leaves of this shrub and bait in areas frequented by Musk deer. Another technique uses a pointed bamboo arrow or splinter dipped in poison fixed down hill across a regularly used path in a mountain ridge at the level of belly height. When the Musk deer is disturbed on one side of the ridge, it flees towards the other side by leaps and bounds. At the same time, the poison splinters may inflict a wound in the abdominal region and kill the animal.

Another technique was to shoot Musk deer. In the past this was the main method of killing Musk deer but now due to the security situation in the country, all private guns have been impounded in the District Administration Office, Manang. So shooting was replaced by snaring.

Potential Poaching area:

Pisang is one of the potential poaching areas of Manang district compared to Humde and other places of Manang district. According to local people, the eastern part of Humde is potential site for poaching where there is less movement of local people. Three years ago, many snares were found in the Humde area but this year, patrolling teams were unable to find any snare in the area. In Pisang area, with heavy poaching every year, many snares were destroyed by the patrolling group. Generally, Meraka danda, Namche, Nalgo, Kyadi and Kyothopa Pakha (Map: Block 1 and Block 3) are high potential poaching areas of Pisang; whereas in Block 2 (Chenarma Pakha) there is less poaching. High numbers of snares were destroyed by patrolling teams in Nalgo, Namche, and Meraka danda of Pisang area. The eastern part of Humde area is a potential site for poaching. In 2061BS (2004), Patrolling teams from Pisang found 6 snares with symptom of death of Musk

deer. According to Ankhwaching Gurung and Bhujung Gurung (CAMC, Pisang), they estimated about 25 Musk deer were killed by poachers in 2059/2061BS (2002-2004) from Pisang forest. There is also high poaching pressure in Tilche forest of Thoche VDC.

Numbers of Snare removed by CAMC and Musk deer Conservation Committee:

Patrolling By	Site	Number of Snare remove/year			
		2004	2003	2002	2001
Pisang CAMC	Pisang forest	22	400	550	335
Musk deer Conservation joint sub Committee, Manang and Tanki Manang VDC	Humde area	-	-	-	490
Thoche VDC	Tilche forest				43

According to Pisang CAMC, there were high number (550) snare, were found in 2002 and Pisang patrolling team were able to collect male 1 Musk deer in trap, 2 Musk deer head, 8 legs of Musk deer, 2 bags and 335 trap in 2001. see blow figure for this.

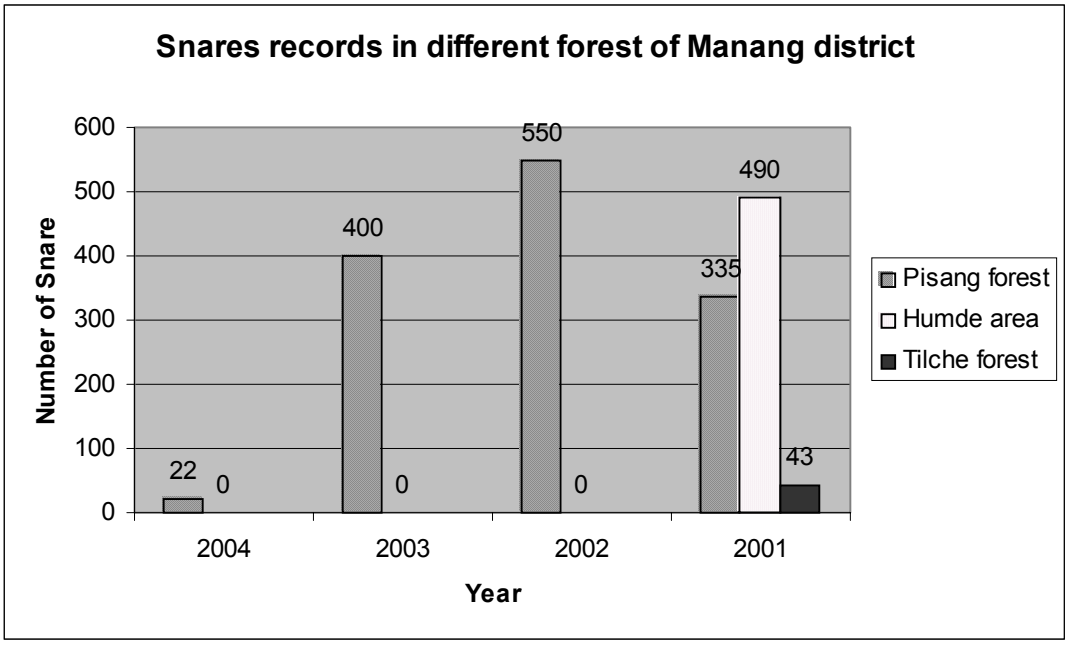


Figure: Patrolling team able to catch poachers with musk deer different parts in 2001

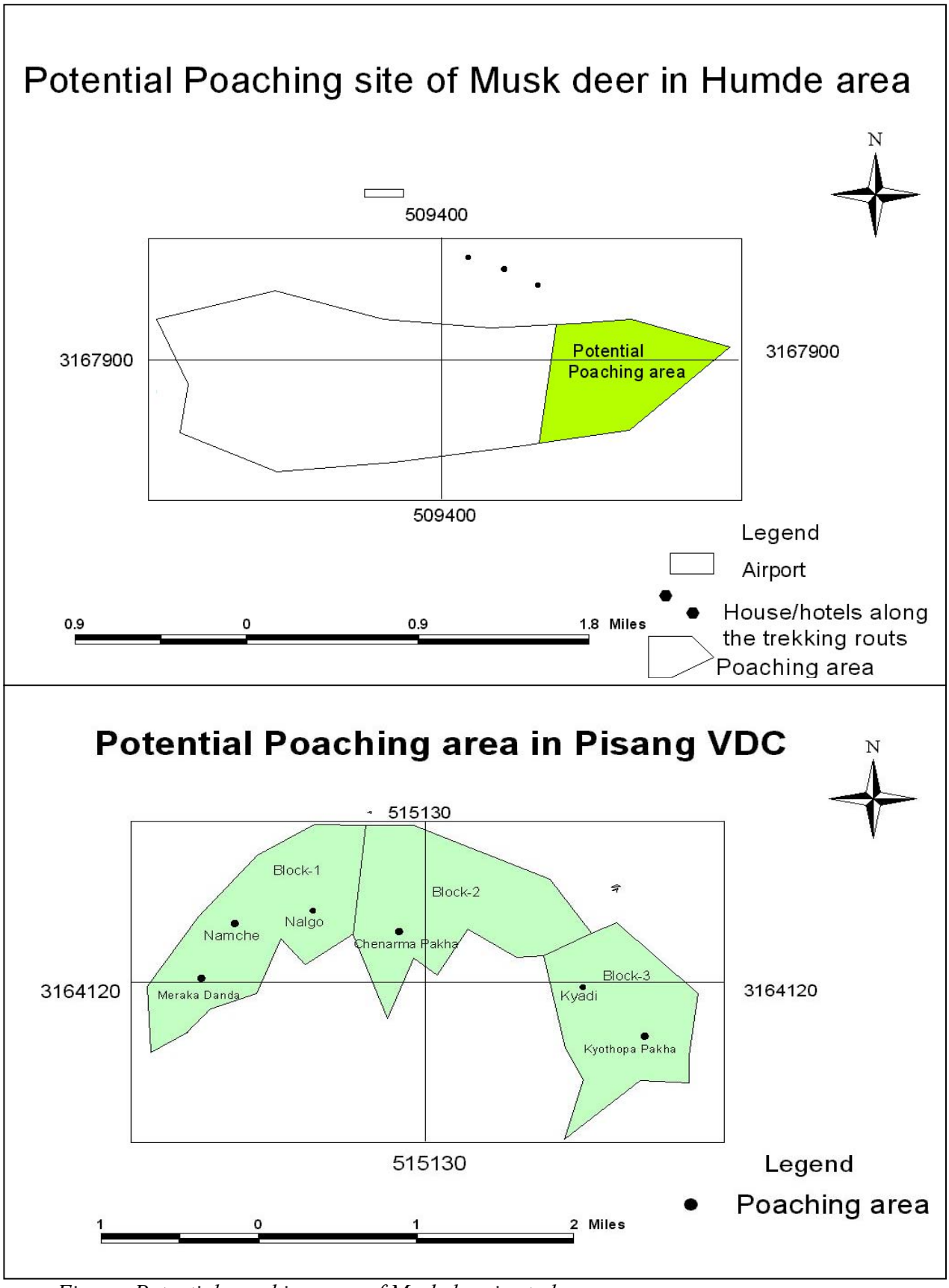


Figure: Potential poaching area of Musk deer in study area.

Pattern of Trades and Use:

The musk secreted by the musk gland of the males has been used in the perfumery industries for a long time for its intensity, persistence and fixative properties. In Asia, including China, it has also long been used in traditional medicine as a sedative and as a stimulant to treat a variety of ailments (Green, 1985, Sheng, 1998, Homes, 1999). In China, Musk deer have been hunted for musk, and musk purchasing has been conducted in rural markets or via local medicine companies and the perfume industry perfume is produced based on natural musk, but production is not high at present (Zhang, 1983). The use of musk in the perfume industry in China has decreased because of the high price, and because of animal welfare and species conservation concerns. The effects of musk have been known in Traditional Chinese Medicine (TCM) for several thousand years, musk being used in about 300 pharmaceutical preparations (Sheng, 1992). China has a high domestic demand for musk (Homes, 1999), and this originates from both legal and illegal sources within the country. The total demand for musk is between 500 to 1,000 kg per year in China (Sheng, 1998).

Global Trade:

China, India, Kyrgyzstan, Mongolia, **Nepal,** Russia, Soviet Union, Cambodia, France, Germany, Japan, Macao, Senegal, Singapore, Switzerland, Uzbekistan are the exporters of raw musk and **42 countries** (Belgium, Australia, Bulgaria, Canada, China, Denmark, East Germany, Finland, France, Gabon, Germany, Ghana, Honduras, Hong Kong, India, Indonesia, Italy, Japan, Macao, Malaysia, Mauritius, Netherlands, New Zealand, North Korea, Norway, Philippines, Poland, Portugal, South Korea, Romania, Senegal, Yugoslavia, Soviet Union, Switzerland, Spain, Taiwan, Thailand, Togo, UAE, UK, USA, Singapore) import Musk deer products, including raw musk (Homes, 1999).

China, it is one of the major exporters of Musk deer derivatives. Very little is known about the trade and consumption of musk inside China. According to Wang *et al*. (1993) the quantity of musk that was annually traded in China in the early 1980s ranged from 2,000 to 2,500kg. According to Sheng and Ohtaishi (1993), some 500,000 Musk deer were killed every year in China in the 1960s. This over-exploitation of Chinese Musk deer populations led to declines from approximately 3,000,000 Musk deer in the 1950s to

about 1,000,000 animals in the 1970s. Much of this musk is used in the production of medicinal derivatives and then traded worldwide.

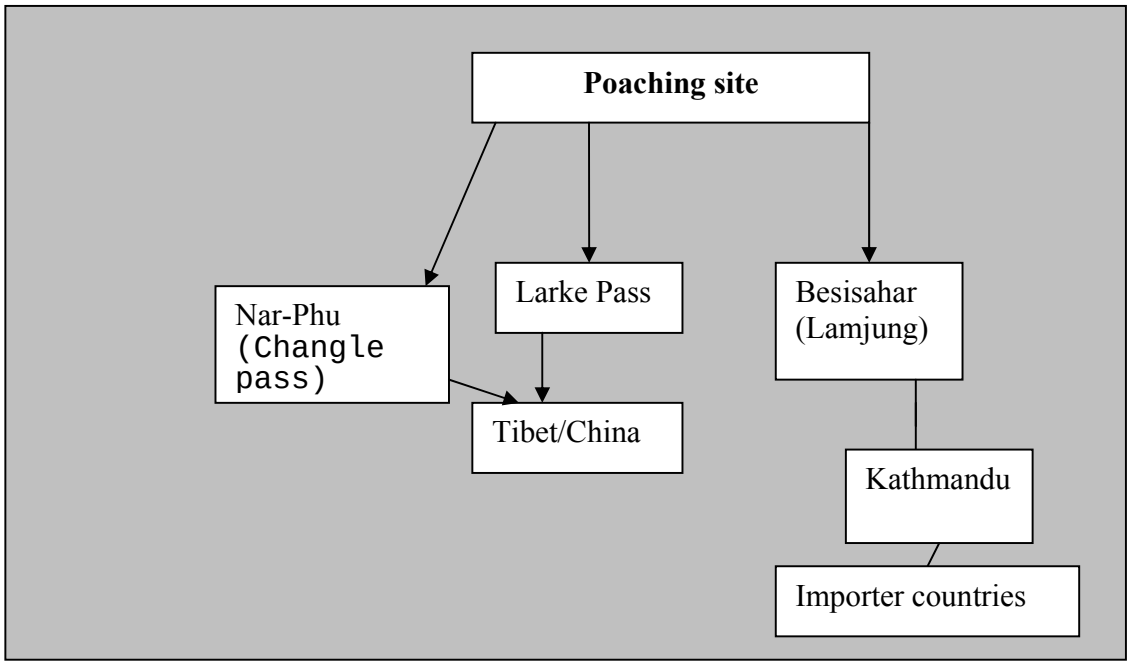
Haridwar, India. The seller said that it is musk pod and selling US$ 23 a piece but it is not original musk pod.

Photo by Aryal, A. at Haridwar, India

Trade pattern in Manang

It was a very difficult task to identify the trade pattern of Musk deer in study area. During the study periods many snares and signs of poaching of Musk deer were found in the study area which shows that there is also trade in Musk deer. The trade is impossible without involvement of local people (who provide information about patrolling and do not necessarily set snares / kill Musk deer directly, only provide information to poachers so as to remain safe from the CAMCs and other authorities), and it is very difficult to discover who is involved. Generally poachers come from Gorkha, Dhading, Lamjung and Tanahaun districts. According to local people and former hunters one male Musk deer produces about 3 tola (1 tola = 11.64gm) of Musk. At local level one tola of Musk is priced at NRs 5,000. Poachers supply to local middle-men who supply onwards to Tibet. Poachers also supply to middle-men in Kathmandu hiding the musk pods in ghee (clarified butter) bottles. In 2061BS (2004), Patrolling team of Pisang found 6 snare with symptom of death of Musk deer.

Collection, protection & supply technique of Musk: Generally poacher use ghee bottle for the supply of musk. For this they wrap the musk in ghee coloured plastic paper and half-fill a bottle of ghee then insert the musk package and finally fill the bottle with ghee. In this way musk scent is masked and it is easy to supply any where. During the distribution of collected medicinal and aromatic plants, they hide musk in these products as well.



Conservation status of Musk deer in Manang

Religion of Manang (Buddhism) is great for the conservation of wildlife. Sherpa Gulcha (a Buddhist Lama), has made great contributions and encouraged conservation of Musk deer in Manang VDC. He encouraged the formation of Musk deer Conservation Committees and provided NRs. 50,000 (Approx. US$715) for the conservation of Musk deer and now that committee is under the CAMC, Manang VDC and Tanki Manang VDC namely *"Musk deer Conservation joint sub Committee, Manang and Tanki Manang VDC*, which was established in 2053BS (1996) (see appendix 1), having 7 members. ACAP provided NRs. 85,000 (Approx. US$1,215) as endowment fund and CAMC Manang and Tanki Manang, VDC also collected the same amount and deposited in committee bank account using the interest for the conservation activities specially for the patrolling. Presently the committee has NRs. 209,000 (Approx. US$2,986). Musk deer Conservation joint sub Committee has invested about NRs. 50,000 (Approx. US$7,143) over the last 6 years for patrolling and other community development activities. CAMC Pisang operates a Musk deer Conservation Committee itself - there is not a separate body for the conservation of Musk deer. CAMC Pisang mobilized local people for the conservation of Musk deer and has been doing regular monitoring work for

the conservation of not only Musk deer but also other wildlife of their area. They patrol Musk deer habitat regularly and destroy large numbers of snares every year. They can punish those who are responsible for Musk deer poaching. Two years ago, the Musk deer Conservation joint sub Committee of Manang and Tanki Manang fined about NRs. 800,000 (approx. US$11,429) from those responsible for the poaching of Musk deer. The funds generated have been used for Musk deer conservation work and community development works. These instances indicate that harnessing of religious elements and indigenous systems with conservation connotations may be beneficial for overall conservation effort of ACAP.

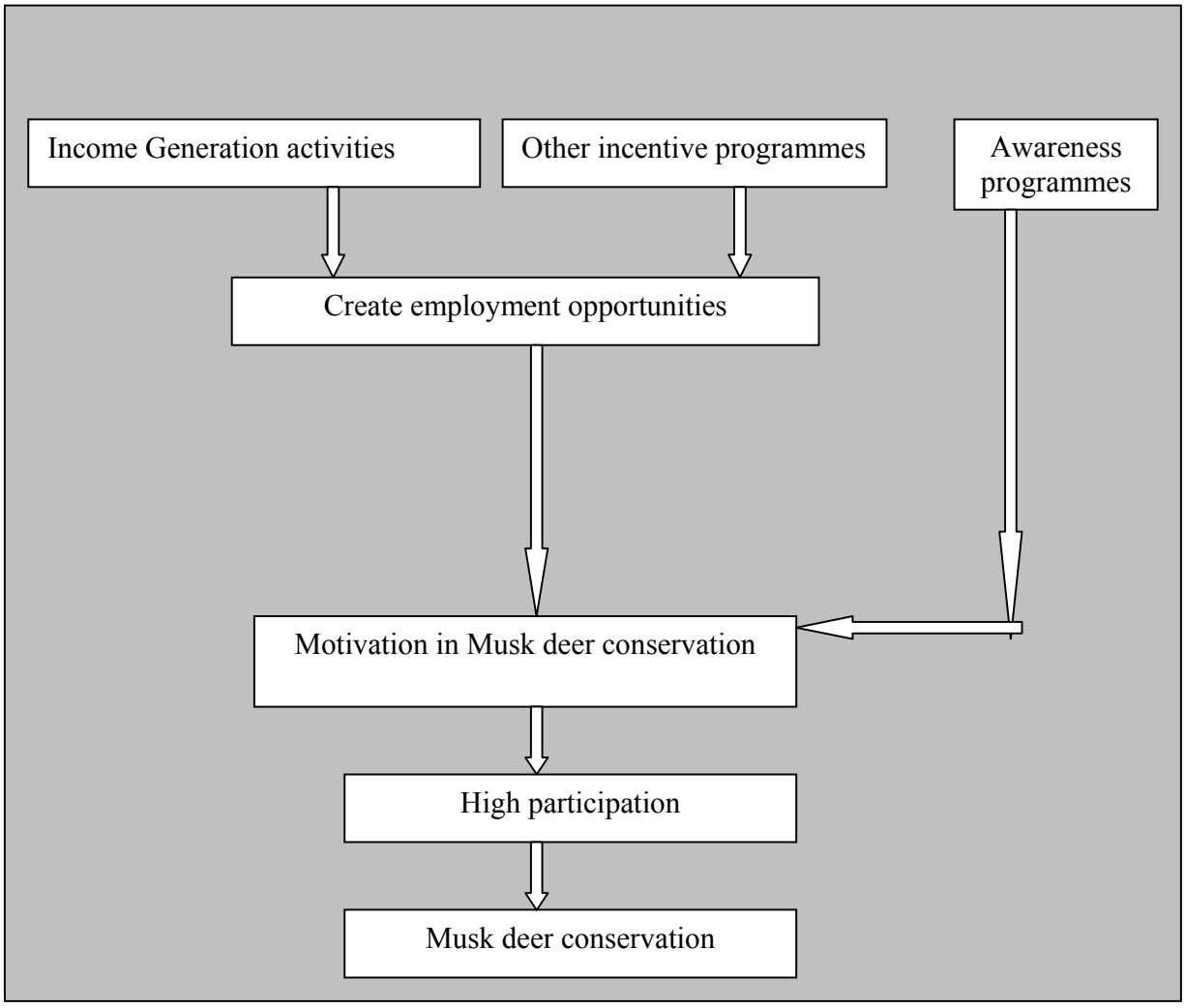
Study shows that poaching of Musk deer is reducing every year over the last 3 years due to regular patrolling in Musk deer habitat by CAMC Pisang and Musk deer Conservation joint sub Committee Manang and Tanki Manang VDC(it is on the base of patrolling team views and colleted snare records). CAMC, Pisang and Musk deer Conservation joint sub Committee have been patrolling during free time from their agriculture work. When the farmer or local people busy in their agricultural activities, at same time poacher are active to put snare and hunt to Musk deer. Therefore, committee most careful in this time and should do regular patrolling works through the mobilization of local people.

Management / Conservation of Musk deer through people participation

Musk deer, Snow leopard and Blue sheep are beautiful animals of Manang district and attractive to tourists therefore, Musk deer and other high profile animals should be managed in such way by which local people can earn money as well as protect its natural habitat. For this, Musk deer Conservation joint sub Committee should be given technical and financial support and should be fully empowered to undertake Musk deer conservation activities. This committee is also interested to establish a natural zoo in Humde area with two pair of Musk deer and other animal of the high altitudes can be displayed for tourists as well as creating a small breeding population for future release in natural habitat, to help restore the wild population. By such means as this they want to

increase tourist time spent in Humde which also directly benefits local hotel owners and suppliers of local products / services.

In natural habitat CAMCs / Musk deer Conservation joint sub Committee should do regular monitoring / patrolling for conservation of Musk deer and other animals. A Core Area should fixed for Musk deer habitat where local people strictly prohibited for domestic livestock grazing and forest product collection, or any activities which may disturb Musk deer etc. ACAP should strengthen the existing Musk deer Conservation joint sub Committee by training, etc. There should be incentive programme for the effective conservation of Musk deer in natural habitat, such as provision of alternative energy, employment opportunity, income generation activities, education development, etc. these activities help to motivate local people for the conservation of Musk deer. *Below figure:* showing the motivation pattern of local people for musk deer conservation.



For the effective management/conservation of Musk deer following activities should be carried out:

- **Institutional Coordination / Capacity Building**: Musk deer Conservation joint sub Committee should coordinate with different stakeholders for the conservation of Musk deer with help of ACAP. Formal or informal training such as Nature guide training, cooking-baking training, handicraft training, and other wildlife Conservation training should be given to local people and committee member who express interest. Especially institutional capacity building training should be provided for committee members and strengthening the existing Musk deer Conservation joint sub Committee by training etc. ACAP should provide capacity development training for local people especially for those who have poor economic condition. These activities help to strength the capacity of local people and thus reduce the pressure on Musk deer habitat.
- **Conservation Education**: there is a lack of awareness; villagers do not know the importance of wildlife. Therefore, Awareness Programmes should be carried out for the school students, youth club, and leaders for the conservation of Musk deer as well as other wildlife of Manang. ACAP, UCO, Manang should be helped to carry out Awareness Programmes for CAMC, Students, youth clubs and leaders.
- **Patrolling:** Regular patrolling should be done in each Musk deer habitat. The patrolling should do once a week by Musk deer Conservation joint sub Committee / CAMCs. The Committee should regularly mobilize local people for patrolling and patrolling activities should be continuous in busy agricultural periods.
- **Punishment and fine:** Committee should take hard action against those caught poaching or disturbing Musk deer habitat.
- **Awards:** should be provided for those who have given great contribution for the conservation of Musk deer.
- **Conservation Action Plan**: Make effective Musk deer Conservation Action Plan through the participation of local stakeholders, scientific experts, ACAP, Conservation Committees, etc. The plan should then be implemented through the Musk deer Conservation joint sub Committee and CAMCs.

- **Alternative Energy Development**: Local people are dependant on Musk deer habitat for fuel wood collection. Alternative source of energy such as solar water heater, kerosene, electric rice cooker should be encouraged. ACAP should support such activities.
- **Restoration of degraded land**: there was a large forest above the Nangsang Kharka (upland pasture) 40 years ago. But now there is nothing as it was destroyed by forest fire and deforestation for fuel wood and timber. This site should be restored by plantation of *Betula utilis, Abies sp, Pinus wallichiana*, etc.

- **Income Generation Activities**: main source of income of local people of Manang is tourism, but all people of VDCs are not involved in tourism business. Some are involved in the collection of Non-Timber Forest Product (NTFPs) for subsistence income and some people are poachers. Gainful employment opportunity should be created for those people who have poor economic condition.

    1. **Non-timber Forest Products (NTFPs) Farming / Sustainable harvesting of naturally available NTFPs**: high altitude favours the high valuable medicinal and aromatic plants of NTFPs that can be directly consume in market so that first CAMCs should find out commercial NTFPs, estimate available marketable NTFPs and prepare sustainable harvesting guideline for the collection of NTFPs with the coordination of ACAP. After that local people can be allowed to collect NTFPs and CAMC should supply those collected NTFPs in Market. ACAP should facilitate for supply in proper trader / consumer of NTFPs. Similarly, Local people should be encouraged to farm NTFPs on their own land. These activities should also reduce poaching of Musk deer.

- **Natural Zoo or breeding centre establishment:** Humde area of Manang is one of the most potential sites for the establishment of a Musk deer Breeding Centre. In future it could be expanded as a Musk deer Farming Centre.
- **Ecotourism:** developing opportunities for ecotourism – so that tourists can pay for guided trips to see musk deer –thereby contributing to the local economy.
- **Musk deer Farming:** Musk deer farming is a good income source which can be seen from experience in China. It is also possible in Nepal. There are some legal

constraints in this regard and the need for knowledgeable manpower, funding, etc. In order to develop this concept, good coordination with relevant government ministries and departments and with ACAP will be essential. For this, A feasibility study is essential before the programme implementation. ACAP should take the lead in this. (see Appendix-5 for preliminary financial analysis of farming)

Need of Musk deer Harvesting programme and Community benefit: The benefits to be accrued from the management, that includes a harvesting scheme of Musk deer, are manifold. ACAP is protecting a highly vulnerable species together with its habitat from further degeneration. Local people would profit immensely from the harvesting scheme. It would be an alternative means of income and an opportunity to manage their natural resources. It must be remembered that the Manange people are migrating in large numbers to Kathmandu and other urban areas, due to the harshness of the mountainous terrain they inhabit. The landscape is incredibly beautiful but the poor quality of soil does allow much scope for agriculture. Such migration could very well lead to degradation of the Manange culture. A sound means of income through the Musk deer pod harvesting scheme would be instrumental in encouraging the local people to stay. A well designed "special project" for managing /harvesting the species in its natural habitat is needed.

- **Musk deer habitat conservation:** a Core Area should be fixed for the conservation of Musk deer and that habitat should be protected with prohibition on collection of forest product, domestic livestock grazing, forest firing, and other human activities which directly disturb Musk deer and their habitat. ACAP should take the lead on this.
- **Research and regular monitoring of Musk deer population**: Regular research should be done regarding its population, ecology, habitat structure etc. Population should be regularly monitored through silent drive count method or pellet group count methods, Action research should be carryout by ACAP through the participation of Musk deer Conservation Committee and CAMC.

Threats

Habitat loss:

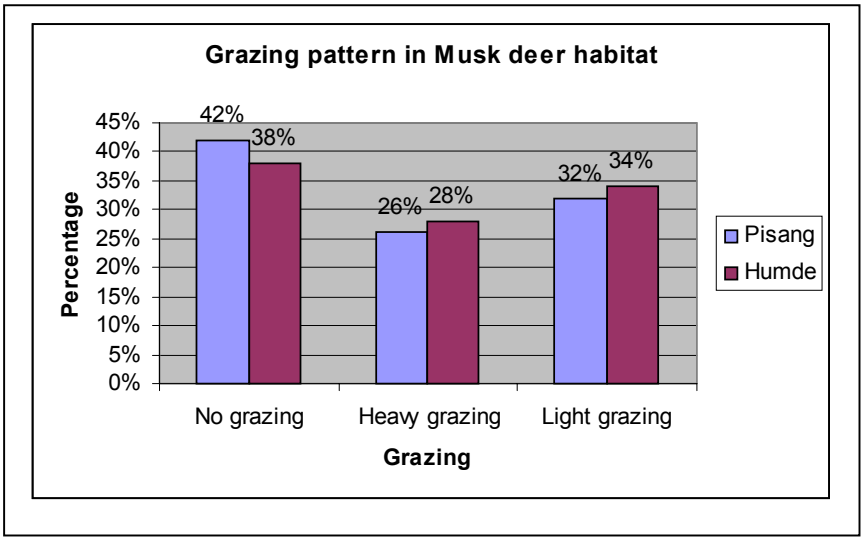
Excessive degradation and fragmentation eventually leads to habitat loss. Potential habitat of Musk deer has already been lost due to high deforestation and fire in NW part of Humde area. Local people of the Humde area are highly dependant on Musk deer habitat for fuel wood and in Pisang forest they depend on the timber available there. Pisang suffers from high rates of deforestation for timber and fuel wood. Conversion of NW part of Humde's forest into degraded land and the high pressure on forest of Pisang and Humde for fuel wood and timber is causing loss of good habitat for sensitive Musk deer.

Prey

According to local people, Yellow-throated Marten (local name Malsapro) killed about 15 juvenile Musk deer over the last three years. During a field visit in September 2004, I found a piece of Musk deer skull and scat of both Snow leopard and Yellow-throated Marten. In both species' scat, there was Musk deer hair. According to local people Generally, Yellow-throated Marten kill the juvenile Musk deer.

Grazing

Owing to high seasonality and low primary productivity, the Himalayan region supports relatively low ungulate / herbivore biomass. It is therefore obvious that with the increase in the biomass of domestic livestock in many areas, wild ungulates such as Musk deer have suffered competitive exclusion. Sathyakumar *et. al.* (1993) have reported that increased livestock grazing and associated impacts have led to low Musk deer densities in many areas in Kedarnath Wildlife Sanctuary, India. In



Pisang, 58% of Musk deer habitat has domestic livestock gazing pressure (26% heavy grazing and 32% light grazing) while there is 62% grazing pressure in Musk deer habitat in Humde area.

Poaching

Poaching is one of the main threats for the population of Musk deer in the study area. Especially Pisang VDC has a large favourable area for the Musk deer and similarly high pressure of poaching in this region. Musk deer Conservation Committee and CAMC, Pisang has been patrolling regularly and each year they find many snares and signs of killing of Musk deer by poachers. Poaching is high in Pisang compared to Humde. According to field survey, 75% out of 69 respondents of Pisang report ongoing poaching of Musk deer while only 29% out of 87 respondents of Humde reported poaching in Humde area.

Figure: Musk deer leg which was killed by Snow leopard

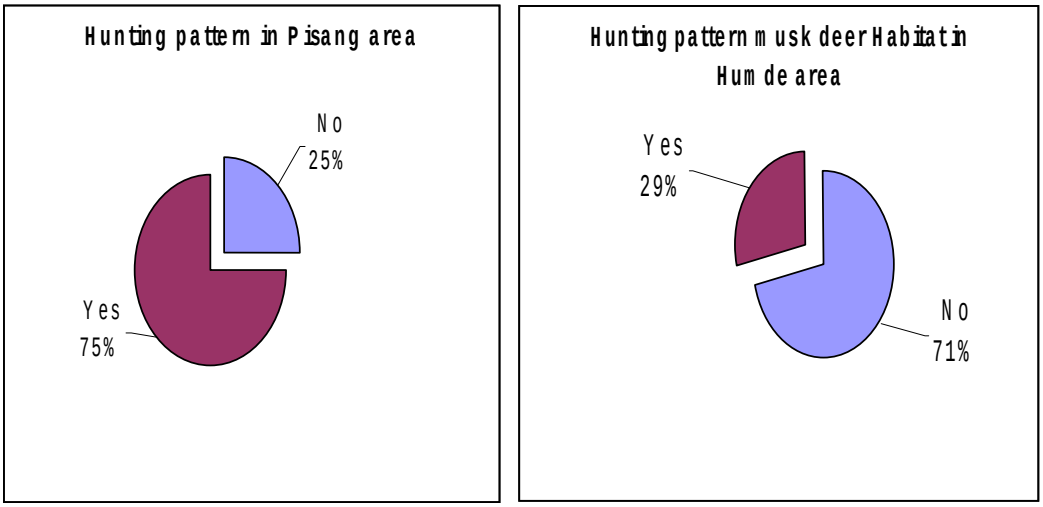


Figure showing local respondents perception regarding hunting of Musk deer

Chapter: Eight

Conclusion and Recommendations

Conclusions

1. Musk deer is distributed in all VDCs of Manang district except Phu VDC and Ghyaru VDC (reported by locals). High density of Musk deer is found in Nyeshang Valley. Pisang harboured good high number of Musk deer followed by Tilcho forest of Thoche VDC, Manang and Tanki Manang, Khansar, Chame, Dharapani, Tache Bagarchap and Nar VDCs. Potential Musk deer habitat in the study area was 7.82km^2 for Pisang VDC and 5.1km^2 in Humde area, on the basis of survey.
2. Average population density of Musk deer in Humde area was 4.5 individual/Km^2 and estimated 23 individuals are present in Humde area and similarly population density of Musk deer in Pisang area is 3.4 individual/Km^2 and approximately 27 individuals are present in Pisang forest, based on direct observations using a silent drive census technique.
3. Regression equation for the estimation of Population density/km^2 (X) is (X) = 0.59+0.003Y on the basis of pellet density/Km^2 (Y).
4. Population trend has been declining at a high rate in all VDCs of Manang district expect Manang and Tanki Manang VDC (According to local reports).
5. Musk deer most preferred 3,300 to 3,700m altitudinal range in the study area, having 36 to 45 degrees angle of slope, NW and northern aspect with good cover structure (dense forest) on the basis on about 80% sampling size on latrine site.
6. High rate of pellet encounter in forest land followed by shrub land, grazing land and open land.
7. High rate of pellet encounter in areas of 50 to 75% crown cover and 50 to 75% ground cover. In Humde area, *Betula utilis* (IVI=138.89) was most prominent trees species of Musk deer habitat while in Pisang VDC, *Abies sp.*

(IVI=133.86) was most prominent tree species and followed by *Betula utilis* (IVI=61.87), *Juniperus sp.* (IVI=31.39), *Cupressus sp*. (IVI=31.09), *Pinus wallichiana* (IVI=21.08) and *Rhododendron campanulatum* (IVI=20.76). In Humde area, important species were *Betula utilis* followed by *Cupressus torulosa* (IVI=46.62), *Abies sp.* (IVI=44.69), *Juniperus sp.* (IVI=41.39) and *Pinus wallichiana* (IVI=31.39).

8. Snare/trap is currently the preferred method of poaching. In the past poachers used guns, poison and dogs for killing Musk deer.
9. There are high threats to Musk deer habitat due to overgrazing by domestic livestock, forest fire, timber and other forest product collection, etc.
10. Musk deer Conservation joint sub Committee, Manang and Tanki Manang VDC, and CAMC Pisang have been playing important role to conservation of musk deer. The committee has been mobilizing local people for patrolling regularly.

Recommendation:

1. Strengthening the existing Musk deer Conservation joint sub Committee by training, incentive programme for local people, etc. for effective conservation of Musk deer in natural habitat.
2. ACAP should coordinates with concern Governmental authorities and Musk Deer Conservation sub Committee/CAMC for :
   - Effectively protect musk deer and its habitat with key area(s)/within key zones through enforcement and restriction/controlled management of livestock grazing by securing the support of local villagers.
   - Raise awareness among local people.
   - Developing opportunities for ecotourism – so that tourists can pay for guided trips to see musk deer –thereby contributing to the local economy.
3. There should be identified potential musk deer habitat in other parts of the Annapurna Conservation Area and undertake surveys to determine the species distribution and status, which can use for developing a conservation action plan.
4. There should carry out research activities such as an assessment of the status of musk deer, its habitat and poaching throughout the ACA. More research is needed to make correlation between pellet group density and musk deer density.
5. Awareness programmes are essential for school students, leaders, villagers, etc., to change the attitude of local people towards the conservation of Musk deer and other species.
6. For really effective conservation measures, popular participation is essential, particularly in the Nepal context of poor enforcement and little rule of law. Hence, the following conservation measures area recommended:
   - Enforcement of existing protection measures against poaching, and vigorous action against hunters and traders.
   - Humde area of Manang is a potential site for the establishment of a Musk deer Breeding / Farming centre better than Godavari Musk deer breeding centre. ACAP should take action to explore this potential and

seek necessary cooperation and support from the relevant government authorities. In order to protect the animal in the wild, focus should be on anti-poaching and management of Grazing so that musk deer population can recover however, there is so a need to provide benefits to local livelihoods and harvesting of musk on a village corporative basis is one model worth exploring; ecotourism for viewing wildlife including musk deer is another.

- Establishment of special forest zones for Musk deer. A Core Area should be demarcated in prime Musk deer habitat where local people are prohibited to graze domestic livestock and collect forest products or to carry out any activities which may disturb Musk deer. And these zones should be monitored annually to observed changes in population size.
- Regular patrolling should be done in all Musk deer habitat particularly in times when agriculture demands many people to be out in farm and forest land (before the winter snowfall).

7. There is an urgent need to develop cooperation across international borders with china and India to combat trade in musk.

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Appendix 1

Name list of Musk deer Conservation joint sub Committee, Manang and Tanki Manang VDC of Manang district

1. Chairman: Chhiring Gurung
2. Secretary: Wangel Ghale
3. Treasurer: Dakpa Dorjo Gurung
4. Member: Tendoje Gurung
5. Member: Karma Gurung
6. Member: Phunjo Gurung
7. Member: Tenjing Gurung

Appendix 2

Field survey in Musk deer habitat:

Data Collection Sheet

Plot No: _____ VDC/ site name……

Investigator: **Date:** **Time:**
Altitude: **Slope:** **Aspect:**
GPS data No:

Pellet condition: ❑ Very fresh <24hr**,** ❑ fresh<2-10 days**,** ❑ old<30days
Hoof mark: **Very fresh/Fresh/old**

Cover (within 50m radius)
❑ Cliff ❑ Rock ❑ Cave ❑ Gully ❑ Streambed ❑ No covers ❑ Others…….

Anthropogenic Pressure
1. Grazing ❑ No ❑ Light ❑ Heavy ❑ Types of livestock…….
2. Fire ❑ No ❑ occasional ❑ Regular
3**.** Approximate distance from Human Settlements ……
4. Hunting…..
5. Trails: Human trails…. Trekking routes…..Grazing trails……others….
6. Wilderness ❑ No ❑ Yes
7. Forest Product Collection: ❑NTFPs…….. ❑ fuel wood ❑ others……..

Habitat / Vegetation
1. Habitat type
❑ Forest ❑ Shrub land ❑ Grassland ❑ Open land ❑ Others…….
2. Crown Cover
❑ 0-25% ❑ 26-50% ❑ 51-75 % ❑ 76-100%
3. Ground cover
❑ 0-25% ❑ 26-50% ❑ 51-75 % ❑ 76-100%
Land feature: Rolling terrain…….. Bowl….. Summit or top…… Broken terrain…. Stream bed…. Swampy/marshy….. Level ground……..
Water source: River P/T….Stream P/T….Pound P/T…. Spring P/T…Ditches, distance...
4. Dominant Species: ……..

Tree inventory (10m × 10m)

SN	SPECIES	DBH	HEIGHT	REMARKS

Shrub layer (4m ×4m)

SN	SPECIES	FREQUENCY	REMARKS

Herb layer (1m × 1m)

SN	SPECIES		REMARKS

Sign of Other Mammals

SN	SPECIES	SIGN TYPES

Any other specific / important notes:

Interview form for Musk deer **Format No:….**

1. Respondents/Name: Age: VDC/village/district:….
2. Occupation:……
3. Information Based on Musk deer:…….
   - ♦ Do You know Musk deer?…..Y/N ❑like ❑dislike ❑don't know
   - ♦ Have you seen the Musk deer?
   - Where……
   - How many……..Male…. Female…….
   - When…….
   - Do you know its legal status? ❑Yes ❑No
4. Do you know about traded of Musk deer?..... what product and where they supply……
5. Do you know about Musk deer potential poaching area of your VDC?.....
6. What they use to poach the Musk deer?
7. Do you know Musk deer being killed by human/animal in your area?
   If yes…….

By Whom-

Why-

8. Do you know about it population trend increase or decrease or same in recent year or not sure ?

9. What is your opinion about Musk deer? ❑Good ❑Bad

Why……

8. Can you provide the name of specific area……..Where they are seen regularly...

9. In your opinion what is it's threaten causes……..….

11. Do you have any idea how they can be conserved? ❑Yes ❑No

If yes…..

Important Notes:

Appendix 3

Some GPS points of study area

GPS Point:

S.N	Name	Coordinate	Altitude
1.	trekking rout	N29^0 36’ 08.1’’ E84^0 10’ 36.8’’	3255
2.	Livestock grazing area	N 28^{0}35’15.5’’ E 84^0 11’ 12.1’’	3195
3.	Lower forest area.	N28^0 35’ 35’’ E84^0 11’ 08.4’’	3251
4.	Livestock grazing area	N28^0 28’ 57.2’’ E84^0 10’ 58.1’’	3228
5.	Livestock grazing area	N28^0 36’ 10.2’’ E84^0 10’ 20’’	3184
6.	Livestock grazing area	N28^0 36’ 22.6’’ E84^0 09’ 48’’	3213
7.	Livestock grazing area	N28^0 36’ 38.7’’ E84^0 9’ 18.2’’	3212
8.	BETULA FOREST	N28^0 37’ 27.5’’ E84^0 05’ 32.4’’	3860
9.	BETULA FOREST	N28^0 37’ 29.6’’ E84^0 05’ 13.9’’	3909
10	BETULA FOREST FINISHED	N28^0 37’ 43.7’’ E84^0 05’ 34.9’’	3673
11.	BETULA FOREST START	N28^0 36’ 15.7’’ E84^0 08’ 23.8’	3650
12.	BETULA FOREST	N28^0 37’ 38.5’’ E84^0 05’ 36.3’’	3677
13.	DEATH Musk deer	N28^0 38’ 08’’ E84^0 04’ 57.5’’	3548
14.	FARM LAND	N28^0 38’ 13.7’’ E84^0 05’ 24.7’’	3420
15.	H1 (HABITAT)	N28^0 36’ 33.3’’ E84^0 09’ 1.7’’	3458
16.	HAIR FOUND	N28^0 35’ 59.2’’ E84^0 8’ 32.3’’	3802
17.	HIGH DEFORESTATION	N28^0 37’ 52.2’’ E84^0 04’ 40.2’’	3759
18.	HUMDE FATTERN (KHARKA)	N28^0 36’ 2.4’’ E84^0 04’ 41.5’’	3695
19	HUMDE BAUA	N28^0 38’ 13.9’’ E84^0 05’ 06.7’’	3356

20.	LAST POINT	N 28^0 36' 24.1'' E84$^{0'}$ 08' 27.8''	3535
21.	NARA DANDA	N28^0 39' 57.6'' E84^0 01'' 25.9''	
22.	Musk deer Habitat	N28^0 36' 29.1'' E84^0 8' 55.9''	3421
23.	Musk deer Habitat	N28^0 36' 30.5'' E84^0 08' 58.9''	3493
24.	Musk deer Habitat	N28^0 36' 0.9'' E84^0 08'' 31.9''	3904
25.	Musk deer Habitat	N28^0 36' 10.9'' E84^0 08' 24.7''	3864
26.	Musk deer Habitat	N28^0 36' 20'' E84^0 8' 25.4''	3564
27	Musk deer Habitat	N28^0 36' 22.3'' E84^0 8' 47.3''	3448
28	Musk deer Habitat	N28^0 36' 17.9'' E84^0 08' 44.9''	3498
29.	Musk deer Habitat	N28^0 36' 15.7'' E84^0 08' 44''	3565
30.	Musk deer Habitat	N28^0 36' 10'' E84^0 8' 43.3''	3597
31.	Musk deer Habitat	N28^0 35' 56.1'' E84^0 08'39''	3737
32.	Musk deer Habitat	N28^0 35'56.4'' E84^0 8' 37.5''	3765
33.	SNARE AREA	N28^0 35' 55.7'' E84^0 08' 40.6''	3730
34.	PEAK PISANG	N28^0 36' 4'' E84^0 08' 31.2''	3887
35.	PELLET	N28^0 36' 1.6'' E84^0 08' 31.6''	3931
36	PELLET HABITAT	N28^0 35' 57.8'' E84^0 08' 32.8''	3803
37.	PELLET	N28^0 35'' 55.6'' E84^0 08' 41.8''	3700
38.	PELLET	N28^0 36' 04.1'' E84^0 08' 43.3''	3642
39.	PINUS FOREST	N28^0 37' 47.4'' E84^0 05' 32.8''	3591
40.	PISANG	N28^0 37' 0.5'' E84^0 08' 48.5''	3230

41	PISANG BHIR	N28^0 36’ 36.3’’ E84^0 09’ 3.6’’	3306
42.	PISANG GOTH	N28^0 36’ 57.4’’ E84^0 09’ 57.4’’	3399
43.	Musk deer Habitat	N28^0 38’ 05’’ E84^0 04’ 53.1’’	3571
44.	Musk deer Habitat	N28^0 37’ 48.6’’ E84^0 04’ 43.7’’	3785
45.	Musk deer Habitat	N28^0 37’ 43.2’’ E84^0 04’ 48.2’’	3796
46.	Musk deer Habitat	N 28^0 37’ 48.3’’ E84^0 05’ 32.5’’	3580
47.	PPLLET	N28^0 37’ 30.7’’ E84^0 05’ 03’’	3853
48.	VO5 (VANTAGE POINT)	N28^0 37’ 27.9’’ E84^0 05’ 17.8’’	3933
49.	VO6(VANTAGE POINT)	N28^0 37’ 26.9’’ E84^0 05’ 17.5’’	3813
50.	VANTAGE POINT	N28^0 37’ 31.2’’ E84^0 05’ 09.9’’	3871
51.	VANTAGE POINT HUMDE	N28^0 37’ 41.3’’ E84^0 04’ 50’’	3809
52.	VANTAGE POINT (GOOD VANTAGE POINT)	N28^0 37’ 29.4’’ E84^0 05’ 34.9’’	3887

Musk deer habitat boundary point GPS (UTM) of Humde area

S.N.	X	Y
1.	511000	3168250
2.	510541	3168212
3.	511839	3168011
4.	509827	3168175
5.	508911	3168249
6.	508000	3168498
7.	507000	3168247
8.	507253	3167701
9.	507198	3167251
10.	508012	3166924
11.	509001	3167002
12.	510094	3167150
13.	511000	3167308

Musk deer habitat boundary point GPS (UTM) of Pisang area:

S.N.	X	Y
1	512334	3163334
2	512701	3163562
3	512932	3163821
4	513667	3164601
5	513901	3164320
6	513420	3164000
7	514390	3164666
8	514746	3163731
9	515000	3164400
10	515223	3164214
11	515561	3164746
12	516059	3164421
13	516332	3164430
14	516567	3163380
15	516735	3163009
16	516562	3162336
17	517335	3163000
18	517828	3163000
19	517828	3163291
20	517912	3164002
21	517101	3164818
22	516821	3164702
23	516412	3165294
24	515007	3165909
25	514012	3165911
26	513421	3165567
27	512824	3164870
28	512304	3164071

Appendix-5
Preliminary financial analysis of musk deer farming in Sagarmatha National park. (Appendix -5 is adopted from Dr. Duncan Knowler et. al, 2004).

Financial analysis of a musk deer farm based on data from the experimental deer farm at Godavari, outside Kathmandu, run by the Department of National Parks and Wildlife Conservation (DNPWC). However, a less intensive form of farming is envisioned, allowing for a semi-captive arrangement that more closely mimics the natural situation of the deer than the more intensive Chinese farming model. It is possible to adopt a farming approach because musk deer are non-migratory and require surprisingly small territories. The analysis takes the form of a discounted cash flow analysis, whereby revenues and investment and annual costs are entered over a 15 year project life and then discounted to Year 0 using a real (no inflation) discount rate of 12%. All prices are indicated in 2001 Rupees (NR), based on an exchange rate of about NR75 per U.S. dollar. The following additional assumptions were used in the analysis:

- Initial herd size is 50 deer, composed of 10 males and 40 females, held within a 16 ha enclosure near a suitably located village such as Phortse;
- Deer are corralled using nets held by approximately 12 persons who then transfer the animals to the nearby farm site;
- Herd growth assumptions include a calving rate of 80% of mature females (age 3 years and 5up) and differential mortality rates of 40% per year for calves and 10% for adults;
- Musk is collected from adult male deer once per year at a rate of 12 gm/deer, with only a 50%harvest rate allowed in Year 1 for this item and annual costs as well (due to startup delays/complications);
- Musk is priced at the farm gate at NR1500/gm on the basis of a 1996 price estimate in Hong Kong of US$36,000/kg (rounded to US$40,000/kg), which was then reduced by 50% to allow for marketing and transport margins;
- Investment costs include an allowance of NR100,000 for construction of a small shelter and office plus purchase of a propane refrigerator (US$1000), live capture of deer at 12 persons working 2 days for each animal at a wage of NR200/day, training allowance of NR100,000 and 3300m of fencing at NR5860/m (US$78/m) with an allowance for maintenance of 1% of initial cost per year;

- Annual costs include a supervisor/manager at NR120,000/year, 26 person-months of hired labour per year at NR4000/month (2 persons full-time plus additional 2 persons for one month to help with musk collection), feed supplements of NR900/animal/year (Dr. Gairhe, pers. comm., 2001), an allowance for antibiotics and tranquilizers of NR20,000/year,[7] and propane requirements of 1 gallon for 9 days (40 gallons/year) at a delivered price of NR125/gallon (US$1.67/gallon).

The proposed musk deer ranching operation makes use of a semi-captive approach (as opposed to the intensive farming practiced in China), it is heavily penalized by the estimated costs of fencing at Rs 5860 per lineal meter. Special fencing is required to prevent the entry of leopards and other predators (or poachers) into the deer compound and at over 3 km in length, to enclose an initial herd of 50 deer, the cost is prohibitive. Assuming the cost estimates are reasonable, even if the cost of fencing was fully subsidized the musk deer operation would still not break even. Thus, even if a more simple fencing technique could be found, it is unlikely to render the operation profitable. Moreover, no allowance has been made for expansions in fencing as the herd grows in size; this would only worsen the project's financial picture. Even if two extractions of musk per animal per year are assumed (sometimes obtained in research), the operation still incurs large economic losses. Only if the fencing cost is set at zero, and two musk extractions per year are assumed, does the net present value of the operation turn positive (NR 1,267,900). Parry-Jones and Wu (2001) quote investment costs for a captive breeding facility holding up to 25 to 30 deer of US$ 188,000 (NR 14 million) in the mid 1990s, which is somewhat higher than the costs used in the present analysis, on a per animal basis. However, they appear to refer to a more intensive captive breeding operation rather than the lower intensity, semi-captive farming approach assumed here. Parry-Jones and Wu cite Chinese investment costs of about US$ 12,000 to 24,000 to

[6] This fencing cost estimate is based on figures provided by the Department of National Parks and Wildlife Conservation; the assumptions used are reproduced in Appendix G. Please note that a more recent estimate of the costs of transporting materials by helicopter to Khumbu is NR625,000 so this figure was used instead of the NR900,000 shown in Appendix G (P. Shrestha, pers. comm., 2003).

[7] This rough estimate is roughly based on the approximate requirements for ROMPUN 100 and VETALAR outlined in the previous section and prices obtained from the Internet of US$29.95 for 50cc of the former and US$45 for 100 mg/ml X 10 ml of the latter (www.endlessmeds.com/vet_2.html, September 10, 2003).

install capacity for producing 1 kg of musk annually, which is far less costly than the figures assumed in the present study. Thus, it is difficult to assess the credibility of the costs used in Table 2. In any event, the highly unprofitable nature of the investment over a wide range of assumptions renders this concern less important.