



SNOW LEOPARD *Panthera uncia* PREDATION OF LIVESTOCK: AN ASSESSMENT OF LOCAL PERCEPTIONS IN THE ANNAPURNA CONSERVATION AREA, NEPAL

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Abstract

Public attitudes towards snow leopard *Panthera uncia* predation of domestic livestock were investigated by a questionnaire survey of four villages in snow leopard habitat within the Annapurna Conservation Area, Nepal. Most local inhabitants were subsistence farmers, many dependent upon yaks, oxen, horses and goats, with an average livestock holding of 26.6 animals per household. Reported losses to snow leopards averaged 0.6 and 0.7 animals per household in two years of study, constituting 2.6% of total stockholding but representing in monetary terms almost a quarter of the average annual Nepali national per capita income. Local people held strongly negative attitudes towards snow leopards and most suggested that total extermination of leopards was the only acceptable solution to the predation problem. Snow leopards were reported to be killed by herdsman in defence of their livestock. The long-term success of snow leopard conservation programmes may depend upon the satisfactory resolution of the predation conflict. Some possible ways of reducing predation losses are also discussed.

Keywords: snow leopard, blue sheep, livestock predation, public attitudes, Annapurna Conservation Area, Nepal.

INTRODUCTION

High-altitude grasslands in Himalayan valleys are important components of the habitat of snow leopards *Panthera uncia* and their main natural prey species, the blue sheep *Pseudois nayaur*, but in Nepal and elsewhere most such areas have also long been used for livestock grazing by local inhabitants. The occasional killing of livestock by wild predators is almost inevitable when they are brought into close contact in this way, and in many areas this gives rise to significant conflict between conservation objectives and the livelihood of herdsman.

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In communities with a subsistence economy even small losses can be of economic importance and can generate negative attitudes towards wildlife and conservation in general (Mishra, 1982; Upreti, 1986).

Snow leopards have been reported to kill livestock in most parts of their range but the extent of this predation and its impact on local farmers is poorly understood (Mallon, 1984; Schaller *et al.*, 1987, Fox *et al.*, 1988, 1991; Sherpa & Oli, 1988; Annenkov, 1990; Jackson, 1991).

The main objective of this study was to investigate the public perception of the snow leopard's predation of livestock in the Annapurna Conservation Area, Nepal. Also investigated were the local people's attitude towards snow leopard conservation and towards blue sheep, the leopard's main prey, but also a potential competitor with domestic livestock for grazing. The farmers' claims of economic loss due to snow leopard predation and their suggestions for solving this problem were also examined.

THE STUDY AREA

The study was conducted in the upper Marsyangdi valley of Manang district in the Annapurna Conservation Area, Nepal. This area lies in the rain shadow of the Annapurna mountain range and precipitation is low (*c.* 500 mm). The vegetation consists of grasslands with interspersed scrub characterized by *Juniperus squamata*, *Caragana gerardiana*, *C. brevispina*, *Rosa sericea*, *Ephedra* spp. and *Lonicera* spp. Above 4800 m vegetation is scarce and consists mainly of *Rhododendron anthopogon*, *Potentilla biflora*, and *Saxifraga* spp.

The snow leopard and red fox *Vulpes vulpes* are the only large mammalian predators and the blue sheep is the only wild ungulate in the study area. Small mammals include Himalayan marmot *Marmota himalayana*, Royle's pika *Ochotona roylei*, and stone marten *Martes fiona*. The birdlife is relatively diverse, and includes bearded vulture *Gypatus barbatus* and Himalayan griffon *Gyps himalayensis*, which are potential competitors with the snow leopard for carcasses, and Tibetan snowcock *Tetrogallus tibetanus*, and Himalayan snow-

cock *Tetrogallus himalayensis*, which are potential snow leopard prey.

Crop farming and animal husbandry are the most important economic activities in the area. Most of the accessible parts of the study area are grazed by domestic livestock on a seasonal rotational pattern. Gathering of firewood is also an important human activity and appears to have affected the habitat by decreasing the abundance of juniper scrub, an important habitat component that provides cover for snow leopards while stalking their prey.

There were altogether nine villages and 975 households within the snow leopard habitat in Manang district. Four villages, Bhraka, Khangsar, Manang, and Tanki Manang, with 549 households were surveyed in this study.

METHODS

The study was based on a questionnaire survey of 102 randomly selected households (21 in Bhraka, 29 in Khangsar, and 52 in Manang and Tanki Manang) representing 18.5% of total households. The questionnaire requested information on the number of each livestock type owned by households, the number lost to

predation, the monetary value of losses, and methods of reducing the loss. Additional questions were included to gauge the respondents' general knowledge of wildlife, and attitude towards conservation. The attitude responses were recorded on a 5-point scale: 1 = strongly liked, to 5 = strongly disliked (Table 1).

A survey of this type was the only feasible approach with a largely illiterate population but was open to the possibility of inaccurate responses from the herdsmen. A number of precautions were taken to reduce such potential bias. The questionnaire interviews were conducted only after the research team had been in the area for eight months studying snow leopards and blue sheep. During this time general information was collected on livestock numbers, losses of livestock and the monetary value of animals through independent observations and by attending sales transactions. A fully objective assessment of livestock numbers could not be made because the animals were usually widely dispersed over the available grazing land, moved frequently and were not identifiable to individual owners. However, the information obtained could be used to gauge whether herd sizes or predation losses were grossly exaggerated. We also cross-checked the stockholdings, and type and number of livestock reported as

Table 1. Questionnaire used in the study

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1. Please give details of your livestock: () Yak () Yak/cow hybrids () Cow/ox () Goat () Sheep () Horse () Total
 2. Have snow leopards ever killed your livestock? () Yes () No
If yes, please give following details for 1989/90 and 1988/89: (a) Date (b) Place (c) Age & sex of livestock killed (d) Number (e) Estimated cost
 3. Have blue sheep ever damaged your crop? () Yes () No
If yes, give following details for 1989/90 and 1988/89: (a) Date (b) Place (c) Type of crop (d) Estimated value
 4. Do you think that it is necessary to control the predation of livestock by the snow leopard? () Yes () No
If yes, which of the following methods do you think are appropriate (if more than one, please rank to show your preference, 1 for the most preferred and so on)?
() Improving husbandry practices (e.g. closer guarding of herds, coralling animals in predator proof enclosures at night, use of guard dogs).
() Avoiding the areas with high predation risk.
() Financial compensation for the predation loss.
() Selectively removing problem leopards.
() Eradication of the snow leopard.
() Other (specify).
 5. If you know of any incidents in which snow leopards were killed, please give following details: (a) Date (b) Place (c) Methods used (d) Number killed (e) Reason
 6. Which of the following wildlife are found in your surrounding? () Tiger () Leopard () Snow leopard () Black bear () Jackal () Red fox () Thar () Blue sheep () Pika () Musk deer () Wolf
 7. Please indicate your attitude towards following wildlife:

Wildlife	Strong like (1)	Slight like (2)	Indifference (3)	Slight dislike (4)	Strong dislike (5)	Reason
Snow leopard						
Blue sheep						
Wildlife in general						

 8. Is hunting allowed in your surrounding? () Yes () No
If no, who prohibited hunting? () Government () Village council () Monastery () Other (specify)
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Table 2. The average number of livestock per household^a in the Manang area, Nepal

Village	Yak	Cow/ox	Horse	Goat	Sheep	Total	SD	Range
Bhraka	0	2.7	1.2	21.5	0.6	25.9	17.2	0–61
Kangsar	5.8	5.0	1.1	12.4	0.9	25.3	15.4	6–68
Manang/Tanki Manang	5.1	0.9	1.7	19.5	0.2	27.5	13.1	2–64
Combined average	4.3	2.4	1.4	17.9	0.5	26.6	15.3	0–68

^a Number of households surveyed: Bhraka, 21; Khangsar, 29; Manang and Tanki Manang, 52.

lost to snow leopards by a sample of nine respondents from Manang and Tanki Manang villages. This was done during social discussions and casual conversation with their neighbours or fellow herdsman. All the losses claimed by those interviewees were independently verified by one or more villagers.

The attempts to validate the methodology suggested generally consistent and truthful responses to the questionnaire. Only in a few cases involving yaks and horses did there seem to be an over-estimate of the value of animals lost to predation. However there was in any case a considerable range of monetary values for such animals, depending upon their individual qualities.

RESULTS

Livestock holdings and predation losses

Herdsman in the Manang area maintained herds of yak, milk cows, draught oxen, horses, goats and sheep. Individual family holdings were small, mostly less than 40 animals in total, with an average of only 26.6 (Table 2). Only 14.3, 10.3 and 5.8% of households held more than 50 animals in Bhraka, Khangsar, and Manang and Tanki Manang combined, respectively. On average, 38.2% of all households held small herds, consisting of 20 or less animals per household.

The majority of livestock were goats, with an average of 18 per household. Few sheep were kept, with only 0.5 per household (Table 2). Yaks, cows, and horses were kept in small numbers, averaging 4.3, 2.4, and 1.4 per household, respectively.

Table 3. Type and number of livestock reported to have been lost to snow leopards in the Manang area, Nepal (percentage of total holdings in parentheses)

Livestock	1988–89 ^a		1989–90
	Losses	Total	Losses
Horses	16	147	12 (8.2)
Yaks	10	441	13 (2.9)
Oxen/cows	1	251	0 (0.0)
Goat	31	1847	42 (2.3)
Sheep	2	51	5 (9.8)
Total	60	2737	72 (2.6)
Number/household (all surveyed households)	0.6		0.7
Number/household (only those reporting losses)	1.5		2.0

^a Total number of livestock for the households surveyed were available only for 1989–90.

Of the 102 households surveyed, 39 (38.2%) and 35 (34.3%) reported losses of livestock to snow leopard predation in the years 1988–89 and 1989–90, comprising totals of 60 and 72 animals, respectively. Most of the losses were goats (51.7% in 1988–89, and 58.3% in 1989–90) but yaks, horses and sheep were also reported to be predation victims. The average loss of animals per household over the whole area was 0.7 in 1989–90, representing 2.6% of total livestock holdings (Table 3). Reported losses in Khangsar village were higher than elsewhere, at 5.1% of total livestock holdings.

The average estimated loss per household in monetary terms was Nepal Rupees 2070 (£1 = NRs 75) in 1988–89 and NRs 2175 in 1989–90. Most losses per household were less than NRs 5000, but 12.8% and 20% of households reported a loss of over NRs 10000 in the years 1988–89 and 1989–90, respectively (Table 4). The most severe incidents involved the loss in a single attack of two adult horses from one household, estimated to be worth NRs 30000 and 11 goats from another household, worth an estimated NRs 13200.

All of the predation incidents were reported to have occurred on the grazing areas and none within villages. There was a marked seasonal pattern, with 42% of losses during winter (December–February), 28% in spring (March–May), and 15% each in summer (June–August) and autumn (September–November).

Suggestions for reducing loss

All respondents stated that it was necessary to reduce the damage caused by snow leopards. Total eradication of the leopards was thought by most (51.9%) to be the only remedy worth considering, and an additional 35.3% believed that eradication should be attempted first and compensation schemes implemented only if

Table 4. Numbers of households suffering economic losses (three categories) from snow leopard predation of livestock in Manang, Nepal (percentage in parentheses)

Year	Loss categories (in NRs)			
	None	Small (<5000)	Medium (<5000– 10000)	High (>10000)
1988–89 (n = 39)	63 (61.8) ^a	25 (64.1)	9 (23.1)	5 (12.8)
1989–90 (n = 35)	67 (65.7) ^a	24 (68.6)	4 (11.4)	7 (20.0)

^a Percentage of the total number of households surveyed.

this failed. Only 9.8% suggested that compensation should be attempted first followed by eradication if this proved unsuccessful and 2.9% thought that compensation would be a satisfactory solution. Other possible options, such as the selective removal of individual leopards or changes in husbandry practices, were universally viewed as unacceptable.

Only three respondents were willing to provide any information on the extent of snow leopard poaching by local people. They were aware of five adults and two cubs that had been killed in the past decade, but what proportion of the total deaths these comprised is unknown. All of the reported killings were done in retaliation for livestock predation, mostly when the leopards were found guarding kills of large domestic animals. No reports of poaching for fur were received. From the almost universal silence on the subject, it must be suspected that snow leopard killing occurred more frequently than reported.

Public knowledge of and attitude towards snow leopards and other wildlife

Seventy-eight percent of respondents accurately distinguished 50% or more of the wildlife species that occurred in their surroundings from those that did not occur, indicating a good knowledge of their natural surroundings (Table 1, question no. 6). All were aware that hunting was not permitted in the area but opinion differed on the source of the restriction. Of the 102 individuals who responded, only one knew that the ban was government law, 55 believed the origin to be religious, and 46 believed that it was religious but also reinforced by law.

The attitude of the local people towards snow leopards was strongly negative and they cited the killing of livestock as the only reason. Attitudes towards wildlife in general were neutral but strongly positive towards blue sheep (Fig. 1). Respondents stated that these were beautiful and harmless and they enjoyed seeing them. This was unexpected as blue sheep use the same pastures as livestock and are potential competitors.

Only one respondent, the owner of a tourist trekking

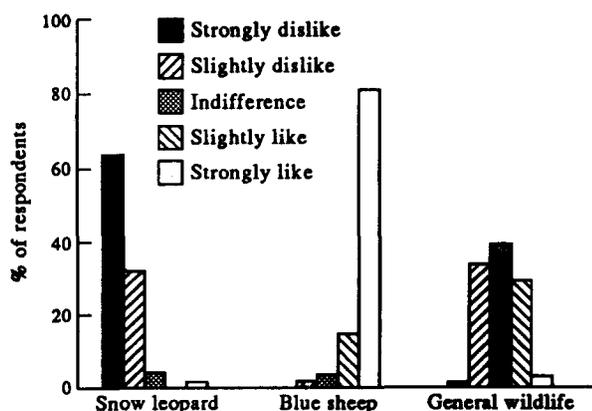


Fig. 1. Attitudes of local pastoralists towards snow leopards, blue sheep and wildlife in general (number of respondents—snow leopard, 100; blue sheep, 100; wildlife in general, 92).

lodge, expressed a strong liking for snow leopards. Residents of a village distant to the trekking trail (Khangsar) had significantly more negative attitudes towards snow leopard than those along the trail (Bhraka, Manang, and Tanki Manang; $\chi^2 = 7.28$, $p < 0.05$).

DISCUSSION

Obtaining objective assessments of the numerical and economic losses of livestock to predators has always presented problems. It is particularly difficult to separate predation as a proximate cause of loss from ultimate causes such as disease, nutrition, weather, or accident; many predators may take injured or sick individuals or scavenge carcasses (Kruuk, 1972; Houston, 1977; Hewson, 1990). The direct quantification of predator impact is rarely possible and rates of loss reported by farmers may be deliberately inflated or fail to distinguish between proximate and ultimate causes (Wagner, 1988). Experimental approaches have seldom been attempted (Hewson, 1990).

In the case of rare and elusive species such as the snow leopard, which lives in inhospitable terrain and has large home ranges, direct observation of livestock predation could only be achieved by a very substantial research investment. Despite the problems inherent in the use of questionnaire techniques to obtain information, this approach provides useful initial insight into the local people's perception of the problem, and can be used to judge the need for more detailed work.

Studies of predation problems in the United States have shown that livestock farmers tend to attribute deaths of their animals to predators regardless of the actual cause of death, and to exaggerate the number of animals lost to predation (Wagner, 1988). In this study, the presence of the research team in the area for several months before the survey, personal contacts made with the herdsman, and other measures taken to cross-check the information should have minimised the extent of misleading claims. Also the relatively small livestock holdings and the close day to day husbandry enabled herdsman to make detailed statements about individual animals. For the most part they were able to distinguish clearly between illness or accident and predation as causes of death. Nevertheless, the possibility of a degree of exaggeration in their claims cannot be excluded.

During the winter months, when most of the losses were reported to occur, 39% of snow leopard faeces collected in the study area contained the remains of livestock (Oli *et al.*, in press). Extensive scavenging was unlikely as the herdsman located dead livestock, often within hours of their disappearance, to secure the meat and hides. The analysis of faeces thus provides some independent support for the claims of high predation losses.

High levels of livestock predation have been reported in other parts of the snow leopard's range (Mallon, 1984; Schaller *et al.*, 1987; Sherpa & Oil, 1988; Fox *et al.*, 1991; Jackson, 1991). In Manang, the monetary

value of reported losses, averaged over all households in the community, was equivalent to about a quarter of the average *per capita* income in Nepal. In Qomolangma Nature Preserve, Tibet Autonomous Region, China, where the snow leopard was one of the principal predators, the average predation rate was 1.2% of the total livestock population, and the economic value of predated livestock averaged about \$26 per family per annum, which was considered to be a significant loss by the local residents (Jackson, 1991). Schaller *et al.* (1987) reported that the livestock predation rate in the Mariang commune of the Taxkorgan Reserve of Xinjiang, China, was 7.6% for the sheep and goats and 1.7% for large animals between January 1984 and April 1985. They also noted that the loss of even three goats represented a considerable financial burden to a family with just 50 animals. Therefore, it seems likely that the subsistence economies of many villages within the snow leopard's range are being adversely affected.

The problem of livestock predation seems to be widespread in areas where extensive livestock husbandry is practised (e.g. Dorrance & Roy, 1976; Klebenow & McAdoo, 1976; Boggess *et al.*, 1978; Gee, 1979; Hewson, 1990; Robel *et al.*, 1981; Schaefer *et al.*, 1981; Scrivner *et al.*, 1985; Wagner, 1988). Various methods have been attempted to resolve predator–livestock conflict. Predator control programmes have been implemented in North America and elsewhere with substantial financial investments, but such programmes have often given rise to considerable ecological, social and political controversies (Cain *et al.*, 1972; Pearson & Caroline, 1981; Nass *et al.*, 1984; Bjorge & Gunson, 1985; Hewson, 1990).

Formerly, pastoralists in Manang have killed snow leopards whenever opportunity permitted, and this was associated with considerable prestige and substantial financial reward. However, since the establishment of the Annapurna Conservation Area, the protected status of the snow leopard is held responsible for an increased predation loss, although the loss rates may have remained unchanged.

Investigators in other areas have also reported killing of snow leopards by herdsmen (Jackson, 1979; Osborne *et al.*, 1983; Mallon, 1984; Fox *et al.*, 1991), but we have little understanding of snow leopard population dynamics or of the effect this additional mortality may have on their populations. Nevertheless, given the ever-increasing human activities in snow leopard habitat throughout the Himalayas, we should expect illegal killing to increase, posing a long-term threat to the leopard population.

As the villagers did not regard blue sheep as competitors, there was no desire to reduce their numbers. There seemed therefore to be no immediate threat to the snow leopard's main natural prey.

A financial compensation scheme for stock losses has been implemented in North America (e. g. Minnesota: Fritts *et al.*, 1992; Montana: Fischer, 1989; Alberta: Gunson, 1983; Ontario: Kolenosky, 1983) and elsewhere (e. g. Italy: Zimen & Boitani, 1979; India: Joslin, 1973),

and is considered successful and well worth its cost in some areas (Gurba, 1982; Fritts *et al.*, 1992). Because it involves instant financial incentive, a compensation programme may help change livestock farmers' attitudes towards predators and improve communication with wildlife managers (Gunson, 1983; Fritts *et al.*, 1992). In the long run, a combination of a carefully designed financial compensation programme, improved husbandry practices and an education programme may provide a satisfactory solution to this problem.

A successful resolution of the livestock predation issue is important for the future of both local pastoralists and snow leopards. However, financial compensation would involve a continuing high burden on the limited financial resources of the Annapurna Conservation Area Project. Any alteration of grazing areas or husbandry techniques such as closer guarding or the construction of enclosures for night-time corralling were considered by the herdsmen to be unacceptable.

In the long run, improved husbandry practices, although not popular, might be the best option to reduce the predation losses. The use of night-time corrals in the grazing areas and closer guarding of animals during the day, perhaps by the improved use of dogs, could be considered. However, parallel programmes which provide some economic gain for the affected communities for the maintenance of snow leopard populations might also have to be implemented. This could be achieved partly by increasing wildlife tourism in the area (which is already popular with trekkers) and diverting the revenue to benefit local communities. But this probably would not benefit the individuals who suffer most losses, so some other kinds of financial incentive or compensation for specific losses would probably also have to be introduced. Economic aspects of predation losses documented in this study may be used as a basis for estimating financial resources required to implement a compensation scheme. There is an urgent need for a detailed investigation into the various possibilities and trial schemes to be implemented.

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