



# Human Perceptions about the Himalayan Brown Bear and other Carnivores in Chitral District in the Hindu Kush Range, Pakistan

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## ABSTRACT

The Himalayan brown bear (*Ursus arctos isabellinus*) historically occupied the vast mountain ranges of South and Central Asia. Their range has shrunk significantly in the past century and they currently live in small and isolated populations. Most of their range has not been surveyed; hence information on their distribution is largely based on anecdotal information and expert judgments. The present study investigated the species' current distribution in the Hindu Kush Range in Pakistan, gathering information on human-brown bear conflict along with other large carnivore species in the study area. Multiple survey techniques questionnaire surveys, sign surveys and camera trapping were used during the period 2008–2010 in five study blocks delineated on natural watersheds in Pakistan's Chitral district. Based on questionnaire surveys, sign surveys and direct sighting, Himalayan brown bear presence was confirmed only in the Yarkhun and Laspur valleys. Ninety-six respondents (59 from Laspur Valley and 37 from Broghil Valley) reported a total of 449 livestock losses (90 heads per year) to carnivore species—grey wolf (*Canis lupus*), snow leopard (*Panthera pardus*), Himalayan lynx (*Lynx lynx isabellinus*)—during the five-year (2005–2009) period, which translated into an economic loss of USD 34,297 (PKR 2,931,022); USD 357 (PKR 30,531) per household. Himalayan brown bear was not accounted for any livestock loss. Though the public was seen to be strongly against large carnivores, brown bear was considered 'less dangerous'. Despite limited conflict with humans, brown bear has lost a large part of its historical range in the Hindu Kush Range. The species is confined to the eastern valleys where it is maintaining connectivity with brown bear in Gilgit-Baltistan towards the east and with Afghan populations towards the west.

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## Authors' Contribution

MAN and SH conceived the idea and designed the study. SH and JUD conducted the field work. SA and SH wrote the manuscript. MAN supervised the study and reviewed the draft.

## Key words

Himalayan brown bear, *Ursus arctos isabellinus*, Grey wolf, Snow leopard, Himalayan lynx, Chitral, Conflict, Livestock loss, Perception, Carnivores

## INTRODUCTION

The Himalayan brown bear (*Ursus arctos isabellinus*) is a subspecies that represents an ancient lineage of the brown bear (Galbreath *et al.*, 2007). The brown bear historically occupied the western Himalayas, Karakoram, Hindu Kush, Pamirs, western Kunlun Shan, and the Tian Shan ranges in South and Central Asia (Nawaz, 2008). In Pakistan, approximately 150–200 bears may survive in seven populations over approximately 150,000 km<sup>2</sup> (Nawaz, 2007) across three provinces/states Khyber Pakhtunkhwa (KP), Gilgit-Baltistan (GB), and Azad Jammu and Kashmir (AJ and K) (Nawaz, 2007). In KP, this species is distributed in Chitral, Kalam (Kohistan), Pallas Valley (Indus Kohistan) and Kaghan Valley (Akbar, 2003; Nawaz, 2007). Chitral district, with an area of 14,850 km<sup>2</sup>, provides the largest habitat in KP and marks the western extremity of the brown bear range in Pakistan.

It is the high mountainous dry temperate area of the Hindu Kush Range that connects to brown bear habitat in Afghanistan towards the west (Nawaz, 2007), GB in the east, and a narrow strip of the Wakhan Corridor separating Chitral from Tajikistan in the North (AASA, 2015). Brown bear presence has been reported from several localities in Chitral, including Trich Mir Valley (Schaller, 1977), Torkhow Valley and Yarkhun Valley (Fulton, 1903; Schaller, 1977; Nawaz, 2007). However, the species is rare in the Hindu Kush Range (Nawaz, 2007) and extirpated from a large part of Chitral district. For example, it has been wiped out from Chitral Gol National Park and surrounding areas (Mirza, 2003).

Growing human population, expanding infrastructure, loss of habitat, increasing number of domestic animals, declines in food supply, climate change and increasing human dependence on natural resources are the primary reasons contributing to a persistent decline in brown bear population in Pakistan. Unmanaged and growing tourism also contributes to population decline (Nawaz, 2007) by exposing pristine habitats to human movement, hoteling, camping, and littering. Other threats include killing bears

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for their organs for regional or international trade in medicine, shooting out of excitement people consider them harmful (Sheikh and Molur, 2003) and capturing cubs to train for dancing and even bear-baiting (Roberts, 1997). These threats exist throughout its distribution range in all three administrative divisions. The brown bear in Pakistan is, therefore, a Critically Endangered species in the Red List of Pakistan Mammals (Sheikh and Molur, 2003) even though globally it is considered as least concern.

Human carnivore conflict is a serious problem worldwide, and a primary driver of carnivore population declines (Woodroffe *et al.*, 2005; Broekhuis *et al.*, 2017). Various large carnivore species' tiger (*Panthera tigris*), Mexican wolf (*Canis lupus baileyi*) and African lion (*Panthera leo*) populations are decreasing due to such conflict (Michalski *et al.*, 2006). Worldwide, human-carnivore conflict increases with the expansion of human populations (Woodroffe, 2000; Naughton-Treves *et al.*, 2003), a dynamic that often results in local carnivore extinctions (Woodroffe, 2000). Human-carnivore conflict is complex and difficult to handle because of many factors including, livestock depredation and associated economic losses, religious values, and the monetary value of wild animals' bones and body parts (Dickman, 2010).

Large carnivores constitute a naturally rare, ecologically important, and increasingly threatened group of mammals (Estes *et al.*, 2011; Ripple *et al.*, 2014) that provide emotional, recreational, and cultural benefits to society (Kellert *et al.*, 1996). Facilitating coexistence between humans and carnivores is a global conservation and management challenge (Treves *et al.*, 2006; Dickman *et al.*, 2011). The complexity in resolving human-wildlife conflict arises from the presence of multi-predator systems mitigation strategies tend to be species-specific. Documenting the nature and distribution of such conflicts is an important step towards ensuring that subsequent management and mitigation efforts are appropriately targeted (Morehouse and Boyce, 2017).

Conflict between humans and bears has drawn less attention than that of other large carnivores like felids (Macdonald *et al.*, 2011) and canids (Macdonald and Sillero-Zubiri, 2004). Human-brown bear conflict occurs as a result of crop and beehive damage, livestock depredation, and even human injuries and death and a subsequent diminishing public tolerance for bears (Rigg *et al.*, 2011; Qashqaei *et al.*, 2014; Can *et al.*, 2014). Human-brown bear conflicts are increasing in areas where bears are expanding into private lands bordering their areas of occurrence e.g. national parks, posing a threat to livestock and people.

Pastoral communities living near large carnivores tend to fall in the lowest income categories. Having to bear

significant economic losses, people have a low tolerance for carnivores, their conservation, and the conservation of non-conflict species (Linkie *et al.*, 2007). People's responses depend on tolerance levels (Frank *et al.*, 2005) and they may resort to direct action using poison, hunting, or shooting.

Human-brown bear conflict is a significant issue in northern Pakistan, but there are very few studies describing such conflict despite wide prevalence. In Chitral district, for instance, no study has ever been conducted to gain an understanding of the nature and magnitude of human-bear conflict (or other human-carnivore connection) and develop suitable conservation plans. Brown bears have been reported in Chitral (Roberts, 1997; Nawaz, 2007), but there have been no recorded scientific studies reported from Chitral to confirm occurrence, distribution, population trends and magnitude of conflict with humans as the area is remote and logistically challenging. This study was carried out in five valleys of Chitral district with two main objectives, i) updating brown bear distribution in the area and ii) evaluating the nature of human-brown bear conflict and the perceptions of local people. Alongside human bear conflict, we also documented human interaction with other carnivores of the study area.

## MATERIALS AND METHODS

### *Study area*

The study area is located in Chitral Valley which provides ideal growing conditions for at least 64 endemic plant species, 45 mammalian species, 195 bird species and 28 reptilian species (NWFP and IUCN Pakistan, 2004). The study area was selected based on the brown bear's potential distribution range in Chitral district and was divided into five blocks based on major watersheds viz., Chitral Gol National Park (CGNP) and surrounding areas (Tooshi Game Reserve (TGR), Koghozi Gol and Gaherate Gol), Mastuj Valley, Yarkhun Valley, Laspur Valley, and Torkhow Valley, covering an area of more than 2504.11 km<sup>2</sup> (Fig. 1). The weather in the study area is extremely harsh and cold in the winter but pleasant in the summer. Average summer temperatures range from 25 to 40°C but drop below 0°C in winter. The study area is outside the monsoon range and receives very little rainfall during summer. Winter precipitation occurs in the form of snow (Shah *et al.*, 2013). The topography is represented by highly rugged and steep mountains that provide habitat for large numbers of flora and fauna. Dominant plant species include *Quercus baloot*, *Pinus gerardiana*, *Juniperus excelsa*, *Juniperus communis*, *Betula utilis*, *Salix* spp., *Populus* spp., *Ephedra* spp., *Abies pindrow*, *Picea smithiana*, *Viburnum* spp., *Tamarix* spp., *Rosa webbiana*, *Ephedra* spp. and *Artemisia*

spp. (MACP, 2001). Mammalian species found in the study area are snow leopard (*Panthera uncia*), common leopard (*Panthera pardus*), Himalayan lynx (*Felis lynx isabellinus*), leopard cat (*Prionailurus bengalensis*), grey wolf (*Canis lupus*), red fox (*Vulpes vulpes*), Asiatic jackal (*Canis aureus*), Asiatic black bear (*Ursus thibetanus*), brown bear, stone marten (*Martes foina*), Kashmir flare-horned markhor (*Capra falconeri falconeri*), Siberian ibex (*Capra ibex sibirica*), Ladakh urial (*Ovis vignei vignei*), and the long-tailed marmot (*Marmota caudata*).

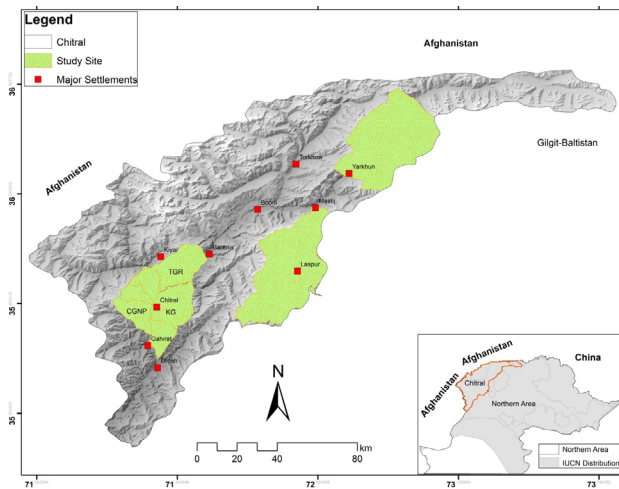


Fig. 1. Study area map.

#### Survey techniques

Multiple survey techniques were used during the period 2008–2010 to determine the brown bear's status and its conflict with locals in the study area.

#### Questionnaire surveys

Human-carnivore conflict surveys were carried out in communities in Laspur Valley, Torkhow Valley, Yarkhun Valley, and Mastuj Valley during the period 2009–2010. Some 169 local people were interviewed about human-carnivore conflict (Table I). The largest number (60) was interviewed in Mastuj Valley followed by 59 from three villages (Raman, Balim and Sor Laspur) in Laspur Valley, 37 from Rech and Ujnu villages in Torkhow Valley, and 13 in Yarkhun Valley (various villages).

Heads of households/adults were interviewed to gather information about the presence of brown bear and other carnivores, sightings, livestock depredation by carnivores, and perceptions about brown bear and other carnivores over the past five years (2005–2009). Questionnaire-based sighting reports were used to determine the presence-absence and human conflict between brown bears and other carnivores in the study area.

#### Sign surveys

Sign surveys were conducted in potential brown bear habitat in Chitral. Seven sign surveys were conducted in six different areas of Chitral during the period September 2008–July 2010. They were conducted in three study blocks CGNP and its surroundings (TGR, Koghozi Gol and Gaerate Gol), Laspur Valley and Yarkhun Valley (Table I). In Yarkhun Valley, the sign surveys were carried out in 2010, while in Laspur Valley, sign surveys were conducted in both 2009 and 2010. Only Bashqar Gol was surveyed in the 2009 survey while the Phargram Gol, Bashqar Gol, and Shandur areas of the valleys were surveyed in 2010. Random points were selected in the study area and a line transect of unequal length was walked at each sampling site. A total of 97 transects of 79.1 km were walked at different sampling sites (Table I). The average length of the transect was 0.82 km and the length of the transect depended on topography and habitat type.

Information like GPS position, location, date, elevation and observer name were noted on transect survey forms at the starting point of each transect. Transects were walked slowly, searching for signs of brown bear on either side of the transect route. Whenever a sign was found, information like its location on GPS, type of sign (old or fresh) and substrate type was noted. Signs of other mammalian carnivore species found in the areas were also recorded. The above-mentioned information was noted on the survey form at the end point. Information about dominant topography of transect, primary habitat type, grazing status, ruggedness and overall aspect of the transect were also recorded.

#### Camera trapping

Camera trapping is being used increasingly for the conservation and monitoring of elusive and rare wildlife species (Jackson *et al.*, 2006). It is extensively used to investigate the abundance, density, diversity and habitat utilization of wildlife species (Soisalo and Cavalcanti, 2006). Camera trapping studies were conducted in different areas of Chitral district from September 2008 to July 2010 with the aim of obtaining a brown bear photo-capture record. The study area included CGNP, TGR, Laspur Valley and Yarkhun Valley (Table I). A total of 134 motion-triggered cameras (6 Reconyx, 128 Cam Trakker™ Ranger, Watkinsville, GA, USA) were installed for 164 days at different locations of the study area. Cameras were placed in rock piles or on metal poles approximately 45–50cm above the ground.

Camera traps were positioned along possible carnivore travelling routes, including sharp ridgelines, near scrapes, cliff bases, rock faces, and along animal trails and paths to maximize capture success. The camera

direction was either faced directly up or down to anticipate travel in order to obtain close-up photographs of the face for quick identification. They generally faced north or south to avoid direct sunlight (Ahmad *et al.*, 2016). All vegetation in front of cameras was removed to avoid false triggers. Cameras and infrared sensors were concealed and covered to protect against the weather (Jackson *et al.*, 2006). This system can be set for delays of 20 seconds to 45 minutes between pictures, and for day, night, or continuous operation. All camera batteries and memory cards were checked and replaced as needed. The number of trap-days was calculated for each camera location from the time of mounting to the time of retrieval (Johnson *et al.*, 2006).

## RESULTS

### *Distribution pattern*

Questionnaire surveys and sign surveys in different valleys of Chitral district confirmed brown bear presence in the eastern part of Chitral district, only. Surveys conducted in CGNP and surrounding areas (TGR, Gaherate Gol and Koghozi Gol) did not provide any evidence of species occurrence in recent years. Based on a questionnaire survey, only a single individual reported brown bear presence in Torkhow Valley. However, questionnaire surveys and sign surveys conducted in the other two study blocks Laspur Valley and Yarkhun Valley (Broghil) provided strong evidence of presence (Table II).

**Table I. Summary of data collected using multiple methods in Chitral district, 2008–2010.**

| <b>Questionnaire Survey</b> |                |                  |         |                            |                           |
|-----------------------------|----------------|------------------|---------|----------------------------|---------------------------|
| S. No.                      | Study area     | No. of household | Year    | -                          | -                         |
| 1                           | Laspur Valley  | 59               | 2009–10 | -                          | -                         |
| 2                           | Torkhow Valley | 37               | 2009    | -                          | -                         |
| 3                           | Yarkhun Valley | 13               | 2009    | -                          | -                         |
| 4                           | Mastuj Valley  | 60               | 2009–10 | -                          | -                         |
| Total                       | 4              | 169              |         | -                          | -                         |
| <b>Sign survey</b>          |                |                  |         |                            |                           |
| S. No                       | Study area     | Study site       | Year    | Total transect length (km) | Mean transect length (km) |
| 1                           | CGNP           | 21               | 2008–09 | 18.76                      | 0.89                      |
| 2                           | TGR            | 6                | 2008–09 | 5.09                       | 0.84                      |
| 3                           | Koghozi Gol    | 8                | 2008–09 | 7.39                       | 0.92                      |
| 4                           | Gahirait Gol   | 8                | 2008–09 | 10.38                      | 1.29                      |
| 5                           | Laspur Valley  | 32               | 2010    | 19                         | 0.59                      |
| 6                           | Laspur Valley  | 9                | 2009    | 8.06                       | 0.89                      |
| 7                           | Yarkhun Valley | 13               | 2010    | 10.54                      | 0.81                      |
| Total                       | 7              | 105              |         | 79.22                      | 0.89                      |
| <b>Camera trapping</b>      |                |                  |         |                            |                           |
| S. No.                      | Study area     | Study site       | Year    | Installed camera duration  | Study duration            |
| 1                           | CGNP           | 40               | 2008    | 56                         | Sep–Oct 2008              |
| 2                           | CGNP           | 20               | 2009    | 28                         | Oct–Nov 2009              |
| 3                           | TGR            | 20               | 2009    | 28                         | Apr-09                    |
| 4                           | TGR            | 20               | 2009    | 28                         | Dec-09                    |
| 5                           | Laspur Valley  | 20               | 2010    | 30                         | May 24–June 22, 2010      |
| 6                           | Yarkhun Valley | 14               | 2010    | 14                         | Jul-10                    |
| Total                       | 6              | 134              |         | 184                        |                           |



**Table II. Evidence of brown bear presence in different valleys of the study area based on different types of survey techniques used in different parts of the study area, 2008–2010.**

| Study site                  | Type of survey       | Date and duration      | Evidence of the brown bear presence                  |
|-----------------------------|----------------------|------------------------|--|
| Yarkhun valley              | Questionnaire survey | July 2010, 1 month     | 5 sightings  |
| Laspur valley               | Questionnaire survey | 2009–2010, 1 year      | 17 sightings   |
| Torkhow valley              | Questionnaire survey | July 2009, 3 months    | One sighting from the northern part of the valley    |
| Yarkhun valley              | Sign survey          | July 2010, 10 days     | Four scats, pugmarks, and one sighting               |
| Laspur valley               | Sign survey          | May–June 2010, 1 month | Four scats, fresh tracks, pugmarks, and one sighting |
| Laspur valley (Bashqar Gol) | Sign survey          | August 2009            | One old scat   |

**Table III. Economic loss [USD (number killed)] due to livestock depredation in Laspur and Broghil valleys, Chitral District, Pakistan, during 2005–2009.**

| Livestock       | Snow leopard | Wolf         | Lynx       | Unknown predators | Total economic loss |
|-----------------|--------------|--------------|------------|-------------------|---------------------|
| Goat            | 316 (9)      | 4,985 (142)  | 948 (27)   | 211 (6)           | 6,460               |
| Sheep           | 386 (11)     | 5,336 (152)  | 491 (14)   | -                 | 6,213               |
| Cattle          | 7,372 (30)   | 10,812 (44)  | -          | 3,440 (14)        | 21,624              |
| Total loss      | 8,074 (50)   | 21,133 (338) | 1,439 (41) | 3,651 (20)        | 34,297 (449)        |
| Average loss/HH | 84           | 220          | 15         | 38                | 357                 |

The numbers in parenthesis represent the number of livestock killed, PKR 85.46 = 1 USD, the exchange rate of PKR to USD pertains to 2005–2009 (Average).

#### Status in Laspur valley

Based on questionnaire surveys in Laspur Valley, about 29% (17) of local people confirmed brown bear sightings in the valley (Table II). These sighting reports were accompanied by sightings of cubs which was a sign of animal reproductive activity in the area.

Based on public sighting reports, two sign surveys were conducted at different sites of Laspur Valley to confirm brown bear presence. A sign survey was conducted in one sub-valley (Bashqar Gol) of Laspur Valley in August 2009. Line transects of unequal length were walked and brown bear signs were searched along the transects. Only one old brown bear scat was observed along a total of nine transects (8.06 km). Average length of the transect walked in Bashqar Gol during 2009 was 0.89 km (Table I).

A second sign survey was conducted in June 2010 in Bashqar Gol along with two more sub-valleys (Phargram Gol and Shandur) to obtain more information about brown bears in the area. Eight transects were walked in Bashqar Gol, but only one fresh brown bear scat was observed in the area (Fig. 2a). Moreover, a brown bear was observed in the area through direct sighting (Fig. 2b). No signs of brown bear were observed in eight transects (average length=0.59 km) in Phargram Gol (Table I).

The third study site in Laspur Valley was Shandur where sign surveys were conducted in June 2010. Sixteen

transects with an average length of 0.59 km were walked (Table I) and four scats (both fresh and old), two fresh tracks, and pugmarks of the brown bear were observed (Fig. 2c and 2d). Local people recorded a mobile phone video of brown bears visiting garbage sites in Laspur Valley and the Shandur Plateau in 2019.



Fig. 2. Photographs from field survey.

### *Status in Yarkhun valley*

About 39% of local people (5) of Yarkhun Valley reported brown bear sightings in the past five years (Table II). Sign surveys were conducted in Yarkhun Valley (Broghil) to confirm the public sighting reports. However, logistical constraints and poor weather did not allow us to conduct large-scale surveys the presence was however, confirmed. The sign surveys revealed four scats (both fresh and old) and some fresh pugmarks of the brown bear. Brown bear were also observed through direct sighting in Broghil which supported local people's claims.

Many camera trapping studies were also carried out in all our study blocks except Torkhow Valley; however, no brown bear was photo-captured.

### *Human-carnivore conflict*

#### *Livestock depredation and economic evaluation*

Ninety-six respondents 59 in Laspur Valley and 37 in Broghil Valley reported 449 livestock losses (90 heads per year) to carnivore species in the area during the five-year period (2005–2009). The grey wolf was held responsible for 338 losses (68 heads per year/75%) while the snow leopard and lynx were blamed for 50 (10 heads per year/11%) and 41 (8 heads per year/9%), respectively. Respondents blamed 20 (4 heads per year/4%) losses on unknown predators. No brown bear-related livestock loss was reported (Fig. 3). The most favorable prey species for grey wolves were sheep (45%), goat (42%), and cattle (13%). Snow leopard's prey species consisted of cattle (60%), sheep (22%), and goat (18%). Lynx prey species were goat (66%) and sheep (34%).

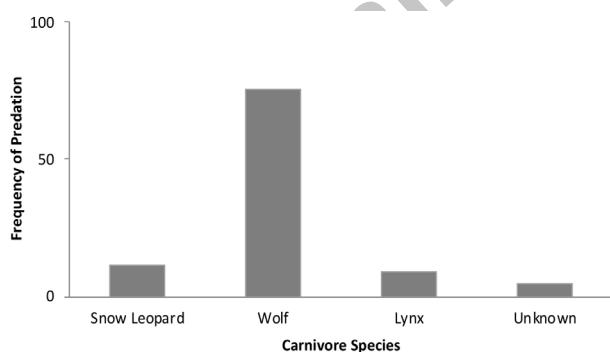


Fig. 3. Livestock killed by carnivores in Laspur and Broghil valleys during 2005–2010.

The reported figure of 449 livestock losses in two valleys constituted an economic loss of PKR 2,931,022 or USD 34,297 (PKR 30,531/USD 357 per household). Of the total loss, grey wolves were blamed for USD 21,133 (USD 220 per household in five years) while snow

leopards and lynx were held responsible for a loss of USD 8,074 (USD 84 per household) and USD 1,439 (USD 15 per household), respectively. A significant amount was also caused by unknown predators (Table III).

#### *Local people's perceptions about carnivores*

People were asked about their perceptions of brown bears and other large carnivores during the questionnaire surveys. Perceptions were categorized into four groups increase, maintain (positive view), decrease and eliminate (negative view).

In the study area, about 30% of respondents wanted to increase the brown bear population, 17% wanted to maintain its current population status, 2% wanted to decrease it, and 13% wanted complete elimination from the area. Other respondents (39%) did not state a preference. A significant number (49%) wanted an increase in the numbers of snow leopards in the area. Greater percentages (53%) of local people possessed negative perceptions about the grey wolf and wanted a decrease in numbers or complete elimination from the area (Fig. 4).

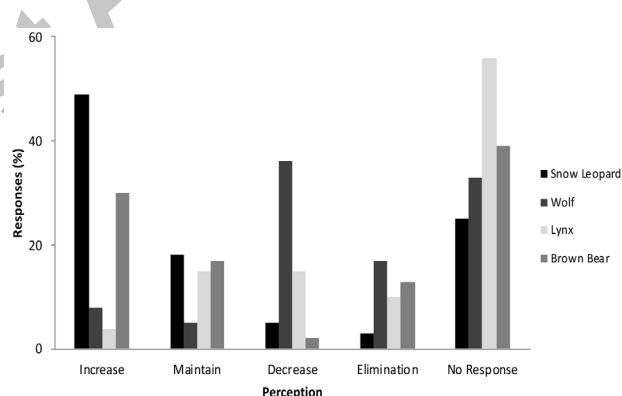


Fig. 4. Public perceptions on carnivores' existence in Laspur and Broghil valleys during questionnaire surveys conducted in 2009–2010.

#### *Public attitude towards carnivores*

The perceived danger of carnivores for livestock was categorized into four levels (1–4) depending on the intensity of danger perceived by local people. Category 1 was assigned to the most dangerous carnivore and category 4 to the least. Communities were asked to rank four carnivore species snow leopard, wolf, lynx and brown bear by their perceived level of danger. A large number of local people (85%) considered brown bears to be the least dangerous animal in the area followed by lynx (73%) and snow leopard (44%). A greater percentage (56%) considered the wolf as the most dangerous carnivore species for livestock (Fig. 5).

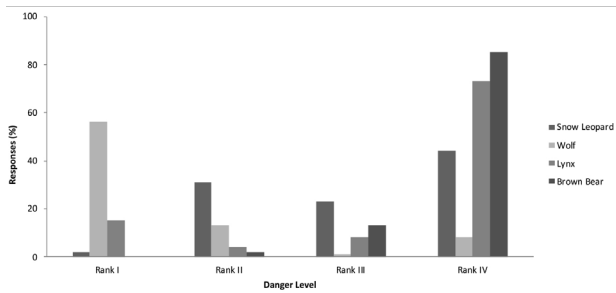


Fig. 5. Community perceptions on threats from carnivores in Laspur and Broghil valleys during questionnaire surveys conducted in 2009–2010.

## DISCUSSION

Brown bear presence in the western part of its distribution range has been claimed in the past (Roberts, 1997; Nawaz, 2007). Multiple techniques questionnaire surveys, sign surveys, and camera trapping surveys were used during this study to obtain reliable information about the target species. Surveys were also conducted in areas where species was believed to be extinct like CGNP (Schaller, 1977; Mirza, 2003) and its surrounding areas. Only sign surveys and camera trapping methods were used in these areas to obtain solid evidence about presence, but none could be found.

Parts of Chitral district where brown bear presence had been claimed in the past included Torkhow Valley, Yarkhun Valley (Fulton, 1903; Schaller, 1977) and the border area between KP and GB (Nawaz, 2007). Questionnaire surveys in Torkhow Valley did not reveal any strong evidence of brown bears only one respondent claimed a sighting of a Himalayan brown bear which could not be confirmed through sign surveys. Public sightings in Yarkhun Valley (Broghil) were confirmed by sign surveys and direct sightings. Himalayan brown bear presence in Laspur Valley bordering the Chitral district of KP with GB on one side and Swat district on the other as previously claimed by Nawaz (2007) was also confirmed by questionnaire surveys, sign surveys, and direct sightings.

The presence of the brown bear in two of our four study blocks Yarkhun Valley and Laspur Valley was confirmed by questionnaire surveys and sign surveys, but not by camera trapping. Camera trapping in Yarkhun Valley (Broghil) was short-termed and could not be extended due to poor weather and floods in the valley. However, one specimen in Laspur Valley arrived at a camera station and pulled the camera out of the ground.

Increased livestock depredation by large carnivores in the Himalayas and Hindu Kush mountains has been attributed to increasing livestock populations (Hussain,

2003). The 96 respondents of the Yarkhun and Laspur valleys reported 449 livestock losses (90 per year) between 2005 to 2009. Grey wolves account for the highest predation followed by Snow leopard, lynx, and unknown predators. The Himalayan brown bear did not account for any livestock depredation due to two possible reasons; (1) due to its rarity in the study area as shown by our results, (2) Himalayan brown bear is predominantly vegetarian, and study conducted by Nawaz *et al.* (2019) in Deosai National Park shows that 70% of analyzed scats were composed of plant residue with very low dietary meat. Our study shows that carnivores prefer goats and sheep to cattle. This is due primarily to the significantly higher number of goats and sheep in the area as compared to other livestock. In addition, goats and sheep are more vulnerable to predation because larger-sized carnivores can drag them to safe places (Kabir *et al.*, 2014; Ahmad *et al.*, 2016; Rehman *et al.*, 2020). Another study in Chitral reported annual livestock losses of 27 (Din and Nawaz, 2010) and 261 (Din *et al.*, 2013). The highest depredation of livestock in the study area can be attributed to thin natural prey and the presence of multiple large-sized carnivore species.

The reported figure of 449 livestock losses in two valleys constituted an economic loss of USD 34,297 or PKR 2,931,022 (PKR 30,531 or USD 357 per household). The grey wolf was a major culprit in both valleys of the study area. The major economic loss reported by local people was in the form of cattle depredation, although a smaller number of cattle were killed by carnivores as compared to goats and sheep but the market value of cattle is much higher than that of goats and sheep.

Human-carnivore conflict can be particularly controversial when the resources concerned have economic value (livestock) and the predators involved have a high conservation profile (Graham *et al.*, 2005). Attitudes are commonly seen as people's evaluation of some object or animal (e.g., carnivore) that range from positive to negative (Ajzen, 2001). For example, attitudes towards carnivores can be positive when they are associated with tourist revenue (Dickman *et al.*, 2011), but negative when carnivores are perceived as threats to livestock or human life (Dickman, 2008). Community perception about brown bears in our study is very positive and most people wanted to increase or maintain populations. It was also found that there was no direct conflict between people and the Brown bear. Brown bears did not account for any livestock losses in the reported period a strong reason for local people's positive perceptions. Still, a small percentage (13%) of local people said they wanted to eliminate the species from the area, which may be due to its large size, which can frighten people.

A large percentage of local people also possess

a positive perception of snow leopards despite heavy livestock losses because it is seen as a sign of bravery and beauty children are often named after the snow leopard in this region (Ahmad *et al.*, 2016). On the other hand, most of local people have highly negative perceptions about grey wolf and lynx and wanted to decrease their numbers or completely eliminate them from the area (due to large economic losses). The likely reason for negative perception about lynx is due it threatens to poultry which is one of the major source of livelihood for these local communities, although no incidents of lynx predated on poultry was reported in this study. Similarly, a low percentage of locals possess negative perception about brown bear owing to the fear of crop damage which result huge economic loss (Ahmad *et al.*, 2016) but no crop damage was reported in this study.

### CONCLUSION

Our study concludes that within the study area, the Himalayan brown bear is present only in Yarkhun and Laspur valleys, and probably lives in a small population. This marks a drastic reduction in historically reported range in the Hindu Kush. The species no longer exists in the western and southern parts of the district and appears to be confined to eastern valleys adjacent to GB where brown bear lives in several valleys. The Yarkhun Valley is connected to the Wakhan corridor in Afghanistan to the north-west where brown bears do exist. Thus, remaining brown bear populations maintain connectivity with other populations towards the north-east of GB. The absence of brown bear from the rest of Chitral district is likely due to the unsuitable terrain in the south-western Chitral which has steeper topography and small patches of alpine plateaus which is considered suitable habitat for brown bear. Furthermore, human densities which have increased in the past few decades in these areas have increased the pressure on natural habitats. Climate change is also a factor and southern areas are getting warmer. For example, snow leopard population has declined in southern Chitral and common leopards from the south are occupying these areas. Finally, historical information from some of these areas is no longer considered accurate.

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### Statement of conflict of interest

The authors have declared no conflict of interest.

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