Online ISSN: 2588-3526

Journal of Wildlife and Biodiversity

Volume 7 (1): 40-54 (2023) (http://www.wildlife-biodiversity.com/)

Review Article

Conservation strategies and human conflicts with Snow Leopard in Pakistan: A review

Roheela Yasmeen*, Irfan Aslam

Department of Biology, Lahore Garrison University, Sector C, Phase VI, DHA Lahore Pakistan
*Email: roheelayasmeen@lgu.edu.pk

Received: 15 June 2022 / Revised: 03 July 2022 / Accepted: 05 July 2022 / Published online: 05 July 2022. Ministry of Sciences, Research, and Technology, Arak University, Iran.

How to cite: Yasmeen, Y., Aslam, I. (2023). Conservation strategies and human conflicts with Snow Leopard in Pakistan: A review. Journal of Wildlife and Biodiversity, 7 (1), 40 -54. **DOI:** https://doi.org/10.5281/zenodo.6803386

Abstract

Snow leopards (*Panthera uncia*) are documented in the higher altitudes of South Asia. The snow leopard is recognized as showcase species in Pakistan. The snow leopard has been delegated a fundamentally imperilled species in Pakistan by the IUCN. It is vanishing from various areas of its immense assortment of habitats in Asia. The snow leopard lives in elevated zones, preferring mountainous edges, gorges, cliffs, and rough outthrust as its habitat. *P. uncia* has also been recorded in more rolling terrain and grassy areas. In Pakistan, the *P. uncia* occupies relatively parched, elevated districts which include Swat, Dir, Kohistan, and the Chitral territory of Khyber Pakhtunkhwa, Gilgit Baltistan, and Neelam Valley. The fundamental threat to snow leopards is unlawful to trade in leopards, particularly skins, conflict with residents, as well as the absence of protection laws, the capacity to enforce rules, and lack of information. Different hazards include territory trouble, habitat deterioration, abatement of prey, exponential human masses development rate, mining, and neediness of the locals. Many networks are working in Pakistan for the conservation of this species, the main purpose of this review was to highlight the feeding preferences, the effect of climate on this important species, and the area of conflict between humans and snow leopards. The purpose of this review article was to highlight the conflicts with humans and also recommend conservation strategies.

Keywords: Habitat deterioration, human-wildlife conflicts, conservation

Introduction

Panthera uncia is considered a decisively endangered species in Pakistan declared by the IUCN (2010) that is vanishing from numerous pieces of its habitat in Asia (McCarthy and Chapron, 2003, 2003; Mahmood et al., 2019). This species is intuitive to mountain ranges and presents at the altitude of 3000- 4500 m. It was widely distributed in the past with a distribution range of 10.47 million km^2 but presently its range has been reduced to 3.20 million km^2 (Mahmood et al., 2019). The chronological range of *P. uncia* is confined to the zones in the Altay, Tien, Pamir, Shan, Kun Lun, Hindu Kush, Karakoram, Himalaya ranges, and upland of central Asian countries (Hussain, 2003). The legitimate status of the species is to a great extent obscure and there may be up to 4,000-6,500 snow leopards in its diversified habitat (McCarthy and Chapron, 2003). In Pakistan, the *P.uncia* occupies relatively parched elevated districts which include Swat, Dir, Kohistan, and Chitral territory of Khyber Pakhtunkhwa (KPK), Gilgit Baltistan (GB) regions of Northern Areas, and Neelam Valley (Malik, 1995). Snow leopards are also scantily present in the northern disconnected mountain valleys of the Chitral district (Schaller, 1977). The snow leopard has a wide coverage of the territory of up to 1,000 kilometers square (McCarthy, 2000). The species has a notable status universally and is treated as a showcase species of the tremendous environment of the greater Himalayas (Alexander et al., 2016). Pakistan's evaluated *P. uncia* natural surroundings are roughly 80,000 kilometers square of which about half is viewed as prime territory (Hameed et al., 2020). As indicated by (McCarthy et al., 2017) *Panthera uncia* is considered vulnerable in light of the fact that the worldwide population is noted as more than 2,500 snow leopards. Pakistan has the world's 3rd biggest population of *P. uncia*, whilst in Pakistan; the biggest population is in GB (Hussain, 2003). GB has the two biggest National Parks, Khunjerab National Park (KNP), and Central Karakoram National Park; both Parks have living spaces for the species. It is expected that the Karakoram Mountain is essential to moderate the hereditary decent variety of the snow leopard (Fox, 2008). Mahmood et al. (2019) reported that out of a total of 7209 only 719 terrestrial protected areas of Asia have this species in the past whereas, in the present day, only 311 protected areas support this species.

Prey preferences and food of the Snow leopard

Snow leopards have been documented to prey on mountainous ungulates and domestic animals, they additionally also feed on small size mammals and different game birds (Roberts, 1977; Schaller, 1977). *Panthera uncia* is considered as flagship species in the mountainous region of the

Asian continent (Schaller, 1976). They are top-ranked carnivores, so their occurrence and endurance are an additional point of landmark for integral and vigorous ecological zones (Jackson, 1996). Preservation of vital prey species for the snow leopard is decisive in favor of the endurance of the snow leopard (Hayward et al., 2006). Almost 20% of the *P. uncia* population decrease over the recent two decades is due to a decrease in its prey asset base. The greater part of the *P. uncia* varies with regions that have been overloaded with prey populations (Bagchi and Mishra, 2006). In these areas, there has been a decline in wild prey availability due to competition for resources with domestic ungulates. In some areas, the disease has further caused a rapid decline of wild prey (Mccarthy and Chapron, 2003). The effects of such losses contribute to the direct decline of snow leopards, as carrying capacity diminishes, and increased predation of domestic livestock by snow leopards, elevating conflict and retaliatory killing by pastoralists (Bagchi and Mishra, 2006). Livestock depredation in such cases can also be substantial, varying from 2% to 10%. Snow leopards are elusive predators whose key habitats are alpine regions within altitudes of 900–4500 m (Bagchi and Mishra, 2006; Sangay and Vernes, 2008). As they are difficult to observe and follow, there is a dearth of published information on the snow leopard diet, as well as other aspects of its ecology, in comparison to other charismatic large carnivores (Shahzad et al., 2012). Hence fecal or scat analysis and diet profiles that offer insights into the predatory behavior of a species, also generate reliable assessments of levels of conflict due to livestock depredation if present (Suryawanshi, 2013). A single snow leopard requires 1.5 kg of meat per day (Schaller, 1977). In general, their most commonly taken prey at individual sites consists of wild sheep and goats (blue sheep (*Pseudois nayaur*), Siberian ibex (*Capra sibirica*), Markhor (*Capra falconeri*), and argali (*Ovis ammon*), but their diet can also include pikas, hares, and game birds (Chukar partridge (*Alectoris chukar*) and Snowcock (*Tetraogallus spp*). In predation ecology, searching and pursuing time for prey are key factors that influence foraging strategies. Thus, a predator chooses a foraging area and prey species, to minimize the sum of these two factors. Studies have shown the local dietary requirements of the snow leopard; however, these studies describe site-specific food habits of the species that are heavily influenced by available prey, hence an overview of food habits throughout the snow leopard's distribution is timely to identify the preferences in the snow leopard's diet concerning prey type and size across varied landscapes (Roberts, 1977; Anwar et al., 2011).

Prey species of snow leopard

Bharal or Blue Sheep *(P. nayar)*

Blue sheep are present across the South Asian countries, exceeding into the Karakoram array in the Shimshal Valley of the Northern areas of Pakistan. Occasionally snow leopards prey upon blue sheep in Pakistan to fulfill their diet requirements (Schaller, 1977).

Markhor *(Capra falconeri)*

Capra falconeri has a comparatively restricted distribution in Asia. It is present in northern Pakistan and also observed from Baluchistan (Pakistan), present exterior to *Panthera uncia* range (Shackleton, 1997). *Capra falconeri* inhabits altitudes between 600 meters and 3600 meters above the tree line. Such species are present in scrub forests made up primarily of (*Pinus gerardiana*), oak (*Quercus ilex*), pine, and juniper (*Juniperus macropoda*) (Roberts, 1977; Schaller, 1977). The boundary with *P. uncia* is fewer than among the other species, but markhor may symbolize significant prey specie in Gilgit and Chitral (Roberts, 1977; Schaller, 1977).

Musk Deer (*Moschus spp*)

There are six species found transversely in various parts of the Snow leopard habitat. Every species is mostly found in subalpine scrub dwelling and forest alpine areas so territory beyond the *P. uncia* is to some level restricted. Musk deer are presented in the alpine to sub-alpine forests and low scrub at a height of 2,200-4,300m in the southern hills of the Himalayan region. Musk deer are preyed upon by snow leopards in Northern areas of Pakistan (Roberts, 1977).

Livestock Predation by Snow leopard

Snow leopards prey upon domestic animals occasionally, (cattle and yak-cattle hybrids, horses, camels, dogs, sheep and goats, yaks) and have been documented in the majority of leopard's range. The number of domestic animals killed by snow leopards varies from 1 to 30% (Jumbay-Uulu et al., 2014) in some instances it reaches up to 70% where conflict reaches to maximum between locals and snow leopards (Bagchi and Mishra, 2006; Shehzad et al., 2012; Wegge et al., 2012). The frequency of predation by snow leopards on domestic animals depends on several aspects, which include the presence of other prey species, the pattern of the season, topography, herding, and guarding applications. Snow leopards kill domestic animals in open pastures but sometimes enter houses and kill goats and sheep (Sunquist and Sunquist, 2002). These "additional carnage" incidents cause serious financial strain and significant damage to local herder's livelihoods.

Human conflict with Snow Leopard

Natural life is a valuable asset of the biological system, which is in question, especially by virtue of anthropogenic exercises (Bagchi and Mishra, 2006; Manferdo, 2008). Humans-conflicts with wildlife take place when the necessities and supplementary conduct of people sway wildlife adversely (Madden, 2004; Dar et al., 2009; Chattha et al., 2013). Snow leopards are compelled to live near people and they need to seek space and prey species (Bhatia et al., 2013: Partasasmita et al., 2016). Today, the conflict between humans and wildlife is emerging as a major challenge in the arena of conservation biology (Farrington et al., 2019). Human-wildlife conflict is a noteworthy issue to be considered for the administration and affects human needs (Ahmad and Javed, 2007; Shehzad et al., 2015; Naha et al., 2018). Human exercises are accounted for to discourage carnivore populations through direct discrimination (Cardillo et al., 2004; Inskip and Zimmermann, 2009; Winterbathc et al., 2012,) the killing of its prey (Karanath et al., 2004), and thrashing of living spaces (Harihar et al., 2009). Few carnivores seem to adjust and even flourish in human tainted situations (Athreya et al., 2013; Odden et al., 2014; Bouyer et al., 2014) and carnivores might yet get profit by one another under explicit environment (Banerjee et al., 2013). Carnivores' population can persevere in spite of high human populaces when social resilience is high, clashes are overseen appropriately and protection arrangements are successfully executed (Linnell et al., 2001; Treves and Karanath, 2003; Karanath and Chellam, 2009). Snow leopard is in danger of extinction and facing diversified threats across its habitat (IUCN Red List, 2014). Enormous carnivores have significant effect on biological systems' wellbeing and exceptional modification in environments has been associated to carnivore reign (Miller et al., 2001).Immense increase in human population and subsequently domesticated animals possessions have brought about the decline of rangelands and reduction of hoofed animal population which mutually have encouraged killing of carnivores and domestic animals predation (Dsitefano, 2005). Consequently, significant intimidation was looked by the enormous carnivores which are human prompted and financially powered activities of humans (Woodroffe and Ginsberg, 1998). The endangered Snow leopard flourish in the distant and rough altitudes of Southern and Central Asia in close proximity to a huge number of domesticated animals possessed by the agriculture sector living beneath the paucity (Mishra et al., 2003). Examples of domesticated animals killed by *P.uncia* go back to the centuries. The snow leopard has allegedly caused domesticated animals' misfortunes of twelve percent of the livestock property traversing its range (Hussain, 2000; Nagail et al., 2007; Din et al., 2013). Domesticated

animal predation by *Panthera uncia* increments with the expansion in animals and feral prey populaces however the geographical and fleeting example of predation shifts inside and among countryside, also with nearby surroundings (Suryawanshi, 2013). Diet examinations uncover the extent of animal arrays from fifteen to seventy percent recurrence and sorts of domesticated animals' killings rely upon the socio-biological aspects (Bagchi and Mishra, 2006; Wegge et al., 2012; Jumbaby Uulu et al., 2014). The subtle environment, little thickness, scanty conveyance, and isolated and out-of-reach living space make *P. uncia* difficult to study, what's more, the accessible socio-environmental data originates from thin fixes over its range, for the most part, kept to secured regions (Snow leopard network, 2014). A significant origin of contention between authorities and locals in the Indian subcontinent spins around domesticated animals and yields harm inside their zones (Hussain, 2003; Kharel, 1997; Mishra, 1997). Snow leopards are now again accused of misfortune from different sources of mortality, for example, infection, utilization of harmful plants, and mishaps (Namgail et al., 2017). In Nepal, local inhabitants consider eliminating snow leopards as the only practical solution (Oli et al., 1993). As this issue develops, it is progressively essential to look for relief techniques that make supportable conjunction (Mishra et al., 2003). Carnivorous species such as the snow leopard are especially engaged with the struggle in view of their huge home ranges and taking care of necessities that for the most part covered by humans (Khorozyan et al., 2018; Redpath et al., 2013). The primary threat to snow leopards is an illegitimate exchange of body parts, struggle with local residents, as well as the absence of preservation rules, capacity to enforce laws, and information (Li and Lu, 2014). Different intimidations like incorporating natural surroundings misfortune, discontinuity, not having successful law authorization, a decline of prey population, exponential human population development and growth rate, poverty, street development, and hydroelectricity improvement (Advani, 2014; Forrest et al., 2012).

Conservation Strategies

Formerly, it has been attempted to re-establish *P. uncia* population by proclaiming a huge region as a natural protected area, however, such plans can't work without the contribution of the locals. Money-related plans remunerate an exceptionally limited quantity (three percent) when contrasted with setbacks acquired by the *P. uncia* (Bagchi and Mishra, 2006). So as to repay the herders' hardships and mellow their disposition towards the *P.uncia*, the Project Snow Leopard (PSL) under the Baltistan Wildlife Conservation and Development Organization (BWCDO) has started including the surrounding areas ranchers and the Ecotourism ventures of Gilgit Baltistan as a

protection scheme (Hussain, 2000). The Project Snow leopard is mutually supervised by the board of trustees of residents and project authorities. Due to the incident of *P. uncia* predation on domesticated animals, the town board of trustees and PSL authorities decide the measure of reimbursement to be given to the anxious owners. It might assist in the protection of Snow leopards in the territory. Another *P. uncia* safeguarding Program, together with the WWF-P and Snow Leopard Trust has declared the proximity of Snow leopard in the 12 gorges of the district Chitral managed by the Snow Leopard Trust and Snow Leopard Information Management System (SLIMS) (SLT, 2001-2007). A large number of hazards to this species and their environment showed landscape-level preservation methodologies must be built up that depend on solid data on species endurance prerequisites. A worldwide technique to defend snow leopards and the immense biological system they possess which incorporates twelve countries and supports one billion individuals have just been set up: The Global Snow Leopard Ecosystem Protection Program (GSLEP). Under the GSLEP activity, the choice of model scenes requires away from of territories that speak to the species' prime environment with the goal that preservation endeavors in the following decade can concentrate on making sure about regions that hold or can possibly hold a bigger population of snow leopards. Ongoing mechanical improvements like camera entrapping and molecular techniques take into consideration aggregate solid proximity records that could be utilized to develop practical species circulation dependent on exact information and progress scientific methodologies like MaxEnt.

Ongoing examination shows that forty percent of the one hundred seventy secured zones worldwide of the *Panthera uncia* are littler than the home extent of a solitary grown-up male and just thirteen percent is enough for a 90% likelihood of containing at least 15 mature females (Johanson et al., 2015). Moreover, it has been assessed that equal to thirty-three percent of the *Panthera uncia* recognized or prospective territory is found less than a hundred kilometers from the global outskirts of the 12 nations (Snow leopard network, 2014). The Global Snow Leopard and Ecosystem Protection Program (GSLEP) calls for advancing the trans-limit preservation plan to lessen threats to Snow leopards and related to the biological system (Snow leopard working secretariat, 2013).

Trophy Hunting

The initiative of trophy hunting as a preservative instrument was suggested in the 1970s by the late Major (retired) Amanullah Khan in Pakistan who observed reducing populations of big ungulates

in living spaces where they used to hunt their prey. The practice of trophy hunting started in the late 1970s in Pakistan. Trophy hunting programs, whenever structured and accomplished scientifically and properly, can give different financial and natural advantages by the local and worldwide ranks. Such methodology has flourished as an unsettled and burning subject in the world on account of its significant financial and environmental results (Lindsey et al., 2007; Angula et al., 2008; Naidoo et al., 2016). There have been numerous instances through which trophy hunting can produce wages for the locals (Woodford et al., 2004; Naedal et al., 2012) preservation benefits in certain nations and money-related help for representation of natural life in certain areas (Leader-Williams et al., 2005). Trophy hunting produces not have many advantages for the locals (Naidoo et al., 2016; Pasmans et al., 2017). Such income generated activity of trophy hunting program isn't conveyed appropriately to the society that serves in the preservation of trophy hunting animals (Harris et al., 2002; Nordbo et al., 2017). A usual issue with trophy hunting is the absence of checking of wildlife populations (Khan et al., 2016). Khunjerab National Park was recognized as a National Park in 1975 by the Government of Pakistan with a domain of 4455 kilometers square to protect Snow leopards in Northern areas of Pakistan. Khunjerab National Park is a combination of two unique regions. One of the vicinity is possessed by the locals of the Shimshal Community and named as Shimshal KNP and other is known as Khunjerab Village Organization and named as KVO's KNP (Mir et al., 2006; Khan et al., 2016). The Shimshal's community cover shielded ¾ of the Khunjerab National Park region, however isn't overseen appropriately with basically no looking after of the Khunjerab National Park. In Shimshal's KNP there is no road access and just restricted gutsy trekkers visit there. Trophy hunting was brought in the year 1993 into the specific area known as the Community Controlled Hunting Area present in the shielded region of KNP (Khattak et al., 2019). The purpose was to expand the population dimensions of prey animals including blue sheep (*Pseudois nayaur*), Ibex (*Capra sibirica*) and *Panthera uncia*, to create maintainable pay for the locals (Frost et al., 2008). A past investigation has indicated that the trophy hunting program has not assisted in varying doubtful discernment at odds with wildlife animals in a constructive manner (Sharma et al., 2015) the perceptions of the community about *P. uncia* were comparatively less negative to the wolves, perhaps because of protection projects or mindfulness bringing up in the network about *Panthera uncia*. Most of the local inhabitants see Snow leopard as their opponent. Such conflict between humans and *Panthera uncia* has expanded by means of the presentation of

trophy hunting programs, so it is time to review the applications of trophy hunting in Pakistan (Kachel et al., 2016).

Recommendations

1**.** Conservation activities are just conceivable with the proper data on wildlife and its living spaces. Wildlife living spaces essentially contain water resources, range, and food covers. So it is basic to gather information about the food environment of the Snow leopard

2. Society conservation measures focusing on *P.uncia*, its prey, and living spaces should be ecologically, monetarily, and publicly long-lasting and liable.

3. The approach on the faith that every contributor tries to help despite age, gender, or status, from the earliest starting point of protection applications, prompts successful plans that better guarantee ecological conduct.

4. The best approach to empower Snow leopards to endure isn't to make protected zones that seize them from the local inhabitants. It is proposed that support nearby herders rather so they can get by in spite of snow leopard attacks.

5. In Pakistan, local communities do not encompass aggression toward Snow leopards, however, if locals get remunerated for snow leopard fatalities, then local communities encompass no concern in eradicating snow leopards. Consequently, appealing to the local community and making mindfulness campaigns may prompt reestablishment and raise the number of *P. uncia* in Pakistan.

6. Authorities should review the applications for trophy hunting.

7. Need to assess the consequences of climate change on snow leopard populations and habitats and how to cope with such changing scenario of the world in regards to snow leopards.

Conclusion

Concurrence with Snow leopards can be accomplished by enabling locals and serving them to build more pleasant and ecological interaction with their surroundings, in which *Panthera uncia* is seen as esteemed resources as opposed to nuisances to be wiped out. It is generally recognized that the fate of most secured zones relies on the extent to which local community apprehension, requirements, and urges are communicated by the researchers. Ecotourism remodeling is the main conclusion in resolving the human-wildlife conflicts, which need additional exploration. Human–Snow leopard conflicts could be lessened through ecotourism and which helps in conserving the flimsy ecological unit.

References

Advani, N. (2014). WWF wildlife and climate change series: Mountain gorilla. World Wildlife Fund, Washington, DC.

Ahmad, S., & Javed, S. (2007). Exploring the economic value of underutilized plant species in Ayubia National Park. Pakistan Journal of Botany, 39 (5), 1435-1442

Alexander, J. S., Cusack, J. J., Pengju, C., Kun, S., Riordan, P. (2016). Conservation of snow leopards: 440 Spill-over benefits for other carnivores? Oryx, 50(1), 239–243. 441 doi:10.1017/S0030605315001040

Angula, H.N., Stuart-Hill, G., Ward, D., Matongo, G., Diggle, R.W., Naidoo, R. (2018). Local perceptions of trophy hunting on communal lands in Namibia. Biological Conservation, 218(1), 26–31.

Anwar, M.B., Jackson, R., Nadeem, M. S., Janecka, J. E., Hussain, S., Beg, M. A., Muhammad, G., Qayyum, M. (2011). Food habits of the snow leopard *Panthera uncia* (Schreber, 1775) in Baltistan, Northern Pakistan. European Journal of Wildlife Research, 57(1), 1077e1083

Athreya, V., Odden, M., Linnell, J.D.C., Krishnaswamy, J., Karanth, K.U. (2013). Big Cats in our backyards: persistence of large carnivores in a human-dominated landscape in India. PLoS ONE 8, e57872. http://dx.doi.org/10.1371/ Journal Pone, 0057872.

Bagchi, S., & Mishra C. (2006). Living with large carnivores: predation on livestock by the snow leopard (*Uncia uncia*). Journal of Zoology, 268 (3), 217-224.

Banerjee, K., Jhala, Y., Chauhan, K., Dave, C. (2013). Living with lions: the economics of coexistence in the Gir forests, India. PLoS ONE, 8(1), 1–11. http://dx.doi.org/ 10.1371/journal.pone.0049457.

Bhatia, S., Athreya V, Grenyer R, & Macdonald, D.W. (2013). Understanding the role of representations of human–leopard conflict in Mumbai through media-content analysis. Conservation of Biology, 27 (3), 588-594.

Bouyer, Y., Gervasi, V., Poncin, P., Beudels-Jamar, R.C., Odden, J., Linnell, J.D.C. (2014). Tolerance to anthropogenic disturbance by a large carnivore: the case of Eurasian lynx in south-eastern Norway. Animal Conservation. http://dx.doi.org/ 10.1111/acv.12168.

Cardillo, M., Purvis, A., Sechrest, W., Gittleman, J.L., Bielby, J., Mace, G.M. (2004). Human population density and extinction risk in the world's carnivores. PloS Biology. 2, E197. http://dx.doi.org/10.1371/journal.pbio.0020197.

Chattha, S.A., Iqbal, S., Rasheed, Z., Razzaq, A., Husain, M., & Abbas, M. N. (2013). Human-leopard conflict in Machiara National Park (MNP), Azad Jammu and Kashmir (AJK), Pakistan. Pakistan Journal of Zoology, 47(1), 222-228.

Dar, N. I., Minhas, R. A., Zaman, Q., & Linkie, M. (2009). Predicting the patterns, perceptions, and causes of human–carnivore conflict in and around Machiara National Park, Pakistan. Biology of Conservation, 142 (10), 2076-2082.

Davis, A. K. (2010). A technique for rapidly quantifying mammal hair morphology for zoological research. Folia Zoologica, 59(1), 87-92.

De Marnins, A.M. & Asprea, A. (2006). Hair Identification Key of Wild and Domestic Ungulates from Southern Europe. Wildlife Biology, 12(1): 305-320.

Din, J. U., Hameed, S., Shah, K. A., Khan, M. A., Khan, S., Ali, M., Nawaz, M. A. (2013). Abundance of canids and human canid conflict in the Hindu Kush Mountain range of Pakistan. Wildlife of Biology, Pract. 9(1), 20e29.

Farrington, J. D., & Tsering, D. (2019). Human-snow leopard conflict in the Chang Tang region of Tibet, China. Biology of Conservation, 237(1), 504-513.

Floyd, T. J., Mech, L. D, Jordan, P. A. (1978). Relating wolf scat content to prey consumed. Journal of Wildlife Management, 42(1), 528–532

Forrest, J. L., Wikramanayake, E. Shrestha, R. Areendran, G. Gyeltshen, K. Maheshwari, A. Mazumdar, S. Naidoo, R. X. Thapa, G.J. Thapa, K. (2012). Conservation and climate change: Assessing the vulnerability of snow leopard habitat to tree line shift in the Himalaya. Biological Conservation, 150(1), 129-135.

Fox, J. L. (1994). Snow leopard conservation in the wild -a comprehensive perspective on a low density and highly fragmented population. Pages 3-15 in: Fox J. L. and D. Jizeng (editors). Proceedings of the Seventh International Snow Leopard Symposium. International Snow Leopard Trust, Seattle, Washington.

Fox, J. L. (2008). A review of the status and ecology of the snow leopard *Panthera uncia*. (1989);40

Frost, P.G. & Bond, I (2008). The campfire programmed in Zimbabwe: Payments for wildlife services. Ecological Economics, 65, 776–787.

Hameed, S., ud Din, J., Ali, H., Kabir, M., Younas, M., Hao, W., ... & Nawaz, M. A. (2020). Identifying priority landscapes for conservation of snow leopards in Pakistan. PloS One, 15(11), p.e0228832.

Harihar, A., Prasad, D. L., Ri, C., Pandav, B., Goyal, S.P. (2009). Losing ground: tigers *Panthera tigris* in the north-western Shivalik landscape of India. Oryx, 43(2008), 35. http://dx.doi.org/10.1017/S0030605307072043.

Harris, R.B., Pletscher, D.H. (2002). Incentives toward conservation of argali Ovis ammon: A case study of trophy hunting in western China. Oryx, 36, 373–381.

Hussain, S. (2003). The status of the snow leopard in Pakistan and its conflict with local farmer livelihoods. Oryx, 37(1), 26–33.

Hussain., S. (2000). Protecting the snow leopard and enhancing farmers' livelihoods: a pilot insurance scheme in Baltistan. Mt. Research Devision, 20(1), 226e231.

Inskip, C., & Zimmermann, A. (2009). Human-felid conflict: a review of patterns and priorities worldwide. Oryx, 43(1), 18–34. http://dx.doi.org/10.1017/ S003060530899030X.

IUCN Red List. (2014). The IUCN Red List of Threatened Species. Version 2014.2. Downloaded on 18 September 2014. [WWW Document]. <www.iucnredlist.org>.

IUCN (2010). Subject: Unciauncia. http:// www. iucnredlist.org/apps/redlist/details.

Jackson, RM. (1996). Home range, movements, and habitat use of snow leopard (Uncia Uncia) in Nepal. Ph.D. thesis, University of London (External Programme), London, UK. 233 p

Johansson, O., Rauset, G.R., Samelius, G., McCarthy, T., Andren, H., Tumursukh, L., Mishra, C. (2015). Land sharing is essential for snow leopard conservation. Biology of Conservation. 203, 1e7.

Jumabay-Uulu, K., Wegge, P., Mishra, C., Sharma, K. (2014). Large carnivores and low diversity of optimal prey: a comparison of the diets of snow leopards

Kachel, S.M., McCarthy, K.P.; McCarthy, T.M.; Oshurmamadov, N. (2016). Investigating the potential impact of trophy hunting of wild ungulates on snow leopard Panthera uncia conservation in Tajikistan. Oryx, 51(1), 597–604.

Karanth, K.U., Chellam, R. (2009). Carnivore conservation at the crossroads. Oryx 43, http://dx.doi.org/10.1017/S003060530843106X.

Karanth, K.U., Nichols, J.D., Kumar, N.S., Link, W.A., Hines, J.E. (2004). Tigers and their prey: Predicting carnivore densities from prey abundance. Proceeding National Academy Science USA, 101, 4854–4858.

Khan, B., Abdukadir, A. Qureshi, R., Mustafa, G. (2011)**.** Medicinal uses of plants by the inhabitants of Khunjerab national park, Gilgit, Pakistan. Pakistan Journal of Botany, 43, 2301–2310.

Khan, B., Ablimit, A., Khan, G., Jasra, A.W., Ali, H., Ali, R., Ahmad, E., Ismail, M. (2016). Abundance, distribution and conservation status of Siberian ibex, Marco Polo and Blue sheep in Karakoram-Pamir mountain area. Journal of King Saud University Science, 28(1), 216–225.

Kharel, F. R. (1997). Agricultural crop and livestock depredation by wildlife in Langtang National Park, Nepal. Mountain Research and Development, 17(2), 127–134.

Khattak, R.H., Ali, H.; Rehman, E.U., Nawaz, M.A. (2019). Population Structure of Blue Sheep (*Pseudios nayaur*) in Shimshal Valley Gilgit-Baltistan Pakistan. Pakistan Journal of Zoology, 52(1), 699–707.

Khorozyan, I., Ghoddousi, S., Soufi, M., Soofi, M., Waltert, M. (2018). Cattle selectivity by leopards suggests ways to mitigate human–leopard conflict. Ecology of Evolution, 8(16): 8011-8018.

Kokorin, A.O. (Ed.) (2011). Assessment Report: Climate Change and its Impact on Ecosystems, Population, and Economy of the Russian Portion of the Altai-Sayan Ecoregion. WWF, Russia, Moscow.

Leader-Williams., N., Milledge, S., Adcock, K., Brooks, M., Conway, A., Knight, M., Mainka, S., Martin, E.B., Teferi, T. (2005). Trophy Hunting of Black Rhino Diceros bicornis: Proposals to Ensure Its Future Sustainability. Journal of International Wildlife, Law Policy, 8(1), 1–11.

Li, J., Lu, Z. (2014). Snow leopard poaching and trade in China 2000–2013. Biological Conservation, 176(1): 207-211.

Lindsey, P.A., Roulet, P.A., Romanach, S.S. (2007). Economic and conservation significance of the trophy hunting industry in sub-Saharan Africa. Biological Conservation, 134(1), 455–469.

Linnell, J., Swenson, J., Anderson, R. (2001). Predators and people: conservation of large carnivores is possible at high human densities if management policy is favourable. Animal Conservation, 4(1), 345–349.

Madden, F. (2004). Creating coexistence between humans and wildlife: global perspectives on local efforts to address human–wildlife conflict. Human Dimensions of Wildlife, 9(4), 247-257.

Malik, M. M. (1995). Status and Conservation of Snow leopard in Pakistan. Pages 11-20 in Jackson, R and A. Ahmad. (edits.). Proceedings of the eight International Snow Leopard Symposiums. (Islamabad, Pakistan). Snow leopard Trust, Seattle, USA.

Manfredo, M. J. (2008). Who cares about wildlife? In: Who Cares About Wildlife., pp. 1-27

McCarthy, T., D. Mallon, R. Jackson, P. Zahler, K. McCarthy (2017). Panthera uncia. IUCN.

McCarthy, T.M. & Chapron G. (2003). Snow Leopard Survival Strategy. Snow Leopard Trust, Seattle.

McCarthy, T., M., Fuller, T. K., & Munkhtsog, B. (2005). Movements and activities of snow leopards in Southwestern Mongolia. Biological Conservation, 124(4), 527-537.

McCarthy, T. M. (2000). Ecology and conservation of snow leopards, Gobi brown bears, and wild Bactrian camels in Mongolia

Miller, B., Dugelby, B., Foreman, D., Del Rio, C.M., Noss, R., Phillips, M., Reading, R., Soule, M.E., Terborgh, J., Willcox, L. (2001). The importance of large carnivores to healthy ecosystems. Endanger. Species Update 18, 202e210.

Mir, A. (2006). Impact Assessment of Community Based Trophy Hunting in MACP areas of NWFP and Northern Areas. In Mountain Areas Conservancy Project (MACP); IUCN Islamabad Program Once: Islamabad, Pakistan p. 38.

Mishra, C., Allen, P., McCarthy, T., Madhusudan, M.D., Bayarjargal, A., Prins, H.H. (2003). The role of incentive programs in conserving the snow leopard. Conservation of Biology. 17, 1512e1520

Mishra, C., Bagchi, S., Namgail, T., Bhatnagar, Y.V. (2010). Multiple uses of Trans-Himalayan rangelands: reconciling human livelihoods with wildlife conservation. In: DuToit, J.T., Kock, R., Deutsch, J.C. (Eds.), Wild Rangelands: Conserving Wildlife While Maintaining Livestock in Semi-Arid Ecosystems. Blackwell Publishing, pp. 291–311.

Mishra, C. (1997).Livestock depredation by large carnivores in the Indian Trans- Himalaya: Conflict perceptions and conservation prospects. Environmental Conservation, 24(4), 338–343.

Naevdal, E., Olaussen, J. O. Skonhoft, A. (2012). A bio economic model of trophy hunting. Ecology Economics, 73(1), 194–205.

Naha, D., Sathyakumar, S., Rawat, G. S. (2018). Understanding drivers of human-leopard conflicts in the Indian Himalayan region: Spatio-temporal patterns of conflicts and perception of local communities towards conserving large carnivores. Plos one: 13 (10).

Naidoo, R., Weaver, L.C., Diggle, R.W., Matongo, G., Stuart-Hill, G., Thouless, C. (2016). Complementary benefits of tourism and hunting to communal conservancies in Namibia. Conservation of Biology, 30(1), 628–638.

Namgail, T., Fox, J. L., Bhatnagar, Y. V. (2007). Carnivore-caused livestock mortality in Trans-Himalaya. Environment and Management. 39, 490e496.

Network, S. L. (2014). Snow leopard survival strategy. Seattle, Washington, USA. 1–145.

Nordbo, I., Turdumambetov, B., Gulcan, B. (2017). Local opinions on trophy hunting in Kyrgyzstan. Journal of Sustainable Tourism, 26, 1–17.

Odden M., Athreya, V., Rattan, S., Linnell, J.D.C. (2014). Adaptable neighbours: movement patterns of GPS-collared leopards in human-dominated landscapes in India. PLoS One 9, e112044. http://dx.doi.org/10.1371/journal.pone.0112044.

Oli, M. K. (1993). A key for the identification of hair of mammals of a, snow leopard (Panthera uncia) habitat in Nepal. Journal of Zoology. (London), 231, 71-93.

Oli, M. K., Taylor, I. R., Rogers, M. E. (1993). The diet of snow leopard (*Panthera uncia*) in the Annapurna Conservation Area, Nepal. Journal of Zoology (London) 231:365–370

Partasasmita, R., Shanida, S.S., Iskandar, J., Megantara, E. N., Husodo, T., Parikesit, P., Malone, N. (2016). Human-Leopard Conflict in Girimukti Village, Sukabumi, Indonesia. Biodiversity Journal of Biology Divers, 17 (2), 5-8.

Redpath, S. M., Young, J., Evely, A., Adams, W. M., Sutherland, W. J., Whitehouse, A., Amar, A., Lambert, R. A., Linnell, J. D., Watt, A., Gutierrez, R. J. (2013). Understanding and managing conservation conflicts. Trends of Ecology and Evolution, 28(2), 100-109.

Sangay, T., Vernes, K. (2008). Human-wildlife conflict in the Kingdom of Bhutan: patterns of livestock predation by large mammalian carnivores. Biology of Conservation. 141(1),1272–1282

Schaller, G. B. (1976). Mountain mammals in Pakistan. Oryx, 13(1), 351-356.

Schaller, G. B. (1977). Mountain monarchs: Wild sheep and goats of the Himalaya. The University of Chicago Press, Chicago.

Shackleton, D. M. (1997). Wild sheep and goats and their relatives. IUCN.

Sharma, R.K., Bhatnagar, Y.V., Mishra, C. (2015). Does livestock benefit or harm snow leopards? Biology of Conservation. 190, 8–13.

Shehzad W., McCarthy, T. M., Pompanon, F., Purevjav, L., Coissac, E., Riaz, T., Taberlet, P. (2012). Prey preference of snow leopard (Panthera uncia) in South Gobi, Mongolia. PloS one, 7(2), e32104.

Shehzad, W., Nawaz, M. A., Pompanon, F., Coissac, E., Riaz, T., Shah, S. A., Taberlet, P. (2015). Forest without prey: livestock sustain a leopard Panthera pardus population in Pakistan. Oryx, 49 (2), 248-253.

Snow Leopard Network (2014). Snow Leopard Survival Strategy, pp. 1e145 (Seattle, Washington, USA).

Snow Leopard Trust (2001-2007). Annual reports of the snow leopard conservation program in Chitral, Pakistan. Unpublished Reports.

Snow Leopard Working Secretariat. (2013). Global Snow Leopard and Ecosystem Protection Program. Bishkek, Kyrgyz Republic.

Sunquist, M., & Sunquist, F. (2002). Wild Cats of the World. (The University of Chicago Press: Chicago, IL.).

Suryawanshi, K. R. (2013). Human Carnivore Conflicts: Understanding Predation Ecology and Livestock Damage by Snow Leopards. PhD Thesis. Manipal University, India.

Treve, A., Karanth, K.U. (2003). Human-Carnivore conflict and perspectives on carnivore management worldwide. Conservation Biology, 17, 1491–1499.

Wegge, P., Shrestha, R., Flagstad, O. (2012). Snow leopard Panthera uncia predation on livestock and wild prey in a mountain valley in northern Nepal: implications for conservation management. Wildlife Biology, 18(1), 131e141.

Woodford M.H., Frisina, M.R.; Awan, G.A (2004). The Torghar Conservation Project: Management of the Livestock, Suleiman Markhor (*Capra Falconeri*) And Afghan Urial (*Ovis Orientalis*) in the Torghar Hills, Pakistan. Game Wildlife Science, 21, 177–187.

Woodroffe R., & Ginsberg, J. R. (1998). Edge effects and the extinction of populations inside protected areas. Science, 280(5372), 2126-2128.