

STATUS AND ATTITUDE OF LOCAL COMMUNITIES TOWARDS THE GREY WOLF (CANIS LUPUS LINNAEUS, 1758) IN LOWER DIR DISTRICT, KHYBER PAKHTUNKHWA, PAKISTAN

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Abstract. Human-wolf conflict is a major factor contributing to the decline of grey wolf population both locally and globally. This study was carried out in December 2016 to determine the status and nature of human-wolf conflict in the study area. A total 80 locals from all walks of life were interviewed using a semi-structured questionnaire. The grey wolf was declared as a common species by 50% of the locals with an annual sighting rate of 0.3 each. During the year, a total of 256 livestock were lost to grey wolf predation and disease. Of the total, grey wolf was held responsible for a total 71 livestock losses. Goat was the most vulnerable domestic prey as it accounted for 60.5% of the total reported depredations. Out of the total economic loss (USD 27562, USD 344.525/household), grey wolf was accountable for USD 6244 (USD 78.05/household), while disease contributed USD 21318 (USD 266/household). High depredation was observed during the summer season (54%) followed by spring and autumn. The unattended livestock grazing in forest were more prone to grey wolf attack. Most of the respondents (71%) displayed a negative attitude towards grey wolf. Reported human-wolf conflict in the area can be reduced by initiating wildlife importance related awareness programs, livestock vaccination and depredation compensation schemes. Active herding technique is also recommended to reduce chances of wolf attacks on livestock.

Keywords: *human-wolf conflict, predation, diseases, economical loss, live stock*

Introduction

Generally, the large carnivores are known as keystone species in an ecosystem, due to their top position in the food chain. They are considered as the important population regulators of different species especially their prey. Therefore, they play an impactful role in maintaining the quality of a habitat and eventually of the whole ecosystem

(Meyer and Terborgh, 2011; Ripple and Beschta, 2012). Human-wildlife conflict has its roots in the human history and it has intensified many folds over the time. Due to this conflict a large number of species especially, large carnivores have become extinct and threatened or their population is rapidly decreasing in most part of the world (Qamar et al., 2010; Ripple et al., 2014; Van et al., 2018; Jamtsho and Kately, 2019)

Human and wildlife conflict cases are represented by snow leopards (*Panthera uncia*) in the rugged mountains of central Asia (Bagchi and Mishra, 2006), grey wolf (*Canis lupus*) (Linnaeus, 1758) in the North America (Musiani et al., 2003), hyenas (*Crocuta crocuta*) and lions (*Panthera leo*) in Africa (Kolowski and Holekamp, 2006; Kissui, 2008) jaguars (*Panthera onca*) and pumas (*Puma concolor*) in South America (Mazzolli et al., 2002; Polisar et al., 2003), brown bear (*Ursus arctos*) in Tibetan Plateau of northwest China (Tsiring et al., 2006) and dingoes (*Canis lupus dingo*) in Australia (Allen and Sparkes, 2001).

Human-wolf conflict is a major issue in various parts of the world (Ali & Usman, et al., 2016). Primarily, it occurs for two main reasons, first wolf predation on domestic livestock which is the primary source of income in the pastoral communities. Secondly, sometime wolf also attacks on human causing injuries or even death (Krithivasan et al., 2009). There has been 3-18% annual economic loss to the pastoral communities that holds livestock in trans-Himalaya due to snow leopard and wolf (Namgail et al., 2007). The other perception held by livestock owners that contributes to the conflict is surplus killings of livestock by wolf that is beyond its food requirement. It causes a huge economic loss in short time thus negatively influencing the opinion of livestock owners (Gipson et al., 1998; Short et al., 2002; Din et al., 2019). The grey wolf may have occasional attacks on human beings and may cause mortalities and injuries (Shahi, 1982). But these incidences are rare and often because of human interference like destroying dens, traps and persecution of pups (Linnell et al., 2002).

Wolves have traditionally inhabited much of the northern hemisphere and conflicts between them and pastoralists were common and this was primary cause of extirpation of wolves from the western world (Jhala, 2003). Although there are sanctions on wolf hunting but it is killed within its range in retaliatory killings using mostly firearms (Fritts et al., 1997). The other methods used for killing wolves include blocking or smoking out dens containing pups or adults inside them (Kumar and Rahmani, 2000; Singh and Kumara, 2006) and poisoning which is recently come in practice (Jhala, 2003).

The other issues beside retaliatory killings with wolf include habitat loss, degradation and fragmentation, disease, decrease in natural prey population and competition with other carnivore species (Irshad, 2010). Peaceful coexistence between people and wolves is very challenging due to high rate of predation of livestock (Eshete et al., 2018), most of livestock herders perceived wolves as dangerous to livestock and wanted to reduce or eliminate their population from the area. Greater number of livestock density and high predation of wolves led to negative attitude by the local communities (Din et al., 2013). The grey wolf living closer to an urbanized area where plentiful food sources, livestock and garbage are abundantly available, the chances of predation and human-wolf conflict are higher (Timm et al., 2004). A recent study conducted in Karakoram suggested that livestock made about 66-75% of the diet of wolf and snow leopard (Bocci et al., 2017) while, in the Himalayas livestock constituted about 24-27% their diet (Chetri et al., 2017). Besides, spatial trend in livestock depredation by wolf can also be subjected to habitat preference and suitability, abundance of predator in that area (Wielgus and

Peebles, 2014), population of natural prey and competition with livestock over available resources and livestock grazing pattern (Johansson et al., 2015).

Pastoralist-predator conflict is a major social-ecological concern that can affect community attitudes and tolerance towards carnivores (Din et al., 2017). The coexistence predator and livestock can be attained by incorporating livestock management into conservation planning and initiation of predation mitigation and compensation schemes in the sensitive mountain ecosystem where pastoral communities live (Tyrrell et al., 2017). A very few research studies have been conducted in Pakistan in order to evaluate the status and magnitude of grey wolf conflict with locals. However, there was no single record of grey wolf statues, nature of conflict and perception of local communities about the species from the study area. Hence, considering the importance grey wolf ecological role, we conducted this study to explore status, magnitude and nature of grey wolf conflict with resident communities of the area.

Methodology

Field survey

Our study area named Timergara is located in District Lower Dir, Khyber Pakhtunkhwa (KP) province, Pakistan ($35^{\circ}10'N$, $72^{\circ}00'E$). During 2016, we interviewed male participants from the selected villages of the study area. We interviewed only male participants because in our study area, only males are engaged in outdoor activities related to livestock grazing and selling, fodder collection and agriculture, while on the other hand females stay at home doing household jobs. These households represent about 5% of the total households within each village (Shakeel et al., 2016). The questionnaire surveys are considered as an important tool to gather information about presence, tolerance and perception of local communities towards the wildlife species present in an area (White et al., 2005). Moreover, the local people can be a valuable and a reliable source of information about the presence of wildlife species in their area (Lunney et al., 2001; Shima et al., 2019). The participants were selected based on their pre-existing knowledge about different wildlife species in general and grey wolf in specific. The main proportion of the participants included the herders, farmers, locals engaged in different businesses, school/college teachers and local hunters of the study area. The interviews were taken from the respondents in the study area (Fig. 1) with the help of written semi-structured questionnaires designed with open ended questions following (Dar et al., 2009; Din et al., 2013).

In addition, color printed photographs of the species (grey wolf and other carnivores) were shown to the local respondents to evaluate their level of species identification. This was helpful to get credible information during the interview. These types of surveys are considered as an important tool for evaluating attitude, tolerance and perception of local people towards the wildlife species present in an area.

The sequence of questions asked were varied in different interviews, and depended on the response flow of respondents during interviewing. The questionnaire topics mainly covered; the number of grey wolfs sighted by the respondents in one year, perceptions about the grey wolf and human attitude towards grey wolf (current). The attitudes of the respondents who wanted to increase or maintain wolf population in the study area were categorized as a positive while those who desired to decrease or eradicate wolf were grouped as a negative attitude category. Intensity of wolf danger for

livestock was categorized into five main categories; not dangerous, dangerous, slightly dangerous, very dangerous, and extremely dangerous (following L & Rensis 1932). Moreover, we also recorded the primary demographic respondent's data including earning members, age, agriculture land, household (HH) size, occupation, education level, numbers of livestock, and their dependency (L & Rensis 1932) on livestock. All the collected data was put and analyzed in the Microsoft Excel (2016). The map of the study area was developed using Arc Global Positioning System in (ArcGIS, 10.2)

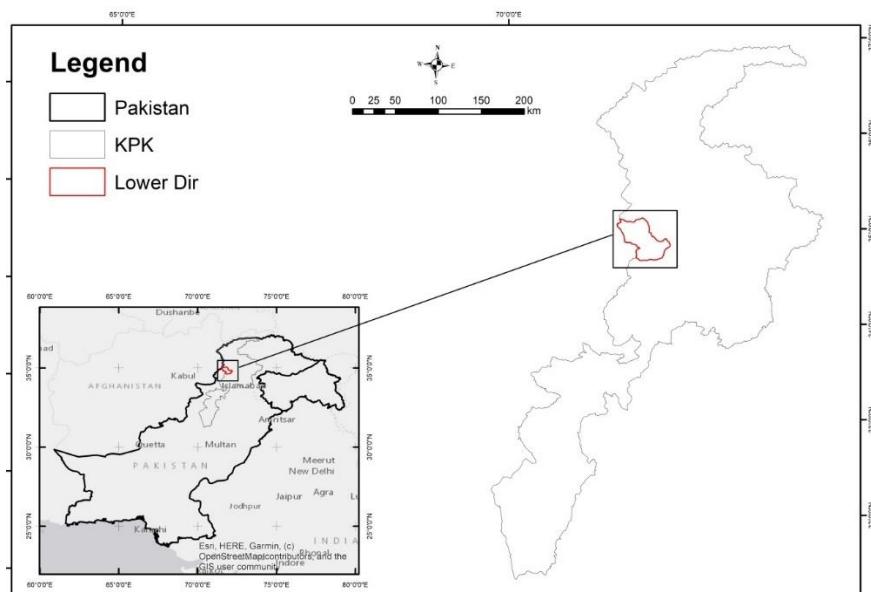


Figure 1. Location of our study area where the questionnaire surveys were done

Results

Demography of local people

During 2016 we interviewed 80 male respondents with an average age of 38 years (range 20-76 years). Most respondents (63.5%) were farmers and herders, followed by business men (19.3%) while the remaining (17.2%) were mainly school teachers, engineers and doctors. Most of the respondent (55.5%) in study sites were also highly dependent on livestock, 20.22% showed medium dependency and 20.22% showed low dependency on the livestock. Only 10% of interviewers poorly recognized the occurrence or absence of wolfs in the study sites (i.e., their information's about the presence or absence of wolfs was low); whereas, 35.5% of people were at average knowledge level and 54.4% were remarkably knowledgeable.

Wolf damage and people response

In the study area livestock rearing was the main source of income. In the study area, our surveyed households ($n = 80$) owned 1745 livestock with an average herd size of 21.8/household. Goats accounted for the largest percentage of livestock (56%), followed by sheep (24%), cattle (17%), and others (mules, horses and donkeys) (3%). We interviewed a total of 80 respondents to document sighting records of grey wolf in the study area. Respondent reported a total of 31 sighting records of grey wolf with an average sighting of 0.3 during the past one year. About the status of grey wolf in the

study area, our respondents shared mix views. Most ($n = 43$, 50%) of the respondents claimed that wolf is a common species in the area, while 46% and 4% respondents declared its status as a rare ($n = 31$) and absent ($n = 6$) respectively in the area (Fig. 2).

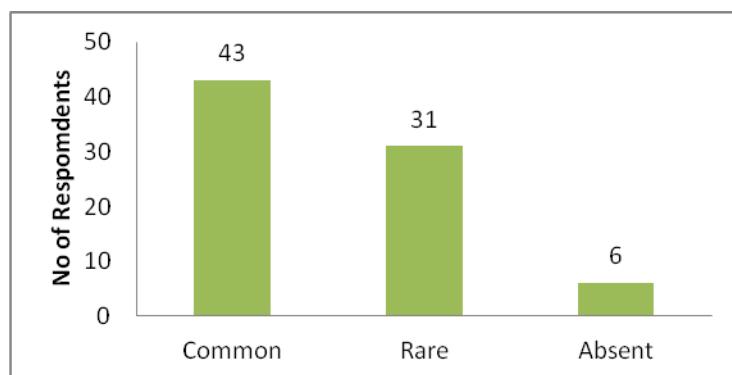


Figure 2. Status of grey wolf in the study area

Respondent reported a total loss of 256 livestock diseases and wolf predation and disease during the year 2016 (Table 1). Among the total 71 livestock losses were caused by wolves, while different disease accounted for 185 livestock losses. Goats were the largely victimized prey species, which accounted 43 (60.5%) of wolf killings, followed by sheep 23 (32.3%), cattle 2 (2.8%) and other 3 (4.2%). The reported figure of 256 livestock losses to grey wolf and diseases constitute an economic loss of USD 27562 (USD 344.525 per household).

Livestock depredation by grey wolf was reported at peak in the summer season, where more than half (54%) of the total livestock depredation occurred. Attack of wolf on the livestock was lowest in spring and winter (4% each) (Fig. 3). During the last year, a total of two attacks of wolf were reported on the human in the study area. The victims were attacked in nearby forest. In the attacks, the victims revived injuries that were not fatal, but it ended in the killing of wolf. Most (71%) of the respondents shared negative views about wolf (Fig. 4). The entire respondents declared the intensity of wolf danger as extremely high for their livestock as compared to rest of the wildlife species found in their area. Locals reported that all livestock depredation occurred inside the forest. Majority (55%) of the livestock depredation occurred when livestock were grazing in the nearby forest unattended by guard.

Table 1. Economic losses due to grey wolf predation and diseases

Livestock	UV (\$)	Wolf		Disease		Total (\$)
		No	Loss in \$	No	Loss in \$	
Goat	80	43	3440	95	7600	11040
Sheep	80	23	1840	59	4720	6560
Cattle	302	2	604	29	8758	9362
Other	120	3	360	2	240	600
		71	6244	185	21318	27562
			78.05		266.475	344.525

UV: unit value, 1 US Dollar = 149, hh: households

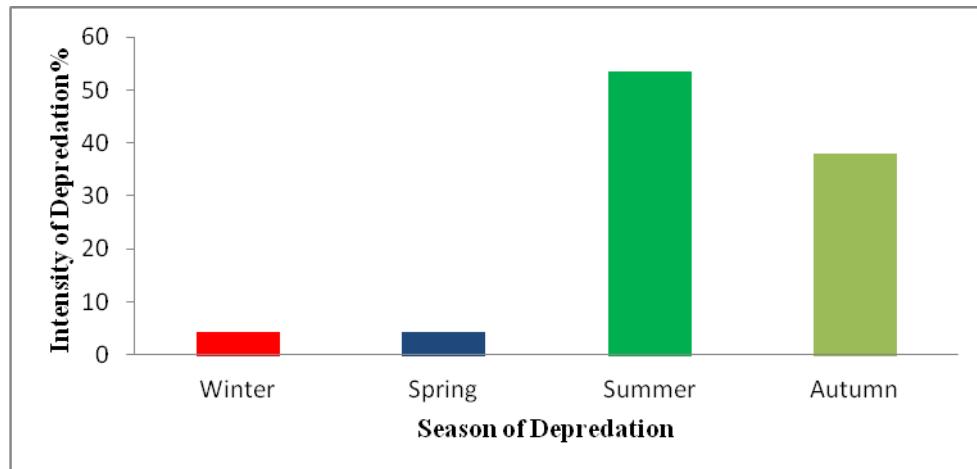


Figure 3. Depredation of livestock in different season of the year

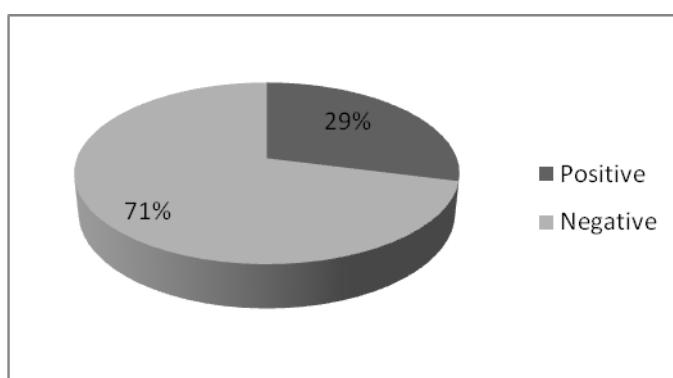


Figure 4. Attitude of locals towards grey wolf

Discussion

The grey wolf is known to the remote and rugged mountainous terrains of the district Lower Dir (KPK). This study was aimed to explore the statues and conflict of grey wolf with the local people of the selected villages of study area. Roberts (1977) and Dar et al. (2009) stated that the northern areas are the intrinsic habitats for the grey wolf. The human population inhabiting the study area is scattered and the presence of pastures and greenery accompanied by rugged terrains makes the area an appropriate habitat for the species. According to Divisional forest officer (Waqif, personal communication, December 27, 2016) locals were attack by an animal that resulted in the certain death of the animals and injuries to victims. The animal was thoroughly examined later one and was identified as a grey wolf.

Due to the unavailability of the veterinary service and high rate of livestock per household in the study area, a high rate of mortalities due to different diseases was observed. In the year 2016 a total of 256 livestock losses were reported by the locals. Due to diseases locals bear an economic loss of USD 21318 (USD 266 per household), that was higher than the economic loss occurred due to wolf depredation USD 6244 (USD 78.05 per household). Similar results (Ahmad et al., 2016; Dar et al., 2009) stated that the diseases in the livestock are the major cause of losses in stocks in the northern part of Pakistan. It is always argued that the carnivore predators are the prime suspects

and responsible factor of livestock losses and paired economic losses. In a recent study, it was concluded that the disease had resulted in the economic loss twice more than the loss caused by carnivore's predators, which was higher than each household's income by selling livestock.

Moreover, a research study carried in Sanjiangyuan part of China by Li et al. (2013) showed 809 livestock mortality cases related to loss due to disease accounting for a money loss of 375,031 USD per annum, which makes 2604 UDS per family yearly. It was evident from the interviews conducted from the affected locals that these economic losses were primarily caused by the livestock disease that were easily curable but were not treated well in time due to unavailability of the veterinary services in the study area, see (*Table 1*).

Livestock depredation is one of the main causes of human-carnivores conflict, which resulted in the retaliated killings of wildlife both locally and globally. The human-wildlife conflict is prevailing in its severe form in the developing countries where locals are highly dependent on livestock rearing. In the Himalayas and Hindu Kush mountain regions the higher rate livestock depredations by large carnivores has been linked with higher population of livestock per household (Jackson and Hunter, 1996; Mishra, 1997; Hussain, 2003; Distefano, 2005). Additionally, the areas having small population of carnivore's natural prey and large livestock population have higher depredation rates (Meriggi and Lovari, 1996; Kolowski and Holekamp, 2006). In our study, the respondent's stated that a total of 71 livestock depredation were caused due to wolf predation last year.

Current study showed that medium size prey including goats and sheep were more vulnerable to grey wolf attacks. The most vulnerable livestock to depredation is the medium-sized livestock weighing 25–45 kg, because predators can easily capture and eat them with ease safety (Dar et al., 2009; Bibi et al., 2013). Similar results were concluded in studies carried out in Musk Deer National Park (Ahmad et al., 2016), Machiara National Park Azad Jammu and Kashmir (Dar et al., 2009; Kabir et al., 2014) and India (Suryawanshi et al., 2013).

Livestock depredation by wolf was found at its peak during summer season, followed by autumn, spring and winter respectively. Livestock depredation normally follows some seasonal patterns. During summer and autumn season the pasture and other grazing grounds of the study area are the suitable locations for livestock grazing. This makes the unattended livestock more vulnerable to predator attack. While during winter season locals usually keep livestock at home nourishing them with the stocked fodders (Dar et al., 2009; Sogbohossou et al., 2011)

The local respondents shared negative perception and attitude towards the grey wolf (*Fig. 4*). Due to conflict over livestock depredation most of our respondents wanted to see the grey wolf population decreases or even eliminated from their area. Usually livestock losses due to carnivores, when coupled with restricting locals from using the naturally resources found in their area like forest, develop negative and aggressive attitude among the locals towards wildlife (Conforti and de Azevedo, 2003). The interviewed locals reported that the wolves were the major predators found in their area, and they consider them the most dangerous to livestock. Moreover, it was also considered to be a threat to local people too. The species is depicted as a sign of viciousness and tyranny in the study.

Most of the depredation was reported when the livestock were grazing inside the near forest in the absence of guard. Herd guarding mechanism and active defense is

important and necessary against the carnivore's attack. Low predation rate was observed in presence of herdsman (Breitenmoser, 1998). Studies conducted in Europe, Italy and France reveal high depredation in the areas where domestic livestock graze freely or rarely guarded (Sillero-Zubiri and Laurenson, 2001; Espuno et al., 2004). Our study also helps to conclude that livestock depredation is much lower when herds were guarded, showing the effectiveness of active guarding.

Conclusion and recommendations

Most of the respondents of the area consider the grey wolf as a common carnivore found in the area. The species was blamed for a high rate of livestock depredation and faced a severe negative attitude of locals as it caused them economic loss. To ensure the grey wolf conservation and reduce the economic losses of the local communities, it is recommended to initiate a vaccination program as the area is lacking any animal care center. Livestock compensation scheme is also recommended because it will shift the negative perception of the local to positive. Proper guarding of livestock is recommended to reduce chances of wolf attacks. Moreover, intensive sign and camera trap surveys are recommended to be carried out in order to determine the abundance and habitat preference of the species in the area.

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REFERENCES

- [1] Ahmad, S., Hameed, S., Ali, H., Khan, T. U., Mahmood, T., Nawaz, M. A. (2016): Carnivores' diversity and conflicts with humans in Musk Deer National Park, Azad Jammu and Kashmir, Pakistan. – European Journal of Wildlife Research 62(5): 565-76.
- [2] Ali, U., Minhas, R. A., Awan, M. S., Ahmed, K. B., Qamar, Q. Z., Dar, N. I. (2016): Human-Grey Wolf (*Canis lupus* Linnaeus, 1758) Conflict in Shounther Valley, District Neelum, Azad Jammu and Kashmir, Pakistan. – Pakistan Journal of Zoology 48(3).
- [3] Allen, L., Sparkes, E. (2001): The effect of dingo control on sheep and beef cattle in Queensland. – Journal of Applied Ecology 38(1): 76-87.
- [4] Bagchi, S., Mishra, C. (2006): Living with large carnivores: predation on livestock by the snow leopard (*Uncia uncia*). – Journal of Zoology 268(3): 217-24.
- [5] Bibi, S., Minhas, R., Awan, M., Ali, U., Dar, N. (2013): Study of ethno-carnivore relationship on Dhirkot, Azad Jammu and Kashmir (Pakistan). – Journal of Animal and Plant Sciences 23: 854-59.
- [6] Bocci, A., Lovari, S., Khan, M. Z., Mori, E. (2017): Sympatric snow leopards and Tibetan wolves: coexistence of large carnivores with human-driven potential competition. – European Journal of Wildlife Research 63(6): 92.
- [7] Breitenmoser, U. (1998): Large predators in the Alps: the fall and rise of man's competitors. – Biological Conservation 83(3): 279-89.
- [8] Chetri, M., Odden, M., Devineau, O., Wegge, P. (2019): Patterns of livestock depredation by snow leopards and other large carnivores in the Central Himalayas, Nepal. – Global Ecology and Conservation 17: e00536.

- [9] Conforti, V. A., de Azevedo, F. C. C. (2003): Local perceptions of jaguars (*Panthera onca*) and pumas (*Puma concolor*) in the Iguaçu National Park area, South Brazil. – *Biological Conservation* 111(2): 215-21.
- [10] 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. – *Biological Conservation* 142(10): 2076-82.
- [11] 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 Biology in Practice* 9(2): 20-29.
- [12] Din, J. U., Ali, H., Ali, A., Younus, M., Mehmood, T., Norma-Rashid, Y., Nawaz, M. A. (2017): Pastoralist-predator interaction at the roof of the world: Conflict dynamics and implications for conservation. – *Ecology and Society* 22(2).
- [13] Din, J. U., Nawaz, M. A., Mehmood, T., Ali, H., Ali, A., Adli, D. S. H., Norma-Rashid, Y. (2019): A transboundary study of spatiotemporal patterns of livestock predation and prey preferences by snow leopard and wolf in the Pamir. – *Global Ecology and Conservation* 20: e00719.
- [14] Distefano, E. (2005): Human-Wildlife Conflict worldwide: collection of case studies, analysis of management strategies and good practices. – Food and Agricultural Organization of the United Nations (FAO), Sustainable Agriculture and Rural Development Initiative (SARDI), Rome, Italy. Available from: FAO Corporate Document repository <http://www.fao.org/documents>.
- [15] Eshete, G., Marino, J., Sillero-Zubiri, C. (2018): Ethiopian wolves conflict with pastoralists in small Afroalpine relicts. – *African Journal of Ecology* 56(2): 368-374.
- [16] Espuno, N., Lequette, B., Poulle, M. L., Migot, P., Lebreton, J. D. (2004): Heterogeneous response to preventive sheep husbandry during wolf recolonization of the French Alps. – *Wildlife Society Bulletin* 32(4): 1195-208.
- [17] Fritts, S. H., Bangs, E. E., Fontaine, J. A., Johnson, M. R., Phillips, M. K., Koch, E. D., Gunson, J. R. (1997): Planning and implementing a reintroduction of wolves to Yellowstone National Park and central Idaho. – *Restoration Ecology* 5(1): 7-27.
- [18] Gipson, P. S., Ballard, W. B., Nowak, R. M. (1998): Famous North American wolves and the credibility of early wildlife literature. – *Wildlife Society Bulletin* 1988: 808-16.
- [19] Hussain, S. (2003): The status of the snow leopard in Pakistan and its conflict with local farmers. – *Oryx* 37(1): 26-33.
- [20] Irshad, R. (2010): Ecology and Conservation of Wild Canisds in the Salt Range Pakistan with Focus on Indian Wolf (*Canis Lupus Pallipes*). – Quaid-i-Azam University, Islamabad.
- [21] Jackson, R. M., Hunter, D. O. (1996): Snow Leopard Survey and Conservation Handbook. – International Snow Leopard Trust, Seattle, WA.
- [22] Jamtsho, Y., Katel, O. (2019): Livestock depredation by snow leopard and Tibetan wolf: Implications for herders' livelihoods in Wangchuck Centennial National Park, Bhutan. – *Pastoralism* 9(1): 1.
- [23] Jhala, Y. (2003): Status, ecology and conservation of the Indian wolf *Canis lupus pallipes* Sykes. – *J. Bombay Natural History Society* 100(2): 3.
- [24] Johansson, O., Rauset, G. R., Samelius, G., McCarthy, T., Andren, H., Tumursukh, L., Mishra, C. (2015): Land sharing is essential for snow leopard conservation. – *Biological Conservation* 203: 1-7.
- [25] Kabir, M., Ghoddousi, A., Awan, M. S., Awan, M. N. (2014): Assessment of human–leopard conflict in Machiara National Park, Azad Jammu and Kashmir, Pakistan. – *European Journal of Wildlife Research* 60(2): 291-96.
- [26] Kissui, B. (2008): Livestock predation by lions, leopards, spotted hyenas, and their vulnerability to retaliatory killing in the Maasai steppe, Tanzania. – *Animal Conservation* 11(5): 422-32.

- [27] Kolowski, J., Holekamp, K. (2006): Spatial, temporal, and physical characteristics of livestock depredations by large carnivores along a Kenyan reserve border. – Biological Conservation 128(4): 529-41.
- [28] Krishnaswamy, R., Athreya, V., Odden, M. (2009): Human-Wolf Conflict in Human Dominated Landscapes of Ahmednagar District, Maharashtra. – Rufford Small Grants Foundation for Nature Conservation, London, pp. 1-53.
- [29] Kumar, S., Rahmani, A. R. (2000): Livestock depredation by wolves in the Great Indian Bustard Sanctuary, Nannaj (Maharashtra), India (with three text-figures). – Journal - Bombay Natural History Society 97(3): 340-48.
- [30] Li, J., Yin, H., Wang, D., Jiagong, Z., Lu, Z. (2013): Human-snow leopard conflicts in the Sanjiangyuan Region of the Tibetan Plateau. – Biological Conservation 166: 118-23.
- [31] Likert, R. (1932): A technique for the measurement of attitudes. – Archives of Psychology 22: 140-55.
- [32] Linnell, J., Andersen, R., Andersone, Z., Balciuskaite, L., Blanco, J. C., Boitani, L., Liberg, O. (2002): The Fear of Wolves: A Review of Wolf Attacks on Humans. – NINA Oppdragsmelding 731, Trondheim.
- [33] Lunney, D., Matthews, A. (2001): The contribution of the community to defining the distribution of a vulnerable species, the spotted-tailed quoll, *Dasyurus maculatus*. – Wildlife Research 28: 537-545. DOI: 10.1071/WR00018.
- [34] Mazzolli, M., Graipel, M. E., Dunstone, N. (2002): Mountain lion depredation in southern Brazil. – Biological Conservation 105(1): 43-51.
- [35] Meriggi, A., Lovari, S. (1996): A review of wolf predation in southern Europe: does the wolf prefer wild prey to livestock? – Journal of Applied Ecology 33(6): 1561-71.
- [36] Meyer, W. M., Terborgh, J. A. (2011): Trophic cascades: predators, prey, and the changing dynamics of nature. – Oryx 45(1): 151.
- [37] Mishra, C. (1997): Livestock depredation by large carnivores in the Indian trans-Himalaya: conflict perceptions and conservation prospects. – Environmental Conservation 24(4): 338-43.
- [38] Musiani, M., Mamo, C., Boitani, L., Callaghan, C., Gates, C. C., Mattei, L., Volpi, G. (2003): Wolf depredation trends and the use of fladry barriers to protect livestock in western North America. – Conservation Biology 17(6): 1538-47.
- [39] Namgail, T., Fox, J. L., Bhatnagar, Y. V. (2007): Carnivore-caused livestock mortality in Trans-Himalaya. – Environmental Management 39(4): 490-96.
- [40] Polisar, J., Maxit, I., Scognamillo, D., Farrell, L., Sunquist, M. E., Eisenberg, J. F. (2003): Jaguars, pumas, their prey base, and cattle ranching: ecological interpretations of a management problem. – Biological Conservation 109(2): 297-310.
- [41] Qamar, Q., Dar, N., Ali, U., Minhas, R., Ayub, J., Anwar, M. (2010): Human-leopard conflict: an emerging issue of common leopard conservation in Machiara National Park, Azad Jammu and Kashmir, Pakistan. – Pakistan J Wildlife 1(2): 50-56.
- [42] Ripple, W. J., Beschta, R. L. (2012): Trophic cascades in Yellowstone: the first 15 years after wolf reintroduction. – Biological Conservation 145(1): 205-13.
- [43] Ripple, W. J., Estes, J. A., Beschta, R. L., Wilmers, C. C., Ritchie, E. G., Hebblewhite, M., Berger, J., Elmhagen, B., Letnic, M., Nelson, M. P. (2014): Status and ecological effects of the world's largest carnivores. – Science 343(6167). DOI: 10.1126/science.1241484.
- [44] Roberts, T. J. (1977): The Mammals of Pakistan. – E. Benn, London.
- [45] Shahi, S. (1982): Status of the grey wolf (*Canis lupus pallipes* Sykes) in India - a preliminary survey. – Journal of the Bombay Natural History Society 79(3): 493–502.
- [46] Shima, A. L., Berger, L., Skerratt, L. F. (2019): Conservation and health of Lumholtz's tree-kangaroo. – Australian Journal of Mammal 41: 57-64.
<https://doi.org/10.1071/AM17030>.

- [47] Short, J., Kinnear, J., Robley, A. (2002): Surplus killing by introduced predators in Australia—evidence for ineffective anti-predator adaptations in native prey species? – Biological Conservation 103(3): 283-301.
- [48] Sillero-Zubiri, C., Laurenson, M. K. (2001): Interactions between Carnivores and Local Communities: Conflict or Co-existence? – Conservation Biology Series. Cambridge University Press, Cambridge, pp. 282-312.
- [49] Singh, M., Kumara, H. (2006): Distribution, status and conservation of Indian gray wolf (*Canis lupus pallipes*) in Karnataka, India. – Journal of Zoology 270(1): 164-69.
- [50] Sogbohossou, E. A., de Iongh, H. H., Sinsin, B., de Snoo, G. R., Funston, P. J. (2011): Human–carnivore conflict around Pendjari Biosphere Reserve, northern Benin. – Oryx 45(4): 569-78.
- [51] Suryawanshi, K. R., Bhatnagar, Y. V., Redpath, S., Mishra, C. (2013): People, predators and perceptions: patterns of livestock depredation by snow leopards and wolves. – Journal of Applied Ecology 50(3): 550-560.
- [52] Timm, R. M., Baker, R. O., Bennett, J. R., Coolahan, C. C. (2004): Coyote attacks: an increasing suburban problem. – Proceedings of the Twenty-First Vertebrate Pest Conference. University of California, Davis, pp. 47-57.
- [53] Tsering, D., Farrington, J., Norbu, K. (2006): Human–Wildlife Conflict in the Chang Tang Region of Tibet. – World Wide Fund for Nature (WWF) China–Tibet Program, Lhasa, Tibet, China.
- [54] Tyrrell, P., Russell, S., Western, D. (2017): Seasonal movements of wildlife and livestock in a heterogeneous pastoral landscape: implications for coexistence and community based conservation. – Global Ecology and Conservation 12: 59-72.
- [55] Van Eeden, L. M., Crowther, M. S., Dickman, C. R., Macdonald, D. W., Ripple, W. J., Ritchie, E. G., Newsome, T. M. (2018): Managing conflict between large carnivores and livestock. – Conservation Biology 32(1): 26-34.
- [56] White, P. C., Jennings, N. V., Renwick, A. R., Barker, N. H. (2005): Questionnaires in ecology: a review of past use and recommendations for best practice. – Journal of Applied Ecology 42(3): 421-430.
- [57] Wielgus, R. B., Peebles, K. A. (2014): Effects of wolf mortality on livestock depredations. – PLoS One 9(12): e113505, 10.1371.