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CHAPTER 12

THE SNOW LEOPARD IN HIMALAYA: A STEP TOWARDS THEIR CONSERVATION BY STUDYING THEIR DISTRIBUTION, MARKING HABITAT SELECTION, COEXISTENCE WITH OTHER PREDATORS, AND WILD PREY-LIVESTOCK-PREDATOR INTERACTION

By

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ABSTRACT

Snow leopard (*Uncia uncia*) is a flagship species of the Himalaya. Very few studies have been done on the ecology of this species in the Himalaya. This paper presents an overview of four studies conducted on snow leopards in Nepal and India, dealing with various aspects of snow leopard ecology including their status assessment, marking behaviour, habitat selection, food habits, and impact on livestock. The information generated by these studies is useful in planning effective conservation and management strategies for this endangered top predator of high mountains.

Key Words: Annapurna Conservation Area, Food habits, Hemis National Park, Himalaya, Langtang National Park, Livestock depredation, Scent marking, Snow leopard, *Uncia uncia*

INTRODUCTION

The snow leopard (*Uncia uncia*) is the top-most predator of high altitude mountains of central and southern Asia (Schaller 1977). They inhabit some of the highest, coldest, most arid, hostile and ecologically fragile regions of the world. The presence and survival of snow leopards is also an indicator of health of the eco-regions they inhabit (Jackson & Hunter 1995). Their distribution is extremely patchy and fragmented, occupying a mix of long narrow mountain systems and islands of montane habitat scattered throughout a vast region surrounding the Central Asian deserts & plateaus and the Himalaya. Snow leopards are generally found at elevations between 3,000-4,500 m, although they occasionally go above 5,500 m in the Himalaya, and at the northern limits of their range can be found between 600-1,500 m (Heptner & Sludskii 1972; Fox 1989; Schaller *et al*. 1994). They are found in 12 countries (Afghanistan, Bhutan, China, India, Kazakhstan, Kyrgyzstan, Mongolia, Nepal, Pakistan, Russia, Tajikistan, and Uzbekistan) encompassing a total potential habitat area of 1,835,000 km^2 (McCarthy & Chapron 2003).

Estimates of the total snow leopard population vary from 4,500 to 7,500 individuals in its entire range (Fox 1994), but Nowell and Jackson (1996) estimated the total effective population size of snow leopard as 2,500 mature breeding individuals, with a declining trend due to various survival threats including habitat and prey loss and persecution. Unfortunately, a large portion of their range also falls along politically unsettled and hostile international boundaries. Snow Leopards are listed as Endangered on the IUCN Red List and in Appendix I of both CITES and the Convention on Conservation of Migratory Species of Wild Animals (CMS). Snow Leopards are protected nationally over most of their range, with the probable exception of Afghanistan. Despite all the legal protection, the survival of this animal in the future remains uncertain (McCarthy & Chapron 2003).

Some of the key research issues for enhancing the chances of snow leopard survival are: distribution of snow leopard and their prey species; interaction between prey-predator population; food habits and habitat use; livestock depredation rates and causes; and interaction with other sympatric carnivore species (McCarthy & Chapron 2003).

We carried out this important research in India and Nepal with financial support from the International Snow Leopard Trust. This paper presents our research findings based on our respective studies designed to better understand snow leopard ecology and conservation.

STUDY AREAS

The first study in this paper was conducted by MKC, and it is about survey of snow leopards, their prey population and associated conservation threats in Langtang National Park, Nepal. The second study was an investigation done by SS, TD and YVB about marking site selection by snow leopards in order to understand their habitat selection strategies in Hemis National Park, Ladakh, India. The third study was also done by SS, TD and YVB; it presents the preliminary research findings of food habits and dietary overlap between the snow leopard and the Tibetan wolf (*Canis lupus chanco*) in Hemis National Park, Ladakh, India. In the fourth study conducted at Annapurna Conservation Area, Nepal, KT investigated the interactions between snow leopards, blue sheep (*Pseudois nayur*) and livestock, and studied the causes of livestock depredation despite the abundant blue sheep population.

Langtang National Park, Nepal

The Langtang valley (between latitudes N 28˚11'87.5" to N 28˚12'28.6" and longitudes E 85˚ 27'31.6" to E 85˚42'16.9") lies north of Kathmandu along the Langtang River in the northern Himalayan range bordering with Tibet (China) in the central region of Nepal (Fig. 1). The elevation varies from 3000-5125 m. The park represents a meeting point between the Indo-Malayan and Palearctic realms and holds a rich biodiversity (DNPWC 2002). Established in 1976 by His Majesty's Government of Nepal, LNP is Nepal's second largest mountain National Park covering 1710 km^2 in Rasuwa, Nuwakot and Sindhupalchowk districts of the Bagmati zone in Nepal. LNP has 46 species of mammals, and its expansive high meadow provides summer habitat for numerous ungulate species such as musk deer (*Moschus chrysogaster*) and Himalayan tahr (*Hemitragus jemlahicus*). It also harbors red panda (*Ailurus fulgens*), Himalayan black bear (*Ursus thibetanus*), clouded leopard (*Neofelis nebulosa*), goral (*Nemorhaedas goral*), wild dog (*Canis alpinus*), pika (*Ochotona* species), and three species of primates: rhesus macaque *(Macaca mulatta*), Assamese macaque (*Macaca assamensis*) and hanuman langur (*Semnopithecus entellus*) (Chalise 2003), and 345 species of birds (Karki & Thapa 2001).

Annapurna Conservation Area

The Annapurna Conservation (ACA) is spread over 7,629 km^2 of Mustang, Manang, Myagdi, Kaski and Lamjung district in northwest Nepal (Fig. 1). Established in 1986, the conservation area is surrounded by high mountains and deep valleys. The conservation area is home to 1,226 species of plants, 101 species of mammals, 480 species of birds, 39 species of reptiles and 22 species of amphibians. The intensive study area consisted of three major blocks i.e. Phu (82.7 km^2), Ngoru (65.5 km^2) and Ghyo (44.1 km^2) of remote Phu valley (192.3 km^2), which is situated at 4,052 m above sea level (84°5' to 84°13' E and 28°40 to 28° 50' N) of Manang district in the ACA.

Hemis National Park, Ladakh, India

Hemis NP is located about 40 km southeast of Leh, within the Ladakh district of the northern most state of Jammu and Kashmir, in India. Hemis NP (*c.* 3,000 km^2) was notified as a national park in 1981 with the purpose of conservation and protection of representative flora and fauna of Trans-Himalayas. It lies on the west bank of the Indus river and comprises the catchments of Markha, Rumbak and Sumdah tributaries at 33°43'-34°11'N, 77°00'-77°38'E (Fig. 2). In the elevations between 3500-6930 m, the terrain is predominantly rugged (Fox & Nurbu 1990). The intensive study area was located in the Rumbak valley (*c.* 100 km^2) which was situated in the western-most part of Hemis NP. The steep side valleys of Rumbak gorge, named Husing, Tarbung, Kahrlung, and the portion of Rumbak gorge connecting these valleys was the primary sampling region.

Hemis protects some 11 threatened species of Trans-Himalayan mammals, most of which are threatened elsewhere in their range. These include snow leopard, Tibetan wolf, Pallas' cat (*Felis manul)*, wild dog, lynx (*Lynx lynx*), Himalayan ibex *(Capra ibex sibrica)*, blue sheep, Tibetan argali (*Ovis ammon hodgsoni*) and Ladakh urial (*O. orientalis vignei*). There is substantial interaction between local people and wildlife in terms of competition between domestic livestock and wild herbivores for food (Namgail *et al.* 2004). Another conflict situation is depredation of livestock by snow leopard and other large carnivores (Bhatnagar *et al.* 1999).

Status of Snow Leopard in Langtang National, Park, Nepal

There have been reports of presence of snow leopard in the Langtang National Park (LNP), but the conformation of its survival in recent years is lacking. Green (1981) reported the existence of snow leopard during an expedition in LNP, especially near the highland snow-fed lake Gosainkunda (3900 m) and Langsisa plateau (4540 m). Additionally, local people, herders and a few investigators frequently have revealed presence of this endangered and protected species in this area. Fresh tracks of snow leopard were also recorded in this region as an evidence of its presence near the river plain at Kyanjing village (3950 m) recently (NAHSON 2003; Chalise *et al*. 2004). We surveyed Langtang valley across the Kyanjing area (Fig.1) for snow leopard and their prey distribution during February 2003 to May 2004, spending 769 hours scattered over 137 days.

The status and distribution of snow leopard were explored by investigation in the field and through a questionnaire survey of local people. The study area (the probable habitat) was divided into five blocks of 5 km each. The signs of snow leopard such as scrapes, scats, pugmarks and scent sprays were recorded wherever possible in 25 km^2. Local people, hotel owners and herders were interviewed in village settlements and pastures in remote *kharka* (highland pasture).

From the questionnaire survey, 90.9% respondents affirmed the occurrence of snow leopard in the area (HH = 60). Local people confirmed the presence of snow leopard in higher elevations of Langsisa Kharka, Langtang Lirung, Langtang Cliff, Sindum, Airport, Yala peak, Numthang, Cherkori, Nayakhang Kharka, Ganjala pass and at lowest elevations in Ghodatabela. The study team members sighted snow leopard on 26 April 2003 in Cherkori (4570 m at N 28˚12.598, E 85˚35.811). Ninety different snow leopard signs were recorded from the five blocks. Most signs were recorded from Cherkori kharka, Langsisa kharka, Yala peak kharka, and Langtang glacier kharka. These areas consist of productive highland meadow that provides suitable habitat for Himalayan tahr, a major prey species of snow leopard of LNP (Khatiwada 2004). Other supplementary prey species found in LNP were pika, musk deer, Tibetan snow cock (*Tetraogallus tibetatanus*) and chukor partridge (*Alectoris chukor*) (Shrestha 1997).

High degree of habitat degradation, continuous livestock grazing, and illegal hunting of Himalayan tahr, musk deer, goral and snow leopard are the major threats in that area. Local people from Langtang affirmed that snow leopard and its prey species used to be hunted in the study area. During the study period, the researchers in the Musk deer conservation area (N 28º 12.13; E 85º33.48) detected 20 leg snares used to trap musk deer and other highland wild animals. Local respondents agreed (62.7%) about ongoing hunting of snow leopard. More than 51% of local people had a negative attitude towards snow leopard due to livestock depredation problems, as it contributes up to 62% of livestock loss.

Langtang valley and its vicinity provide good habitat for snow leopard and its prey species, but it is under threat due to heavy human encroachment and livestock grazing. The highest density of livestock observed was above 4100 m. The seasonal livestock grazing that is prevalent in the area degrades the pastures available to wild ungulates, and ultimately affects the snow leopard population. The local people depend on the forest for firewood, timber, fodder and forage. Therefore, competition between human interests and wild animal habitat utilization is typical of the area. Livestock husbandry is one of the means of the local economy, and depredation by snow leopards poses a tense conflict between the leopard and humans. Conservation education programs highlighting the importance of biodiversity and the role of wildlife in ecosystem were launched in the schools for children and teachers in an attempt to reduce the negative attitude of the livestock herders against the snow leopard.

Marking Site Selection by Free Ranging Snow Leopard in Hemis national Park, Ladakh

Olfactory signals play an important and essential role for socio-ecological communication in carnivores, and more so in solitary carnivores (Ralls 1971; Eisenberg & Kleiman 1972; Macdonald 1980, 1985). The solitary nature of snow leopards coupled with large home ranges and semi-arid resource-scarce habitat requires an efficient communication system amongst snow leopards. For the snow leopard, communication is very important for maintaining the social structure and advertising the reproductive status.

Snow leopards leave a variety of signs in their habitat, with scrape marking and scent marking the two most predominant types of sign. We investigated marking site selection by free ranging snow leopards in Hemis National Park, Ladakh, India (Sharma *et al. this volume*). Walking 15 trails, we encountered 107 scrape sites and 43 rock scent sites and recorded their habitat attributes. We also sampled 99 random sites and 65 randomly selected rocks for quantifying the habitat availability.

We used multivariate analytical techniques, logistic regression and stepwise discriminant function analysis (DFA) to explore the marking site selection patterns of snow leopards. Logistic regression identified the height and slope of overhanging of rock faces, and slope of the terrain to classify sprayed and unsprayed rocks with 91.6% classification accuracy. The stepwise DFA resulted in 78.3% accuracy in classifying scrape sites and random sites, based on substrate, landform ruggedness, dominant topographic feature, rangeland use and openness of the terrain. For scent marking, snow leopards preferred rocks of a particular size (100 cm modal width and 100-150 cm modal height) with a prominent overhang (70-85 cm modal height) and a slope of 40° (modal value) for the marked rock face; and for scrape marking, snow leopards preferred a substrate with soil and shale. Snow leopards seemed to prefer gentle to moderate slopes for leaving scrape marks, while scent marks were mostly left on steeper slopes. 'Highly broken terrain' was selectively used for both scraping and scent marking. Rolling terrain was preferred for scrape marking, while cliffs were preferred for scent marking. In the use of the dominant topographic features for leaving scrapes, snow leopards selectively used the 'river terrace', 'riverside buff' and 'valley bottom', while for scent marking they preferred 'hill slopes' and 'valley bottoms'. Snow leopards appeared clearly to avoid the areas under greater levels of land use disturbance.

Our study results could be used to establish more effective sign-survey designs, enhancing population monitoring of snow leopards. It also gives an insight about marking pattern and mark placement strategy adopted by snow leopards for the efficient and effective dissemination of olfactory information, which is essential to their communication. This study could also help in developing enrichment facilities for captive snow leopards.

Food habits and dietary overlap of Snow leopard and Tibetan wolf in Hemis National Park, Ladakh

The snow leopard and Tibetan wolf are highly endangered sympatric large carnivore species of the Hemis National Park, Ladakh (Fox & Chundawat 1995). The information about food habits and dietary resource partitioning of these two species is poorly understood. This study gives an insight for conservation of both species, since both of them are persecuted by locals for livestock damage (Chundawat & Rawat 1994).

The food habits of the snow leopard and Tibetan wolf were studied in 2004, by analyzing their scats. We used the correction factors developed by Ackerman *et al.* (1984) and Floyd *et al.* (1978) for snow leopard and wolves respectively. Niche breadth was calculated using Levins index (Levins, 1968; Krebs 1989) and the standardized form of Levins index (Colwell & Futuyma 1971). The dietary niche overlap between the two species was calculated using Pianka's Index (Pianka 1973).

We found that snow leopard and Tibetan wolf largely feed on blue sheep and marmot, while livestock occurred in scats of both carnivores. The order of preference of snow leopard was blue Sheep>marmot>domestic goat and that for wolves was blue sheep>domestic goat>domestic sheep. Snow leopards derived 86% of biomass from wild prey species while wolves derived only 56% of biomass from wild prey. This indicates a greater dependence of wolf on livestock compared to that of snow leopard.

The niche breadth of snow leopard (0.35 standardized) was less than that of wolf (0.59 standardized), showing that snow leopard fed on proportionately fewer selected prey species. This might be an indication that the snow leopard is a specialist, while wolves are generalists in diet patterns. The dietary overlap between the two species was high (Pianka index = 0.72) and at such high levels of overlap, competition is likely (Fox & Chundawat 1995; Schaller 1998).

The average food requirement of a snow leopard is 2 kg /day (Jackson & Ahlborn 1989) or 730 kg annually. As an illustration of the menu implications of this food requirement, it translates to the consumption of 9 blue sheep, 51 marmots, 10 hares, 12 pikas, 3 goats, 1 sheep, and 1 cow by a single individual. The estimated population of snow leopards in our study area of Hemis NP is 7-9 individuals and if they all consumed the same prey menu, this population would require 73 blue sheep, 408 marmots, 78 hares, 98 pikas, 22 goats, 7 sheep and 4 cows for their sustenance. If livestock is made unavailable to them, in order to compensate their annual demand, they would need an additional 12 blue sheep, 64 marmots, 13 hares, and 15 pikas.

A wolf's daily requirement of meat is 1.7 kg/ day (Mech 1970) or 620 kg annually. This translates to 6 blue sheep, 11 marmots, 20 hares, 111 pikas, 10 goats, 3 sheep, and 1 donkey annually. We guesstimate that our study area has a population of 7-9 wolves and this population would require 50 blue sheep, 85 marmots, 158 hares, 886 pikas, 83 goats, 20 sheep, and 9 donkeys annually. If we limit their access to livestock, then their additional requirement on wild prey becomes to 38 blue sheep, 66 marmots, 122 hares, and 690 pikas. We found that when livestock is made unavailable to snow leopard and wolf, then predation pressure on blue sheep increases by 40%.

If we assume that both predators are taking 10% of blue sheep population, as stated for a limiting equilibrium state for large predators and large mammalian prey (Emmons 1987), we estimate that the population of 7-9 snow leopards and 7-9 wolves residing in our study area would need a population of 1700-2000 blue sheep.

Our results are indicative and preliminary. Marmots are an important prey species for both species of carnivores, but they hibernate for 7 months of the year. Thus, we expect a strong seasonal difference in food habits of the carnivores. The dependence of wolves and leopards on livestock is also likely to follow a strong seasonal pattern. Although the niche breadths are indicative, these are also likely to vary with season. Data analysis for seasonal food habits is currently underway to provide a clearer picture of the underlying dynamics of predator-prey relationships and competition of these two large carnivores. Although there is a high overlap between the dietary habits of snow leopards and Tibetan wolves, there is some habitat segregation between the two species (Sharma *et al. unpublished information*). Snow leopards prefer broken rugged terrain while wolves seem to prefer relatively rolling high altitude open valleys. While competition between the two cannot be established with surety in this study, it cannot be ruled out either. Both the species are highly secretive and many aspects of their ecology remain poorly understood, especially for the wolf. Long-term detailed studies will be able to give a better understanding of the interactions and co-occurrence of these animals.

What could be the main cause of the snow leopard killing livestock instead of abundant blue sheep?

Coexistence of mammalian predators and their prey (wild ungulates as well as their domesticated relatives) in the high Himalaya has become one of the top conservation concerns. Unless the interfaces of the existence are understood properly and strategies are applied, coexistence may not be possible (Gurung & Thapa 2004).

Blue sheep are considered as an important primary prey for snow leopard in Nepal and elsewhere in the Himalayan region. Therefore the presence of blue sheep populations in the snow leopard habitat may have a significant impact on reducing snow leopard depredation on livestock and eventually in conserving the snow leopard (Oli 1994). It has been shown that the density of blue sheep varies considerably depending on habitat quality, anthropogenic activities and other ecological factors (Oli 1996). Livestock play a vital role in the economy and culture of Nepal and constitute an essential element of the country's subsistence farming system. Thus, livestock is and continues to be the major source of livelihood for herder communities. However livestock depredation has become a significant problem across the snow leopard range in central Asia, being most severe in and around protected areas (Schaller 1998). Such depredation, especially incidents of "surplus killing", in which five to hundred or more sheep and goats are lost in a single night, almost inevitably leads herders to retaliate by killing the snow leopard. Theoretically snow leopard should attack livestock as their secondary prey only when their natural prey is either depleted or hard to find. What could be main cause of snow leopards killing livestock instead of abundant blue sheep? Does the key lie in the system of livestock herding? How can such traditional practices be improved that ensure livestock protection?

The distribution, abundance and habitat use patterns of snow leopards and blue sheep and the degree of livestock depredation was studied in Phu valley of Manang district in the ACA, which is a good quality habitat for both snow leopard and blue sheep. As in other high mountains of world, people in the Phu valley also subsist on traditional livestock herding and maintain herds of yaks, horses, goats, cattle and sheep, making livestock herding a key economic activity. Unfortunately, livestock depredation by the snow leopard has become a major problem in the valley. In this study the correlation between the abundance of prey (blue sheep) and livestock depredation by snow leopards was investigated as a contribution to a simple management plan for the conservation of snow leopards for ACAP.

Sixteen transects were laid down with a total length of 7.9 km (mean transect length=0.5 km). Sign sites averaged 6.8/km and 11.1 sign items/km were recorded. Ghyo block had the highest sign density of snow leopards (13.6 mean sign item/km) followed by Phu block (9.8 mean sign item/km). The lowest sign density of snow leopards was in the Ngoru block (3.9 mean sign item/km). Blue sheep abundance, group size, and sex ratio were also recorded for all three blocks along with livestock abundance and loss due to snow leopard in local villages. Total household number in the Phu Village is 33 (1843 livestock heads) with yak (both male and female) comprising 32.01%, 7.7% young yak, 8.29% sheep, 31.52% goats, 6.30% cows and 4.17% horses. The average size of livestock holding in Phu Valley was 55.8 per household. The counts show that an average 9.6 animal/km² with 612.03 kg/km² out of the total biomass 117,510 kg (summed of minimum assumed weight of different type of livestock by local knowledge). Out of 33 households surveyed, 30 reported that they had lost livestock to snow leopard. On an average 1.8 livestock head/households were lost to snow leopards, and depredation rate was 3.1% (n=58: 28 goats, 16 sheep, one colt, 2 adult yak and 11 sub-adult yak). Within estimated standing available biomass in the Phu Valley, at least 1,850 kg (1.57%) of the biomass was consumed by snow leopards in a year. In Ghyo block 31 animals (53.4%), Phu block 21 animals (36.2%) and in Ngoru block 6 animals (10.3%) were killed by snow leopards. Based on snow leopard sign survey it was guesstimated that density of snow leopards in Phu valley may be 4-5 snow leopard/100 km^2 (with a sign frequency of 11.1 signs /km).

It was found that though the livestock loss is correlated to high snow leopard sign density, it was also related to blue sheep density. For example, Ngoru block showed the lowest sign density (3.9 sign/km^2) with the lowest livestock depredation (10.3%), but blue sheep density was medium (4.7/km^2) amongst three blocks. Though it is presumed that livestock depredation may be minimal if sufficient natural prey is available to local predators, it was speculated that there could be other factors such as season, habitat quality and livestock guarding pattern which leads snow leopards to kill livestock. For instance, Ghyo is basically scrubland that consists of broken terrain with cliffs and rocky outcrops, which is a good habitat of the snow leopard. But this is also the winter pasture where livestock is poorly guarded. Another reason for low success rates of livestock attacks could be that adult yaks and horses (summer pasture) may be too large bodied animals for snow leopards to kill successfully.

Despite a lower density of blue sheep in Ghyo, snow leopard sign density was high compared to Phu and vice versa. Such observations are surprising, but this could be attributed to the presence of high biomass of livestock (more than three times the biomass of blue sheep) in the study area. Fox and Jackson (2002) also reported a similar relationship between snow leopard density and blue sheep in Nepal, where blue sheep density was estimated as 2-4/km^2 and sign frequency of snow leopards was 2.8 sign items/100m, and in Bhutan (blue sheep 4-6/km^2 and 1.2 snow leopards sign item/100m). McCarthy (2000) reported that ibex density does not appear to be a good predictor of snow leopard sign density in Mongolia. Gurung (2002) found 7.3 blue sheep/km^2 and 4.9 snow leopards sign item/km in his study in Khangsar area, where livestock depredation rates were more or less similar to those reported by Jackson (1996) and Oli *et al.* (1994). It could thus be inferred that in such situations the density of wild prey alone cannot predict predator abundance. Biomass of all available prey, including livestock and small mammals, may prove a better predictor. Alternative prey species for snow leopards in Phu valley may include pika and pheasants that occur in the area, but no effort was made to record their abundance.

The changes in the herding patterns have been considered as being the main determinant of livestock depredation by predators. Sherpa (1998) urged that if a herder carefully minds his herds, the chance of wildlife depredation can be drastically minimized. Jackson *et al.* (1996) found that the combination of lax guarding practices, favorable habitat conditions, and high snow leopard density was responsible for the high depredation rate in the Khangsar village, in Nepal. However, snow leopards in Manang valley took livestock despite the availability of blue sheep in relatively high numbers (Oli *et al.* 1993). This study suggests that snow leopards are more likely to encounter livestock, when taking advantages of the excellent cover available to them in the form of vegetation, steep slopes, rocky areas and broken terrain. The depredation of livestock intensity, however, differs between livestock species, season, pasture, and abundance of wild prey (Gurung and Thapa 2004).

This study suggests that the blue sheep abundance determines snow leopard abundance, and livestock depredation by snow leopards may be minimal where there is a good population of blue sheep, and vice versa. However other confounding factors governing the livestock depredation which should not be overlooked are: 1) when both wild prey and livestock are present, livestock are more vulnerable; 2) livestock depredation rate depends on pattern of guarding and livestock type (e.g. sheep and goats are more vulnerable); and 3) there exists "livestock depredation hotspots" -- areas with broken terrain and other habitat features favored by snow leopards such as cover.

CONCLUSION

We studied various aspects of snow leopard ecology in three different protected areas of Nepal and India. With all these studies a common factor emerged: snow leopard prey on a significant amount of livestock everywhere and this possibly leads to conflict between them and local inhabitants. In many parts of their range snow leopards suffer persecution because of livestock depredation. We suggest that reducing poaching pressure on snow leopard's wild prey coupled with better herding practices could mitigate snow leopard-livestock conflicts.

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Figure 1: Location of Langtang National Park and Annapurna Conservation Area in Nepal.

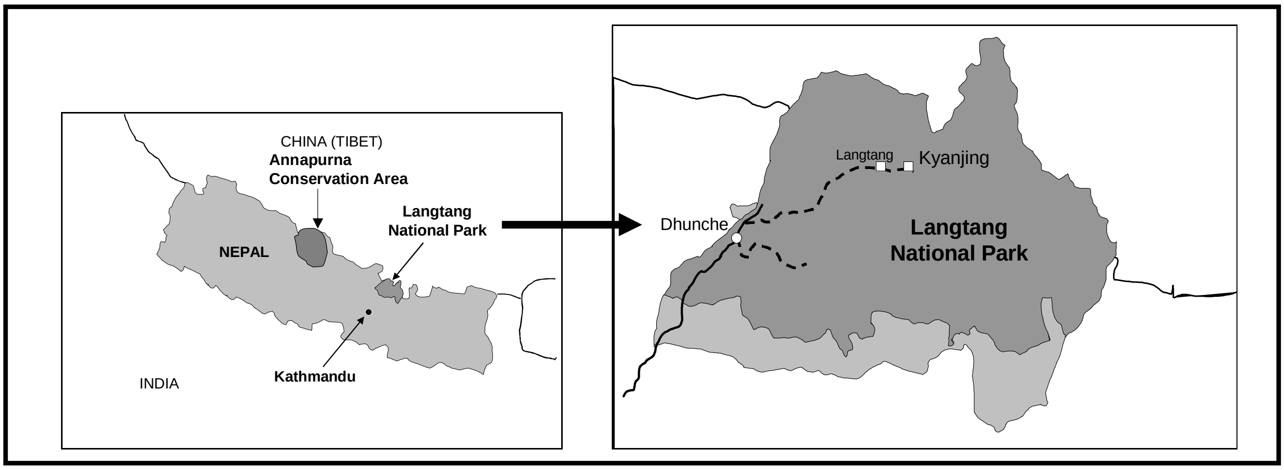

Figure 2: Map of Rumbak valley in Hemis High Altitude National Park, Ladakh, India.