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Living with large carnivores: predation on livestock by the snow leopard (*Uncia uncia*)

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Abstract

Livestock predation by large carnivores and their retaliatory persecution by pastoralists are worldwide conservation concerns. Poor understanding of the ecological and social underpinnings of this human–wildlife conflict hampers effective conflict management programs. The endangered snow leopard *Uncia uncia* is involved in conflict with people across its mountainous range in South and Central Asia, where pastoralism is the predominant land use, and is widely persecuted in retaliation. We examined human-snow leopard conflict at two sites in the Spiti region of the Indian Trans-Himalaya, where livestock outnumber wild ungulates, and the conflict is acute. We quantified the snow leopard's dependence on livestock by assessing its diet in two sites that differed in the relative abundance of livestock and wild ungulates. We also surveyed the indigenous Buddhist community's attitudes towards the snow leopard in these two sites. Our results show a relatively high dependence of snow leopards on livestock. A higher proportion of the snow leopard's diet (58%) was livestock in the area with higher livestock (29.7 animals km^{-2}) and lower wild ungulate abundance (2.1–3.1 bharal *Pseudois nayaur* km^{-2}), compared with 40% of diet in the area with relatively lower livestock (13.9 km^{-2}) and higher wild ungulate abundance (4.5–7.8 ibex *Capra ibex* km^{-2}). We found that the community experiencing greater levels of livestock losses was comparatively more tolerant towards the snow leopard. This discrepancy is explained by the presence of a conservation-incentive program at the site, and by differences in economic roles of livestock between these two communities. The former is more dependent on cash crops as a source of income while the latter is more dependent on livestock, and thereby less tolerant of the snow leopard. These data have implications for conflict management strategies. They indicate that the relative densities of livestock and wild prey may be reasonable predictors of the extent of predation by the snow leopard. However, this by itself is not an adequate measure of the intensity of conflict even in apparently similar cultural settings.

Introduction

The increasing interface between humans and large carnivores is resulting in a worldwide escalation of human–carnivore conflict (Madhusudan & Mishra, 2003; Treves & Karanth, 2003). Carnivores often cause serious economic losses by preying on livestock. For example, coyotes *Canis latrans* in North America (Windberg *et al*., 1997), mountain lions *Felis concolor* ssp. in South America (Mazzolli, Graipel & Dunstone, 2002), wolverines *Gulo gulo* and wolves *Canis lupus* in Europe (Merrigi & Lovari, 1996; Landa *et al*., 1999), foxes *Vulpes vulpes* ssp. in Australia (Greentree *et al*., 2000), tigers *Panthera tigris* in south Asia (Bagchi, Goyal & Sankar, 2003), and lions *Panthera leo* in Africa (Patterson *et al*., 2004) enter into conflict with humans because of livestock predation. Large carnivores are specialized for predation on ungulates, and readily take to killing livestock when opportunities arise (Treves & Karanth, 2003). Furthermore, domestication is believed to have led to a decline in anti-predatory abilities in livestock, making them particularly vulnerable to predation compared with wild ungulates (Zohary, Tchernov & Horwitz, 1998; Landa *et al*., 1999). There are other proximate causes responsible for the escalating levels of carnivore predation on livestock, such as an increase in local abundance of carnivores, increase in livestock populations or decline in wild prey populations (Madhusudan & Mishra, 2003).

Inadequate understanding of the ecological and social issues of human–carnivore conflicts often hinders the formulation of effective conflict resolution and conservation management strategies. For instance, often even basic understanding of the extent of livestock predation, the relative

importance of livestock in carnivore diets or the attitudes of livestock owners towards carnivores are lacking (Madhusudan & Mishra, 2003). There is an urgent need for interdisciplinary applied research (e.g. Hotte & Bereznuck, 2001; Nyhus *et al*., 2003; Ogada *et al*., 2003) that can assist in developing appropriate conflict management strategies (Treves & Karanth, 2003).

Here we examine, from both ecological and social perspectives, an acute human–wildlife conflict involving the snow leopard *Uncia uncia*, a globally endangered large carnivore (IUCN, 2004 Redlist), and the flagship for conservation of wildlife in Asia's highlands. The snow leopard is involved in conflict with pastoralists throughout its range (Mallon, 1984; Schaller *et al*., 1988*a*; Schaller, Jungrang & Mingjiang, 1988*b*; Fox *et al*., 1991; Oli, Taylor & Rogers, 1994; Mishra, 1997; Mishra *et al*., 2003; Mishra & Fitzherbert, 2004). Losses caused by the snow leopard are particularly damaging since they occur in regions with underdeveloped economies, and create antagonism towards conservation efforts in general (Pratt, Macmillan & Gordon, 2004). Pastoralists often have strong negative attitudes towards the snow leopard, and retaliatory persecution in defense of livestock threatens its survival (Mishra *et al*., 2003).

The economic loss because of large carnivores (snow leopards and wolves) in the Spiti region of the Indian Trans-Himalaya (*c*. 12 000 km^2) was earlier estimated to be US$ 128 per family annually, amounting to about half the per capita income of the state (World Bank, 1996; Mishra, 1997). Large areas in Spiti have been declared nature reserves, but the land is owned by the local tribal people who continue to exercise their traditional rights and privileges. Such parks can achieve conservation goals only if the resident people participate in the process (West & Brechin, 1991). But, as existing governmental schemes of financial compensation for livestock predation are plagued by shortages of funds and can recompense only 3% of the loss to the people (Mishra, 1997), it is critical to evaluate the socio-economic aspects of the snow leopard–human interface here.

In Spiti's rangelands, the density of livestock is often several times greater than that of wild ungulates, which is perhaps the most important cause of the high level of conflict (Mishra, 1997). The region has witnessed declines in wild herbivore density and diversity because of competition from livestock (Mishra, Prins & van Wieren, 2001; Mishra *et al*., 2002, 2004; Bagchi, Mishra & Bhatnagar, 2004). Given the low relative abundance of wild ungulate prey, how dependent is the snow leopard on livestock for food? Is the extent of predation related to the relative abundance of livestock *vis-à-vis* wild prey? Does the intensity of livestock predation relate to the levels of antagonism towards the snow leopard? We examine these three questions in this paper by comparing the nature and extent of snow leopard–human conflict in two sites in Spiti that differ from each other in the abundance of livestock and wild prey, and in the economic roles of their livestock (Bagchi *et al*., 2002, 2004).

Materials and methods

Study site

The catchment of the River Spiti is a part of the Trans-Himalayan region in the state of Himachal Pradesh, India. It is flanked by the Greater Himalayas to the south and west, Ladakh in the north, and Tibet in the east, having an average altitude between 3900 and 4300 m (Fig. 1). An agro-pastoral community has inhabited the region for 2–3 millennia. Lying in the rain shadow of the Himalayas, the region is cold and arid, with most of the precipitation in the form of snow. Spiti experiences severe winters with

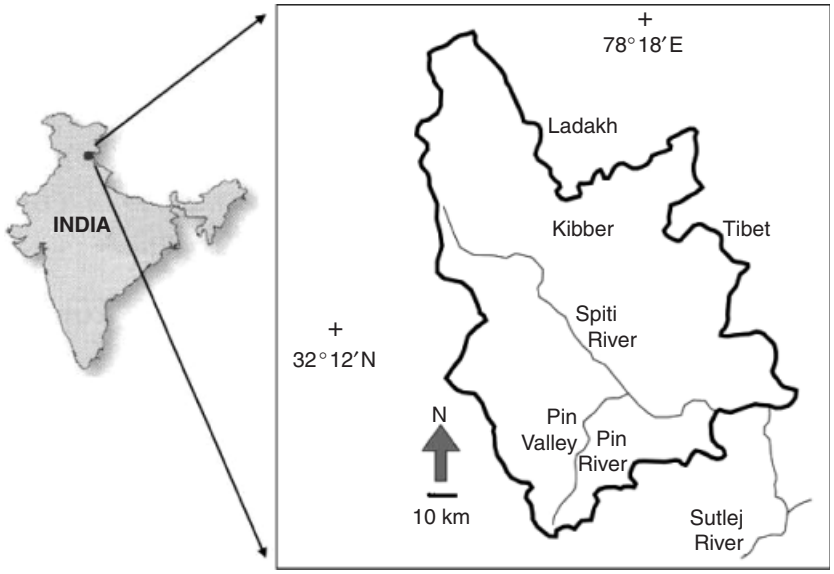

Figure 1 Map of study area showing major drainages of Spiti region, Trans-Himalaya. The intensive study areas were in Kibber Wildlife Sanctuary (north-east Spiti) and Pin Valley National Park (south-west Spiti).

temperatures dropping below −30 °C. Being cold and arid, the vegetation is characterized as 'dry alpine steppe' (very sparse above 4800 m). The livestock assemblage in Spiti includes yaks, cattle, cattle–yak hybrids, horses, donkeys, sheep and goats. During winters, a majority of the animals are stall fed, and most cases of predation occur in the pastures while grazing during spring-summer and autumn. Large carnivores include the snow leopard, wolf and red fox *V. vulpes*.

The catchments of the Pin River in Spiti form the Pin Valley National Park (PVNP, 32°N 78°E), which was one of our study sites. The terrain here is rugged and most of the area has an inclination between 30° and 60°. PVNP has a single wild ungulate, the ibex *Capra sibirica*, and the large carnivores here include the snow leopard and the red fox. Here we estimated animal densities and collected snow leopard scats from an intensive study area of 27 km^2. The nearby Kibber Wildlife Sanctuary (KWS, 33°N 79°E) formed our second study site. The landscape in KWS is rolling, interrupted by a few cliffs. The common wild ungulate in KWS is the bharal *Pseudois nayaur*, along with a very small population of ibex (*c*. 20 animals). Among carnivores, KWS has the snow leopard, red fox and seasonal activity of wolves. The intensive study area here was 31 km^2.

Smaller mammals occurring in both study sites included the pika *Ochotona roylei* and Tibetan woolly hare *Lepus oiostolus*, and ground-dwelling birds like the Himalayan snowcock *Tetraogallus himalayensis* and Chukar partridge *Alectoris chukar* are also potential prey of the snow leopard.

Ungulate abundance

We enumerated the total head of livestock that graze in the rangelands in the two areas, and calculated their densities by door-to-door censuses in villages. The density of bharal in KWS was estimated through annual censuses conducted in 1998 and 2000 (Mishra *et al*., 2004). Ibex density in PVNP was estimated through censuses in 1999, 2000, 2002 and 2003. All censuses were conducted in winter or spring, when wild ungulates congregate in lower, snow-free areas (Mishra *et al*., 2004).

Snow leopard diet

Diet of snow leopard was assessed from undigested remains of prey in scats. Snow leopard scats, identified on the basis of shape, size, and associated signs like scrapes and pug-marks, were collected from ridges and cliffs between November 2001 and May 2002. Very old or disintegrating scats and those of ambiguous identity were not included in the analysis. Confusion in predator identity is often caused by the presence of sympatric carnivores and wolves are seasonally active in KWS. However, wolves use relatively flat and rolling terrain and do not use ridges and high cliffs from where scats were collected. Consequently, the confusion between scats of snow leopards and wolves can be considered to be minimal in this study.

Hair remains of prey were used for species identification (Mukherjee, Goyal & Chellam, 1994) with the help of reference samples and photographic keys (Oli, 1993). Shape, size, color and the structure of the cuticle and medulla of hair were used for identification. No attempt was made to identify species from feathers or wool found in the scats. Data were recorded in terms of frequency of occurrence (proportion of total scats in which an item was found) of individual prey species in scats by examining 10 hairs at random from each scat. The presence of vegetable matter was noted, but not included in further analysis. Similarly, unidentified hairs were not included in the analysis. To assess the adequacy of sample sizes (number of scats examined), we iteratively recorded the occurrence of prey items in five randomly chosen scats at a time, and repeated the procedure until all scats were sampled and cumulative frequencies were obtained (Bagchi *et al*., 2003).

For estimating the relative importance of prey species in the diet, we considered the number of scats produced by snow leopards to be related to the body size of prey consumed (Floyd, Mech & Jordan, 1978). The biomass of prey consumed by a snow leopard to produce a single field-collectible scat was assumed to be similar to that of cougars (*Felis concolor* ssp., Ackerman, Lindzey & Hernker, 1984) as they have similar body sizes (body length, cougar: 0.8–1.3 m, snow leopard: 1.0–1.3 m). The biomass Y of prey consumed to produce a single field-collectible scat was estimated by the linear relation $Y = 1.980 + 0.035X$, where X is the average body weight of the prey species involved (Ackerman *et al*., 1984). This correction factor enables the conversion of frequency of occurrences of prey items in scats to the relative biomass and the relative number of prey consumed (Oli, 1994; Karanth & Sunquist, 1995; Bagchi *et al*., 2003). The relative number of prey consumed was calculated from the daily food requirements of the snow leopard. A felid the size of a snow leopard requires about 1.5 kg of food per day, and thus needs 548 kg in a year (Jackson & Ahlborn, 1984; Schaller, 1998). For this, it has to kill prey equivalent to 822 kg because about a third of ungulate body weight is inedible (assuming smaller prey like birds and rodents are completely eaten, Emmons, 1987; Schaller, 1998). Contributions of an individual prey species to this annual requirement were calculated based on the relative biomass consumed, and subsequently divided by the average body weight to obtain the number of individuals consumed (Schaller, 1998). The body weights of the potential prey species were taken from the literature (Oli, 1994; Mishra *et al*., 2002).

Pastoralists' attitudes

We assessed the livestock owners' perception of the conflict and their general attitude towards conservation through interviews in the largest villages around the two protected areas. A total of 37 families (*c*. 40% of total population) in the village Kibber (KWS) and 20 families (*c*. 35% of total population) in Sagnam (PVNP) were interviewed. Villagers were questioned about details of livestock that they had lost

Table 1 Questionnaire used in the study

Questions related to local perception of the conflict due to predation
1a. Have snow leopards killed your livestock during 2002–2003? Yes/No
1b. If yes, please provide details of the animals killed (species and numbers)
2a. Do you think that such losses are severe and need to be reduced immediately? Yes/No
2b. If yes, who should intervene in finding suitable solutions? Government agencies/Self or local village and tribal councils/ Both/Others (please specify)
2c. What can be a suitable remedial measure? Please specify
3. If you know any incidents of retaliatory persecution of snow leopards, please provide details of approximate date, locality, and number of animals killed
Questions related to local attitudes towards wildlife and conservation
4. Please indicate your attitude towards the snow leopard:
i. Dislike (should be eradicated)
ii. Indifference (no strong opinion)
iii. Like (should be conserved)
5a. Are you aware of legal protection afforded to wildlife around you? Has protected area status around your village had any adverse effect on you?
5b. Please indicate your attitude towards Protected Area status around your village:
i. Dislike (legal status should be dissolved)
ii. Indifference (no strong opinion)
iii. Like (legal protection should be continued)
6a. Is wildlife hunted in your area? Yes/No
6b. If yes, then who hunts? If no, then what deters people from hunting? Fear of legal status/Religious considerations/Other (please specify)

to assess the extent of predation. We also asked them what mitigation measures they would find most useful and how these measures should be implemented in order to have the desired effect. In order to evaluate the intensity of human–wildlife conflicts, we asked people about their opinions on conservation of predators around their villages and also about the legal Protected Area status of their village lands. These are represented as a questionnaire in Table 1. A negative opinion (dislike) was scored as -1, a positive opinion (like) was scored $+1$, and if someone was indifferent or had no definite opinion on the issue (or neutral), the response was scored as 0. Assigning such scores to peoples' responses has been found useful in understanding the factors that influence local attitude towards carnivores (Marker, Mills & MacDonald, 2003). From these, an overall average opinion was calculated (possible range between -1 and $+1$), and statistically compared with 0 using Monte Carlo procedures (Manly, 1991; Crowley, 1992). Significant deviations from 0 (i.e. neutral attitude) were tested by 100 randomized iterations using Microsoft® Excel (Redmond, WA, USA) add-in PopTools (Hood, 2002).

Results

Prey abundance

Bharal density ($\pm$ SD) in KWS was $2.6 \pm 0.2\,\mathrm{km}^{-2}$, and livestock density was $29.7\,\mathrm{animals\,km}^{-2}$. Ibex density in PVNP was $6.1 \pm 0.9\,\mathrm{animals\,km}^{-2}$, while livestock density was $13.9\,\mathrm{animals\,km}^{-2}$. Thus, wild ungulate density in PVNP was more than twice that of KWS, while livestock density was about half.

Snow leopard diet

A total of 95 snow leopard scats were analyzed: 44 from KWS and 51 from PVNP. Four species of wild prey and five domestic species were identified in the scats (Table 2). Bharal, birds and donkeys were the most frequently encountered items in KWS, while ibex and horses were commonly found items in PVNP (Table 2). The relative contribution of each species to the snow leopard's diet stabilized after *c*. 40 scats were examined; so our sample sizes are deemed adequate to represent snow leopard diet in these two areas. Vegetable matter was encountered in 25.5% of scats from PVNP and 27.3% in KWS. Wool was also commonly encountered in the scats (31.3% in KWS and 13.0% in PVNP). Of the total hairs examined, 9% could not be identified in the scats from KWS and 4% from PVNP. About half the scats (50% of scats from KWS and 58% from PVNP) contained remains of a single prey species, while all other scats had two or three prey species.

Wild prey contributed to 42% of the snow leopard's diet in KWS, while domestic livestock constituted 58%. Donkeys, horses, yaks and other cattle contributed substantially to the snow leopard's diet (Table 2). In PVNP, ibex was the major prey species (57% of diet), and wild species contributed to 60% of the diet. Dependence on livestock was still considerable (40%), especially on horses (Table 2).

Conflict perceptions

During 2002–2003, 43% of the families in KWS and 41% in PVNP suffered livestock losses. The average loss per family during this period was 1.1 ($\pm$ 0.1 SE) livestock in KWS and 0.6 ($\pm$ 0.1 SE) in PVNP. All predation incidents occurred

Table 2 Diet of snow leopards in two areas of Spiti, India – Kibber Wildlife Sanctuary and Pin Valley National Park based on analysis of prey remains in scats (sample size in parentheses)

	Wild				Domestic				
	Bharal	Ibex	Hare	Birds	Yak/cattle	Horse	Sheep	Goat	Donkey
Average body weight (kg)	55	76	3	1.5	250	248	35	34	90
Kibber Wildlife Sanctuary									
Frequency of occurrence (n=44 scats)	9	4	3	7	3	2	2	4	6
Per cent of diet	19.8	10.5	3.5	8.0	18.1	12.0	3.6	7.1	17.3
Relative no. of animals killed	2.6	0.9	9.6	44.9	0.6	0.4	0.8	1.5	1.6
Pin Valley National Park									
Frequency of occurrence (n=51 scats)	0	29	2	0	1	6	1	2	2
Per cent of diet	0.0	57.0	1.8	0.0	4.6	27.4	1.4	2.7	4.4
Relative no. of animals killed	0.0	5.0	4.9	0.0	0.2	0.8	0.3	0.6	0.4

Per cent contribution of each prey in diet is calculated after correcting for differences in body sizes of prey. Relative no. of individuals killed are calculated from average daily food requirements of the snow leopard. All calculations are explained in the text.

when animals were grazing in the pastures and none within the villages. Almost every respondent (89% in KWS and 100% in PVNP) felt that this level of loss was severe and needed to be reduced. About half of the people wanted government agencies to intervene in offsetting these losses (47% in KWS and 50% in PVNP). The others felt that the local village council should try and formulate a strategy independently or with governmental support, and they were also open to a possible role for conservation agencies. In KWS, 71% of the respondents felt that a combination of improved herding practices and more efficient monetary compensation in case of a predation event would be able to reduce the losses. In PVNP, the opinion was divided. About 40% people sought improvements in herding practices; 35% looked for more efficient compensation of the loss. All respondents expressed dissatisfaction over the existing governmental compensation scheme and did not find it helpful.

Attitudes towards snow leopards

In KWS, 30% of the respondents had a strong negative attitude towards the snow leopard, and considered their eradication a possible solution. Twenty two per cent thought that they should be conserved, while the remaining had no definite opinion. In PVNP, 45% of the people had a strong negative attitude towards the snow leopard, only 5% felt a need to conserve them, and the others were indifferent. When these were scored (-1, 0 and $+1$), the overall attitude towards carnivores was not negative in KWS (-0.1 ± 0.1 SE, $P = 0.32$) but significantly so in PVNP (-0.4 ± 0.1 SE, $P = 0.04$) based on Monte Carlo randomizations.

All respondents were aware of the legal Protected Area status of the land around their village. In KWS, 94% of the people said that this had not affected their lives in any adverse way, while 70% held the same view in PVNP. About half the respondents were indifferent to continuing this legal protection (50% in KWS and 55% in PVNP). A favorable opinion in support of conservation through legal protection of lands was given by 47% of the people in KWS, whereas 35% of respondents in PVNP wanted the present legal status to be dissolved. As a consequence, the overall score was favorable ($+0.44 \pm 0.1$ SE, $P<0.01$) in KWS while it was slightly negative (-0.25 ± 0.1 SE, $P = 0.1$) in PVNP, based on Monte Carlo randomizations.

Most people said that hunting or active persecution of wildlife does not occur around their village (97% in KWS, 100% in PVNP). Sixty-five per cent of people in KWS and 100% in PVNP thought that this was largely because of religious reasons.

Discussion

A majority of India's protected areas have livestock-related conflicts (Kothari *et al*., 1989). For example, tigers are also in conflict with pastoralists as 10–12% of their diet consists of livestock in some parts of India (Biswas & Sankar, 2002; Bagchi *et al*., 2003). So in comparison, livestock predation in Spiti (40–58% of snow leopard diet) is much more severe.

Although wild species occur in the major proportion of the scats, the contribution of livestock to total biomass is still very high. This is presumably related to the low diversity (and density) of wild prey available to the snow leopard in Spiti; these have largely been replaced by livestock through overstocking (Mishra *et al*., 2001, 2002, 2004). We compared our data of snow leopard diet with those from other parts of Asia like the Manang region of the Annapurna Conservation Area in Nepal (Oli, Taylor & Rogers, 1993), Yushu and Shule-Nanshan regions of the Qinghai province in China (Schaller *et al*., 1988*b*), and the Hemis region of Ladakh in India (Chundawat, Rawat & Panwar, 1994, Table 3). From Table 3, it appears that the levels of livestock losses are lower in the other regions where marmots are an important prey. This species has become extinct in Spiti (Mishra *et al*., 2001, 2002), and possibly resulted in an increased dependence on livestock.

The relative abundance of wild ungulates *vis-à-vis* livestock was greater in PVNP than KWS. As expected, snow leopard predation on livestock was greater in KWS than in PVNP, suggesting that the relative density of livestock *vis-à-vis* wild prey may be a reasonable predictor of the extent of livestock predation by the snow leopard. However, the local

Table 3 Comparison of per cent frequency of occurrence of different prey items in snow leopard scats from Kibber and Pin Valley in Spiti, India against reports from other regions

Prey items	Kibber, Spiti, India (n=44)	Pin Valley, Spiti, India (n=51)	Manang, Nepal (n=213)	Yushu, Qinghai, China (n=46)	Shule Nanshan, Qinghai, China (n=91)	Hemis, Ladakh, India (n=173)
Wild						
Blue sheep	20.5		51.6	66.1	43.2	23.4
Ibex	9.1	56.9				
Cervus deer				4.8	1.2	
Marmot			20.7	89.8	40.1	9.8
Hare	6.8	3.9			6.0	3.1
Smaller rodents[a]			23.5		2.4	4.3
Birds	15.9		1.4		0.1	3.1
Smaller carnivores[b]			9.4			
Domestic						
Yak and cattle	6.8	2.0	14.2	9.3		1.2
Horse	4.5	11.8	2.8			0.8
Sheep and goat	13.6	5.9	0.9	37.8	2.4	12.5
Donkey	13.6	3.9				0.3
Others						
Vegetation	27.3	25.5	19.3	4.8	12.1	41.0
Unidentified	13.6	5.9	5.6	4.8	2.3	

These data are compared against reports from Annapurna Conservation Area, Manang, Nepal (Oli *et al.*, 1993), Yushu and Shule Nanshan in Qinghai region of China (Schaller *et al.*, 1988*b*) and Hemis in Ladakh region of India (Chundawat *et al.*, 1994). Sample size of number of scats analyzed in parentheses.

[a]Smaller rodents include Royle's pika *Ochotona roylei* and Royle's vole *Alticola roylei*.

[b]Smaller carnivores include stone marten *Martes foina*, least weasel *Mustela nivalis* and red fox.

perceptions of the conflict were counterintuitive. People had stronger negative feelings towards the snow leopard in PVNP even though they suffered fewer losses. Their general attitude towards conservation was also less favorable than in KWS. This apparent discrepancy is explained by differences in the economic value of the livestock in these two areas. Traditionally, people in Spiti reared horses for trade, which, even today, have a high value at INR 20 000 (*c*. US$ 400 each). However, with the advent of cash crops as an alternative source of income, there has been a rapid shift in the capital asset as most people, particularly in KWS, have given up horse rearing. Cash cropping became popular in the villages around KWS in 1983 and since then the population of horses here has declined from *c*. 250 animals to just 20 by 2004. With the establishment of a road network, cash crops arrived in Pin Valley in 1998 and 89% of families have taken it up as it generates a reasonably assured annual income of around INR 18 000 (*c*. US$ 370) (Mishra, 2000; Bagchi *et al*., 2002). However, 63% of families around PVNP still depend on horses (Bagchi *et al*., 2002) and any predation by snow leopards amounts to a relatively high economic loss. Our results show that 27.4% of the snow leopard's diet was contributed by horses in PVNP, whereas it was 12% in KWS. Thus, it is likely that people perceive the conflict in terms of the loss incurred upon their most 'valuable' livestock and react accordingly. Additionally, in KWS, a community-based livestock insurance program against wild carnivore predation was started in 2002 (Mishra *et al*., 2003), which presumably has increased peoples' tolerance towards the snow leopard.

Although people resent having large carnivores in their pastures, they do not actively persecute them as in other parts of Central Asia (Mishra & Fitzherbert, 2004), because of cultural and religious reasons. Our data indicate that greater financial security, particularly arising out of alternative income sources in otherwise pastoral communities, can mediate people's attitudes towards wild carnivores. It also highlights the importance of understanding the sociological underpinnings of human–carnivore conflict. Assessing the extent of predation alone is not likely to lead to effective conservation planning, as people's attitude towards carnivores is seen to be embedded in the socio-economic role that livestock play in traditional economies.

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