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Understanding people's responses toward predators in the Indian Himalaya

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Abstract

Research on human–wildlife interactions has largely focused on the magnitude of wildlife-caused damage, and the patterns and correlates of human attitudes and behaviors. We assessed the role of five pathways through which various correlates potentially influence human responses toward wild animals, namely, value orientation, social interactions (i.e. social cohesion and support), dependence on resources such as agriculture and livestock, risk perception and nature of interaction with the wild animal. We specifically evaluated their influence on people's responses toward two large carnivores, the snow leopard *Panthera uncia* and the wolf *Canis lupus* in an agropastoral landscape in the Indian Trans-Himalaya. We found that the nature of the interaction (location, impact and length of time since an encounter or depredation event), and risk perception (cognitive and affective evaluation of the threat posed by the animal) had a significant influence on attitudes and behaviors toward the snow leopard. For wolves, risk perception and social interactions (the relationship of people with local institutions and inter-community dynamics) were significant. Our findings underscore the importance of interventions that reduce people's threat perceptions from carnivores, improve their connection with nature and strengthen the conservation capacity of local institutions especially in the context of wolves.

Introduction

People often live alongside wild animals, experiencing the impacts of wildlife damage as well as the pleasures and utility they provide. A growing body of research has attempted to better understand the nature of human–wildlife interactions, their origins and the factors that influence them (Ingold, 2000; Lescureux & Linnell, 2010; Banerjee *et al*., 2013; Din *et al*., 2017). Studies have shown that tolerance for wild animals or retribution against them is influenced by several socio-political, psychological, cultural, economic and ecological factors (Sekar, 2013; Treves & Bruskotter, 2014; Knopff, Knopff & St Clair, 2016). For example, evidence suggests that, in general, age, gender, education, the nature and magnitude of loss, fear of the animal and the presence of conservation conflicts are some of the factors that impact human attitudes and behaviors toward wildlife (Kellert, 1985; Marchini & Macdonald., 2012; Zajac *et al*., 2012; Dickman, Marchini & Manfredo, 2013).

To assess the drivers of human tolerance of wildlife, Kansky, Kidd & Knight (2016) recommended a model with two components – an outer model comprising variables that account for the tangible and intangible costs and benefits of living with wildlife based on meaningful experiences and exposure, and an inner model comprising 11 variables that affect the perceptions of costs and benefits from wildlife. Their model implies that (1) the inner variables (e.g. wildlife value orientations, personal norms, empathy, institutions, etc.) have a causal relationship with perceived cost and benefits, and (2) thus affect tolerance by affecting perceptions of costs and benefits. Our study complements their attempt to unearth causal mechanisms by drawing on multiple dimensions of human–wildlife interactions.

A recent review recorded 55 correlates or 'proximate' factors influencing human attitudes and behaviors and five broader pathways or 'ultimate' factors through which the various correlates presumably influence human responses: value orientation, social interactions, resource dependence, risk perception and the nature of interaction with the animal (Bhatia *et al*., 2019). Value orientation comprises moral and ethical dimensions such as norms and personal and social preferences which may be shaped by various factors

including religion, social identity or ethnicity (Kellert, 1985; Zinn & Pierce, 2002; Manfredo, 2008; Hazzah, Borgerhoff & Frank, 2009; Dickman, 2012; Marchini & Macdonald, 2012). Social interactions refer to the kind of relationships that people have with each other within the community and with conservation agencies. Conservation conflicts tend to result in intolerance toward wildlife and are often believed to occur due to wildlife damage, societal inequities, power asymmetry, as well as a lack of participation and benefit-sharing in conservation (Knight, 2003; Skogen & Krange, 2003; Mishra *et al*., 2017; Mutanga, Muboko & Gandiwa, 2017; Pooley *et al*., 2017).

Resource dependence captures the economic dimensions of living with wildlife, for example, wealth, income sources, occupation and dependence on resources that may be consumed or damaged by wild animals, such as livestock or crops (Marshall, 2011; Humle & Hill, 2016). Risk perception focuses on the perceived threat from wild animals, and is often a product of emotions such as fear, anger, dread, awe, etc. The type of animal, knowledge and experience of animal behavior, the presence of other potentially dangerous animals, cognitive biases as well as the media play a role in influencing perceptions of risk (Slovic, 1987; Gore *et al*., 2007; Dorresteijn *et al*., 2014; Koziarski, Kissui & Kiffner, 2016; Nyhus, 2016; Farhadinia *et al*., 2017; Trajçe *et al*., 2019). Finally, the nature of interaction with the animal focuses on aspects like frequency and type of interaction (e.g. encounter vs. depredation), location of the interaction (e.g. corral vs. pasture) as well as the economic repercussions of wildlife damage (Fishbein & Ajzen, 1977; Nyhus, 2016; Senthilkumar *et al*., 2016). Tolerance for wildlife can vary depending on how the five factors interact with each other and with human attitudes and behaviors.

In this study, we assessed the relative influence of these five pathways in order to better examine the interconnectedness of the multiple factors influencing human-wildlife interactions. Our focal taxa included the snow leopard *Panthera uncia* and the wolf *Canis lupus*, which are the dominant large carnivores in the high mountains of South and Central Asia.

Materials and methods

Study area

Ladakh is a high-altitude mountain range situated in the Indian State of Jammu & Kashmir. It is located along the borders of China and Pakistan and is split into two districts – Kargil and Leh. The former is predominantly inhabited by Muslims belonging to the Twelver Shi'i sect, whereas the latter is inhabited mostly by Tibetan Buddhists belonging to the Mahayana school (Gupta, 2014; Bhatia *et al*., 2017). The population density of Ladakh is 4 people/km^2 and most inhabitants are involved in subsistence agriculture and livestock rearing, although the presence of the Indian army and a recent surge in tourism have provided local people with alternative employment (Dinnerstein, 2013; Bhatia *et al*., 2017).

Our study villages were in the Rong valley (33°21′–39′N, 78°03′–20′E) in the eastern part of Leh district inhabited predominantly by agropastoral communities (Fig. 1). In this region, as in other parts of Ladakh, people and wild animals share the landscape leading to frequent interactions. Crop damage by wild ungulates poses a challenge, and widespread livestock depredation by the snow leopard and the wolf, at its extreme, results in retribution or preventive killing (Bhatnagar, Stakrey & Jackson, 1999; Maheshwari *et al*., 2012). A study by Bhatnagar *et al*. (1999) from Hemis National Park, Ladakh, found that respondents attributed 55% of the depredation events to snow leopards as compared to 31% to the wolf and small-bodied livestock was preyed upon most frequently. However, there is often a discrepancy between actual and perceived losses (Suryawanshi *et al*., 2014) and in the absence of robust records or observations, it is hard to pinpoint the precise extent or pattern of loss. On an average, however, the average loss per household was nearly USD 300 for all predators combined, with snow leopard attacks taking place more frequently in the corrals than in the pastures (Bhatnagar *et al*., 1999). Surplus killing by snow leopards also tended to have a deeper psychological impact on people.

Apart from strengthening wildlife protection and monitoring, the State and regional wildlife departments provide monetary compensation for livestock depredation in some cases. Parallelly, the Nature Conservation Foundation, an NGO, is involved in community-based conflict management programs including collaborative corral improvement, community-run livestock insurance and livestock-free wildlife reserves in some villages (Mishra, Redpath & Suryawanshi, 2016; Mishra *et al*., 2017).

Organizations like the Snow Leopard Conservancy-India, Ladakh Ecological Development Group, Sher-e-Kashmir University and governmental agriculture and animal husbandry departments are involved with income-generation and capacity-building activities. These include enhancing nature-based tourism, training women to weave and knit, rural

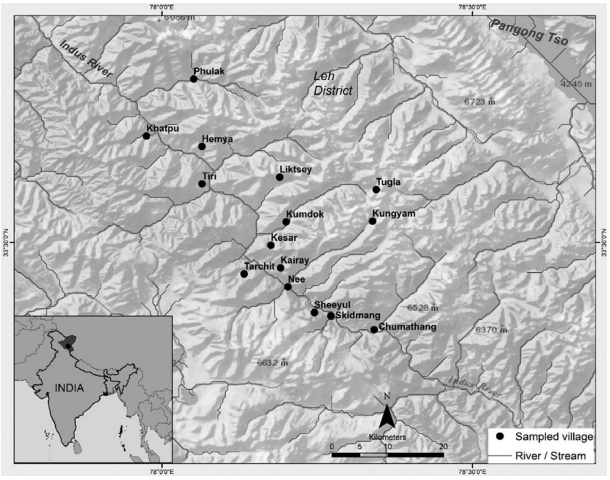

Figure 1 Map of Rong valley, eastern Ladakh, India.

developmental activities like strengthening their link to the markets, subsidizing the cost of agricultural equipment and seeds with better yields, installation of solar-powered units for electricity, and livestock vaccination programs to maintain stock health and minimize mortality. Several youth groups and women's associations also engage in environmental issues like village cleanliness, garbage management, etc.

People in the local communities traditionally resolved internal disputes by consulting the democratically elected *goba* (village head) but after the introduction of the Jammu and Kashmir Village Panchayat Regulation Act (1989), a three-tiered structure of self-governance was created – at the level of the village (*Halqa Panchayats*), administrative blocks (Block Development Councils) and districts (District Planning and Development Boards). Currently, the traditional and the modern institutions operate parallelly.

Data collection

Free, prior and informed verbal consent was obtained from all the participants at the start of the interview. We conducted a pilot survey with 18 households in February 2017. Based on the pilot, the interview questions were modified, and in October 2017, we interviewed 172 individuals from 15 Buddhist villages in the valley. The largest village had 70 households and the smallest village had nine households. We randomly sampled 30% or more of the households in each village (every third household where possible or alternate households in smaller villages) with mean number of respondents per village being 11.5 (SD = 5.01). We commenced our survey by explaining the goals of the study and seeking permission to conduct the interviews from the village head as well as the individual. Each question was posed in Hindi and if the individuals preferred, was translated to Ladakhi by an interpreter. Each interview lasted between 30 min to an hour.

We combined the questionnaire with semi-structured interviews to allow participants the flexibility to elaborate on certain responses (Suryawanshi *et al*., 2014). We created an index for each of the five pathways, based a set of questions (Appendices S1 and S2). We gathered data on people's responses (dependent variable), which was a combination of self-reported attitudes, past behavior and behavioral intent (Suryawanshi *et al*., 2014; Bhatia *et al*., 2019). Research on human–wildlife interactions has focused on either human attitudes or behavior. However, combining the two can lead to a better assessment of how people arrive at decisions, as both these dimensions together tend to produce an outcome toward wild animals (Bhatia *et al*., 2019).

Data analysis

The answer to each question was scored on a scale of −1 to 1 and in some cases, it ranged from 1 to 0 (Appendix S2). The potential and the actual scores for each of the five (independent) variables varied (Table 1). We checked to see if the dependent variable (i.e. response which was a continuous variable that combined attitude + past behavior + behavioral intent scores) was normally distributed and ruled out collinearity between the independent variables. We examined collinearity using Pearson's test with the command *cor* which computes correlation between paired samples, which in our case, were 5 × 5 = 25 pairs. The correlation coefficient was never >0.29. The variables were normalized to the mean for the purpose of linear modeling (Suryawanshi *et al*., 2014).

Because we had sampled in multiple villages, we created a mixed-effects model with the five pathways as covariates with fixed effects, and village as a variable with random effects (Zuur *et al*., 2009). Research has found overwhelming evidence for the role of gender in influencing people's response (Ogra, 2008; Gore & Kahler, 2012; Hua *et al*., 2016; Koziarski *et al*, 2016; Reid, 2016). In the model, we thus added interactions between gender and social interactions, gender and risk perception, gender and nature of interaction with the predators (Gillingham & Lee, 1999; Ogra, 2008; Prokop & Fančovičová, 2010; Bhatia *et al*., 2017). We carried out the mixed-effects analysis using the package 'lme4' in R version 3.5.0 (R Core Team, 2018). We were interested in the relative influence of each of the five pathways on the responses of local people toward the two carnivores. Hence, we fit only the global model and interpreted it based on the value of the coefficient and confidence intervals. We calculated the marginal r^2 values for the global model using 'MuMIN' package (R version 3.5.0, R Core Team, 2018). Additionally, we used Welch two sample *t*-test to check for the difference in responses toward the snow leopard and wolf.

Results

Socio-demographics

Of the 172 participants or interviewees, 62% were females and 38% were males. The skew in sampling was because, in every village, a large proportion of men had migrated to urban centers for work or were enlisted in the army. The age of the participants ranged from 18 to 85 years. The levels of education ranged from 0 to 17 years (equivalent of a Masters' degree), with 57% having no education at all.

Table 1 Actual and theoretical ranges of each factor and responses toward predators. SL refers to snow leopards and W refers to wolves

Factor	Theoretical range	Actual range
Value orientation	−6 to 6	0 to 6
Social interaction	−7 to 21	−2 to 8.75
Resource dependence	0.25 to 8	2.8 to 7.3
Risk perception	−10 to 10	−4 to 8
Nature of interaction	−5 to 4	−4.5 to 4 (SL) −3.75 to 4 (W)
Response toward predators	−12 to 12	−8 to 9 (SL) −10 to 8 (W)

Among those with no education, women comprised 73% and men, 27%. The primary occupation of 86% of the participants was herding and/or farming. The median economic value of their agricultural produce for the past year was $349, whereas the median economic value of livestock holdings was $791 (1 USD = 67 INR).

Conservation engagement, ownership and decision-making

The ongoing conservation and livelihood programs listed by the interviewees (in the order of frequency) were livestock vaccination (87%), environmental awareness (63%), capacity enhancement (55%), corral improvement (47%), wildlife tourism (27%), livestock insurance (20%), wildlife monitoring and protection (15%), monetary compensation for livestock losses (12%) and village reserves (7%). The mean number of conservation and livelihood interventions in a village was 3.3.

We asked the respondents to list both benefits and drawbacks of conservation programs in their village. The reported benefits provided by conservation and livelihood agencies included financial compensation, village cleanliness and garbage management, predator proofing of corrals, income through the sale of handicrafts and wildlife tourism, skill enhancement, wildlife monitoring and protection, material benefits to the village in exchange for their cooperation, livestock disease awareness and prevention.

While almost everyone listed at least one benefit, 78% of the respondents believed that these programs did not have any disadvantages, and 3% had no opinion about it. The remaining (19%) explained the drawbacks with statements like 'People don't benefit equally', 'Discussing depredation incidents relives hurtful experiences', 'The activities take too much time', 'There are too many tourists in the village', 'Organizations don't deliver as promised'.

More than 85% of the respondents said that they looked up to the *Panchayat* (local body of governance) for guidance in decision-making. Upon enquiring who had the strongest influence on their opinions about wildlife protection, 67% said that their opinions were not influenced by anyone, 19% mentioned religious and spiritual leaders and 11% said that they were a result of interacting with the conservation community (i.e. wildlife departments and NGOs).

Acceptability of the killing of predators

The average economic loss per household due to snow leopards and wolves was USD 821 and USD 165, respectively. We asked if the killing of predators was acceptable. 88% of the respondents said it was unacceptable, whereas 10% thought it was acceptable and about 2% had no opinion. When asked to articulate the reasons why it was acceptable or unacceptable to kill a snow leopard or wolf that attacked livestock, 56% offered religious or moral arguments against the killing of carnivores (e.g. 'It is a sin'; 'They are living beings'; 'They need to survive, too'). Sixty-one per cent of those who found killing acceptable offered economic arguments in support of killing/retaliation (e.g. 'They cause losses'; 'Livestock is our source of subsistence'). The difference in responses toward the snow leopard (mean = 1.81, CI = 0.47) and the wolf (mean = 1.74, CI = 0.49) was not statistically significant (t = 0.20, P-value = 0.8).

Role of the five pathways

Our data did not capture the entire theoretical range of each of the five pathways – the extreme positive and negative values were absent. (Table 1). Except for value orientation, all other variables were roughly normally distributed (Supporting Information).

For snow leopards, value orientation, social interactions and resource dependence did not have a significant association with human responses. However, risk perception (β coef = 0.32, CI = 0.23) and the nature of interaction (β coef = 0.41, CI = 0.25) had a significant positive association with responses (R^2 = 0.20; see Table 2). Thus, an individual's response toward the snow leopard was positive if they experienced non-confrontational interactions and perceived lower risk from the predator. For example, individuals who were not afraid to chance upon a snow leopard were more likely to exhibit positive attitudes and behaviors.

For wolves, value orientation, resource dependence and nature of interaction with the predator did not have a significant association with human responses. However, social interactions (β coef = 0.31, CI = 0.27) and risk perception (β coef = 0.32, CI = 0.23) had a significant positive association with responses (R^2 = 0.15; see Table 2). Thus, an individual's response toward the predator was positive with positive social interactions and lower risk perception. For example, individuals who were less afraid of the wolf and those that had a greater engagement with conservation

Table 2 Mixed-effect model output. The parameters highlighted with an asterisk were statistically significant. For snow leopards, risk perception and the nature of interaction with the predator had a positive relationship with human response. For wolves, social interaction and risk perception had a positive relationship with human response

	Response toward snow leopard		Response toward wolf	
Factor	Estimate	CI	Estimate	CI
Value orientation	0.18	0.32	0.18	0.34
Social interaction	0.23	0.25	0.31*	0.27*
Resource dependence	−0.21	0.63	−0.23	0.67
Risk perception	0.32*	0.24*	0.32*	0.23*
Nature of interaction with predator	0.41*	0.26*	0.13	0.31
Sex(M)	1.13	1.78	0.62	1.80
Sex (M):Social interaction	−0.07	0.42	−0.01	0.47
Sex (M):Risk perception	−0.11	0.40	−0.06	0.36
Sex (M):Nature of interaction with predator	−0.24	0.44	0.03	0.48

tended to have more positive attitudes and behaviors toward the animal. Our data revealed no evidence of the association between gender and responses.

Discussion

This study was carried out in agropastoral Buddhist villages with similar economic and cultural contexts. We set out to understand the role of the five pathways in influencing people's relationships with two wild carnivores – the snow leopard and the wolf – in Ladakh. Our findings suggest that in our sampled population, risk perception had a significant influence on attitudes and behaviors toward the two predators. People who perceived greater benefits from the predators; experienced lower fear; had a knowledge about animal behavior or thought they exercised some control over depredation, tended to have more positive responses. Positive responses implied that they derived aesthetic pleasure from watching wildlife (including the two predators), preferred greater predator numbers, found retaliatory killing unacceptable, and were willing to or had engaged with conservation irrespective of the negative impacts.

Previous studies have suggested that perceptions of risk may exceed the actual risk posed by an animal (Riley & Decker, 2000; Dickman, 2010). Perceptions could be influenced by animal behavior, emotions and local beliefs, for example, the snow leopard is feared because it can cause surplus killing of livestock in corrals (Namgail, Fox & Bhatnagar, 2007; Jackson *et al*., 2010). During our informal interactions, many individuals also told us about the widespread belief locally that the snow leopard is addicted to the blood of sheep and goats. According to them, the animal enters the corral, attacks the livestock, and sucks on their blood by puncturing the neck. They believed that after the killing, the snow leopard moves unsteadily as the animal is intoxicated by all the blood it consumes. The wolf, on the other hand, maybe perceived to be dangerous because of its greater visibility, tendency to howl and roam in packs, thus triggering fear (Kellert *et al*., 1996).

Beyond risk perception, there was a key difference in the pathways that influenced responses toward the two predators. For the snow leopard, the nature of interaction with the predator was significant and for wolves, social interactions were significant. Individuals who experienced less damage and non-confrontational encounters away from the villages tended to have positive responses toward the snow leopard. On the other hand, individuals with an awareness of wildlife laws and the presence of institutions to help buffer negative wildlife impacts, and those with a strong social network, tended to have positive responses toward the wolf (Bitanyi *et al*., 2012; Mutanga *et al*., 2017; Pooley *et al*., 2017).

Perhaps, the reason why the nature of interaction was significant for snow leopards and not for wolves could be because the snow leopard is elusive by nature, and people encounter wolves more frequently than they do snow leopards. The snow leopard is responsible for livestock depredation and can often be viewed as a pest or an irritant (Bhatnagar *et al*., 1999). However, its possible resemblance to a local protective deity could serve as an inspiration to the community (Bhatia, 2019), which might temper attitudes and behaviors toward the animal.

The social context seemed to matter for wolves but not for snow leopards. Dickman (2010) similarly noted that perceptions of risk as well as human–human conflicts were important factors affecting tolerance for wild animals, including the wolf. The wolf is a persecuted animal across its distribution throughout Asia, Europe and North America and is traditionally associated with negative symbolism, fear and hatred (Knight, 2003; Hunt, 2008; LeGrys, 2009). State-sponsored bounties to exterminate them are common across it range (Kaczensky *et al*., 2008). In comparison to the snow leopard, which is a flagship species for the high-altitude regions, the wolf receives much less conservation attention.

Given that risk perception and the nature of interaction had a significant influence on human responses toward snow leopards, interventions that alter the context of interaction with the carnivore (e.g. predator proofing of corrals, better herding practices, livestock insurance and responsible wildlife tourism) would be essential (Mishra & Suryawanshi, 2014; Jamwal, Takpa & Parsons, 2019). Preventive measures (e.g. improved corral and herding) can help people feel in control of the situation and avoid livestock depredation, thereby alleviating perceptions of risk. Remedial measures (e.g. community-run compensation, supplementary sources of income through tourism), on the other hand, can help absorb at least some of the financial costs of living with wildlife in these landscapes (Mishra *et al*., 2003).

Similarly, to enhance the acceptability of wolves, practitioners could focus on addressing the psychological impacts of human–wolf interactions with the help of technical interventions whilst working to improve the social support systems within the community, and between communities and local conservation agencies. Practitioners could also focus on being empathetic and responsive to the needs of local communities, for example with the help of nature appreciation workshops, public engagement and information dissemination (Mishra *et al*., 2017).

Suryawanshi *et al* (2014) highlighted the scale-dependence of various factors that affect attitudes toward predators. In their study, factors that were significant at the individual level included gender, education and age of the respondent (for wolves and snow leopards), number of income sources in the family (wolves), agricultural production and large-bodied livestock holdings (snow leopards). However, at the village-level, the significant factors were the number of smaller-bodied herded livestock killed by wolves and mean agricultural production (wolves) and village size and large livestock holdings (snow leopards). While the economics of loss had a significant influence, their study laid emphasis on the role of using multipronged and multidimensional approaches that are sensitive to social as well as ecological dimensions (Suryawanshi *et al*., 2014; Robinson *et al*., 2019). In our study, resource dependence did not have a statistically significant influence on people's attitudes and behaviors. This implies that human responses toward

carnivores were determined not just by whether one owns livestock and loses them to predators but also by the socio-cultural context, the type of experience and its psychological impact. Our study, therefore, reiterates the importance of acknowledging the many facets of human–wildlife interactions that transcend pure economics and delve into the lesser known pathways of tolerance that remain inadequately explored in human dimensions literature.

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Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Appendix S1. A description of the five pathways influencing human attitudes and behaviors.

Appendix S2. Statements to assess the five pathways and responses as well as corresponding scores for each answer.

Appendix S3. Distribution of the five ultimate factors and the response scores.