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Human-Grey Wolf (*Canis lupus* Linnaeus, 1758) Conflict in Shounther Valley, District Neelum, Azad Jammu and Kashmir, Pakistan

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ABSTRACT

Human-wolf conflict is a major issue in various parts of the world due to predation on livestock. Shounther valley (a sub valley of Neelum valley, AJ&K) harbors pasture-based economy in summer season, thereby livestock predation by "Least Concern" grey wolf (*Canis lupus*) is creating a serious conflict between farmers and wildlife. Present study is the first attempt in this area that aimed to assess the intensity of the conflict in terms of livestock depredation. Study area was divided in to eight (8) study sites and data were collected for five months (May to September, 2011) during field surveys at each study site. Results revealed that 76 livestock heads were depredated by grey wolf during the study period; the highest depredation was recorded at Bhedian study site (22%) followed by Mali (185) and Dukk (13%). Sheep (67%) were more vulnerable to depredation as compared to goats (26%) and horses (4%). Most depredations (24%) were noted in the age groups of > 2 years and the preferred time of depredation was recorded as 11 pm to 5 am (65%). Open pens provided more chances of depredation (61%) as compared to fenced pens (22%) and pastures (17%). Overall depredation during the study period resulted in a loss of PKR 433,000 to 26 farmers that raised a rage against the wolf and consequently a retaliatory killing of three wolves was reported; one was gunned down, second was poisoned and the third killed by guard dogs. Watch and ward and herding practices are very poor as most of the depredations (61%) occurred in the absence of protection. Conflict is rising day by day and hindering the conservation of grey wolf in the study area. A comprehensive awareness program should be started with the consultation of local influential persons to improve herding practices, better watch and ward conditions, use of frightening devices and to change peoples' attitude toward the wolf presence in the study area. This base-line study would provide a step toward the conservation efforts of this species in Shounther valley.

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Key words
Grey wolf, depredation, human-wildlife conflict.

INTRODUCTION

Predation is a natural phenomenon evolved with the animals. It becomes a problem when the predator population rises and shares the habitat with a particular prey species and the humans; the predators find domesticated animals an easy prey and prey upon them when the wild prey is not easily available (Shelton, 2004); and occasionally human beings are also attacked (Johnson *et al.*, 2005). This conflict between predators (carnivores) and humans is a significant problem throughout the world (Saberwal *et al.*, 1994; Distefano, 2005). Such conflicts happen most frequently because of competition for shared or limited resources (Mishra, 2007; Conforti and de Azevedo, 2003) and become particularly controversial when the resources concerned have economic value and the predators involved are legally protected (Graham *et al.*, 2005) or occur in protected areas (Lodhi, 2007).

Grey wolf (*Canis lupus* Linnaeus, 1758) belongs to the family Canidae; distributed throughout Pakistan (Roberts, 1997). Wolf is listed as endangered in the red list of Pakistan mammals (Sheikh and Molur, 2005) while it is rated as "Least Concern" globally (IUCN Red List, 2015.2). It is one of the most controversial predators that symbolize the wilderness, devastation, destruction and negative changes (Shelton, 2004). Human-wolf conflict becomes more severe for wolf because of its extensive home ranges and the top position in food chains (Woodroffe and Ginsberg, 1998), resultantly many wolf populations are threatened by habitat destruction, disease and persecution (Treves and Karanth, 2003; Ashenafi *et al.*, 2005).

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Livestock depredation time and place could hardly be predicted (Fritts *et al.*, 2003). Differences in terrain, vegetation, abundance of natural prey and livestock management practices limit the success of wolf predation on livestock that varies from area to area. Livestock depredation is usually localized thus affecting a small number of farmers who experience an uneven share of losses (Fritts *et al.*, 2003; Breck and Meier, 2004). However, even fewer wolves could cause severe financial loss to livestock producers (Young and Goldman, 1944; Gipson, 1983).

Livestock depredation is higher in rough and brushy areas or in remote parts of pastures, and where the population of wild prey is low, whereas it is lesser in open grasslands supporting diverse or high densities of natural prey (Nass *et al.*, 1984; Mech *et al.*, 1988; Meriggi and Lovari, 1996; Mech *et al.*, 2000; Stoddart *et al*., 2001). Wolf predation on beef calves is a seasonal pattern with the majority of depredations occurring between March and September in Minnesota (Fritts *et al.*, 1992) and Wisconsin (Treves *et al.*, 2002).

Intersection of human and wolf activities results in economic losses and in removal of wolf through killing or compelling to move into unsuitable habitats (Shelton, 2004). Conflict has resulted in extirpation of wolves from various parts of the globe, particularly Europe. In some areas this animal has also been reintroduced (Fritts *et al.*, 1992). High predation rate could force the farmers to forego the production of livestock (especially sheep and goats) because this loss is economically unacceptable. This results in the loss of potential income to the producers and the community to which they contribute (Merrill *et al.*, 1966; Shelton, 2004).

Illegal hunting of wolves occurs in some areas of the wolf range. Methods used to exterminate wolves include firearms (major method) (Jhala and Giles, 1991; Jhala, 2003), blocking and/or smoking out dens containing pups and sometimes adults (Shahi, 1982; Kumar and Rahmani, 2000; Singh and Kumara, 2006), dynamiting pups (Mishra, 1997), and more recently using poisons (Jhala, 2003). Wolves are also sometimes killed opportunistically when they become entangled in mesh pens used by shepherds (Singh and Kumara, 2006; Krithivasan *et al.*, 2009). Wildlife department implements strict law enforcement; now herders use poisoned bait and trained dogs to kill solitary wolves, as witnessed in Astore Gali in the study area (Personal observation).

The aim of the present study was to assess the human-wolf conflict in terms of livestock depredation in summer season in Shounther Valley, Neelum. No such study has been carried out in this region. This baseline study could be helpful to sort out conflicts between local communities and wildlife conservation.

MATERIALS AND METHODS

Study area

District Neelum (commonly known as Neelum Valley) falls in the inner Himalayan region in Azad Jammu and Kashmir, situated between 34°28–34°48 N and 37–74°58 E and covers an area of 3450 km^2 (Ali *et al.*, 2007; Qamar *et al.*, 2012). Shounther valley (the study area, 19,631 ha) is one of the prominent sub-valleys of the Neelum valley, branching off from Kel, ending at Shounther Pass on eastern side and Jal Rahi Top on north-western side. Shounther valley supports a blend of Western Himalaya's biodiversity of global priority for conservation (Myers *et al.*, 2000), such as snow leopard (*Panthera uncia*), common leopard (*Panthera pardus*), brown bear (*Ursus arctos*), woolly flying squirrel (*Eupetaurus cinereous*), Himalayan snow cock (*Tetraogallus himalayensis*), and snow partridge (*Lerwa lerwa*). Study area is bounded by district Astore (Gilgit Baltistan) and Ghamot National Park (GNP, AJK) from north-western side, Astor (GB) on northeastern and Musk Deer National Park (MDNP, AJK) on southeastern side (Qureshi, 1990) (Fig. 1). Topographically, this area comprises lofty mountains with broken outcrops, gorges, glaciers, sub-valleys, steep and rolling slopes of alpine pastures. The habitats in the study area include: cold desert areas, alpine pastures, alpine scrub forest, dry temperate and coniferous forests in the Kel Forest compartments number 10-15 (Qureshi, 1990; Qamar *et al.*, 2012). The area receives heavy snowfall and severe northern cold winds during the long winter season, from November to April; high peaks (*e.g.* Sar Wali and Hari Parbat) are covered with snow the whole year long. Eight study sites, ranging from 3110 m (Dukk) to 3940 m (Shounther) elevation, were randomly selected and searched systematically for livestock depredation (Table I).

Methodology

Monthly field surveys were conducted for five months from May, 2011 to September, 2011 in each study site. Data gathered on prescribed data sheets for livestock depredation, all depredation sites and depredated animals were analyzed and photographed. A questionnaire tailored for depredation time, watch and ward condition and compensation was shared with the affected herders. GPS and other habitat, topographic factors were also recorded. Data were analyzed statistically using MS Excel (ver. 2007) and Statistix 8.1 software.

Table I.- Habitat characteristics and altitude of different study sites in the study area during May to September 2011.

S. No.	Study Site	Latitude (N)	Longitude (E)	Alt (m)/ Aspect	Habitat characteristics
1	Bhedian	35° 1'56.03"	74°24'42.13"	3730 Southern	Lofty slopes with patchy distribution of *Salix spp*. Sparse *Betula utilis, Indigofera gerardiana, Berberis lycium, Viburnum grandiflorum, Juniperus spp. Polygonum affinis, Bergenia ciliata* and *Poa* spp.
2	Chang	34°58'46.48"	74°26'46.97"	3300 Northern	Steep and gentle slopes covered with patches of *Betula utilis, Polygonum affinis, Bergenia ciliata, Jurinea dolmiaea, Podophyllum hexandrum, Poa* spp., *Juniperus* spp.
3	Chitta Kathah	34°56'32.88"	74°29'46.79"	3690 Western	Gentle and steep mixed slopes with vegetation blend of *Poa spp., Polygonum affinis, Berberis lycium, Podophyllum hexandrum, Rheum emodi, Saussurea lappa*
4	Dukk	34°58'24.66"	74°27'53.89"	3110 Southern	Gentle slopes with different types of vegetation including *Jurinea dolmiaea, Polygonum affinis, Arnebia benthami, Berberis lycium, Betula utilis* and *Poa* spp.
5	Mali	34°58'39.98"	74°29'56.60"	3690 Southern	Open and gentle slopes, covered mainly with different species including *Aconitum heterophyllum, Arnebia benthami, Bergenia ciliata, Berberis lycium* and *Polygonum affinis.*
6	Mohri	35° 0'27.22"	74°26'18.10"	3320 Eastern/ Southern	Steep and gentle slopes with patchy distribution of *Betula utilis, Aconitum chasmanthum, Polygonum affinis, Aconitum heterophyllum, Juniperus* spp.
7	Neeli Baraf	35° 0'52.98"	74°26'50.00"	3330 Southern	Steep slopes covered with *Bergenia ciliata, Rheum emodi, Arnebia benthami, Juniperus spp* .and *Betula utilis*.
8	Shounther	34°59'36.09"	74°33'35.98"	3940 Southern	*Mixture of steep and gentle rolling slopes covered with Betula utilis, Aconitum heterophyllum, Bergenia ciliata, Polygonum affinis, Saussurea lappa, Arnebia benthami* and *Juniperus* spp.

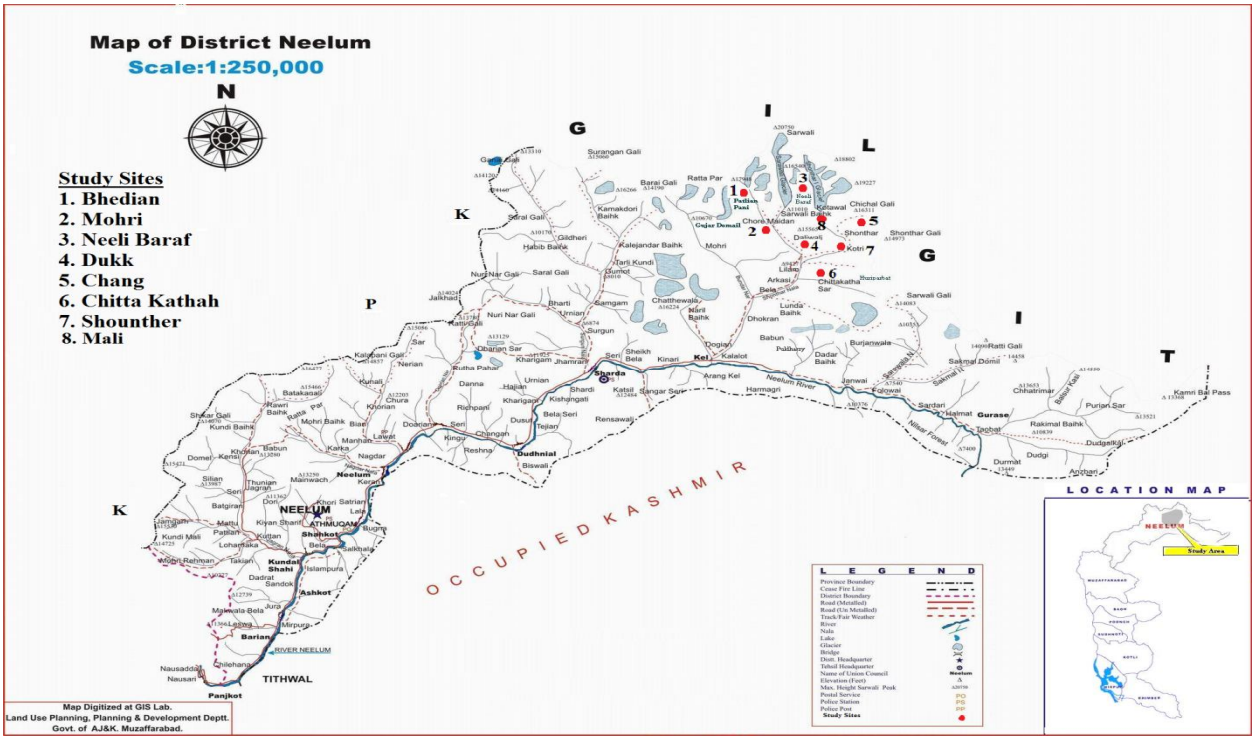

Fig. 1. Map of the study area showing eight study sites in Shounther Valley.

Table II.- Comparison of livestock numbers in the study area during 2011.

Sr.No.	Livestock type	Number (%)	Depredated livestock (%)
1	Goats	7634 (45.75)	20 (26.32)
2	Sheep	5216 (31.26)	56 (67.11)
3	Horses	690 (4.14)	3 (3.95)
4	Cows	2945 (17.65)	2 (2.63)
5	Buffalos	200 (1.20)	0 (0)
	Total	**16,685 (100)**	**76 (100)**

RESULTS AND DISCUSSION

Livestock depredation at study sites

Livestock depredation by grey wolf was recorded in all eight study sites in Shounther valley. A total of 76 livestock heads including sheep, goats, cows and horses were depredated in five (5) months of the study period during summer 2011 (Table II). Data revealed that the highest depredation (22%) was noted at Bhedian site followed by Mali (18%) and Dukk (13%) while minimum depredation was noted at Chitta Kathah (4%) (Fig. 2). Bhedian study site is located far away from human settlements, connected with Jal Rai top (Chilas), thus providing comparatively larger home range and less disturbance to the wolves to survive there. Most of the predator (*e.g.* snow leopard, wolf, black and brown bear) attacks were noticed moderately higher in Bhedian. Topographically Bhedian provides dens and camouflage to wolves that provide shelter and better opportunities for the wolf to find the prey.

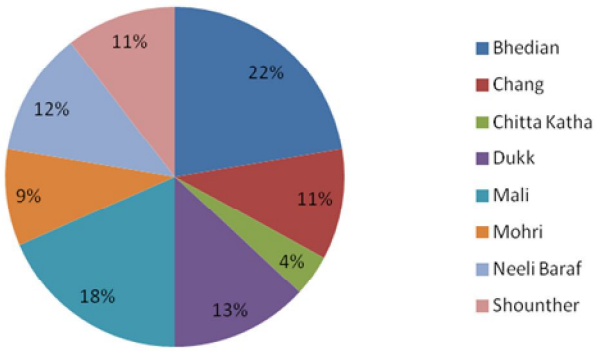

Fig. 2. Livestock depredation by grey wolf at different study sites of the Shounther valley during summer 2011.

Depredation of livestock types

Highest depredation (n=51) 67% was recorded on sheep followed by goats (n=20) 26% and the minimum depredation in cows (n=2) 3% (Table II). Various studies (Forbes and Theberge, 1996; Singh and Kumara, 2006) report that sheep and goats are major prey species reported in different distributional ranges of wolf. Wolves are known to follow the prey species during migratory seasons of shepherds (Singh and Kumara, 2006). Highest sheep depredation was due to several factors; agility is one of the prime importance. Goats are more agile as compared to sheep and it was noticed that during attack, goats dispersed in different directions, which made difficult to select as prey for a single wolf. Contrary to goats, sheep moved in a flock even during attack, as flock reduced agility and speed to escape, resultantly they were more prone to hunting and being killed.

Livestock rearing is one of the important activities in Shounther valley. Livestock farming is the main part of local economy, solely dependent on pasture-based system in summer season. Pasture-raised animals roam freely in natural pastures, where they feed *ad libitum*. High depredation rate could be due to some threshold level of livestock encounters with wolves as reported by Murdock (1969). Easy access to livestock could change the prey priority of wolves from wild prey to livestock (Bjorge and Gunson, 1983; Tompa, 1983; Alderton, 1994; Fritts *et al.*, 2003; Van Camp, 2003; Jethva and Jhala, 2004) whereas wolves in general prefer wild prey; and wolf-livestock problems tend to be minimized where wild prey is abundant. Predation on livestock may also be high because of an increase in predator density in an area and that may be a response to the easy availability of domestic or wild prey (Nass *et al.*, 1984; Yom *et al.*, 1995).

Depredation and age groups of livestock

There was a significant (p=0.038) rise in the number of depredation with the rise in age. Highest (n=24) depredated animals were more than two (2) year old, followed by (n=18) those of 1.5 to 2 years. Least depredation was noted on juveniles (< 6 months) (Fig. 3). This trend showed that wolves mainly attacked larger animals as the juveniles could not be accessed by the predator because they were kept in closed pens during night, to prevent milk sucking, so that herders could milk the goats/sheep in the morning. Another reason for the selection of adult/older animals/livestock could be the energy expenditure behavior of wolves (Meriggi and Lovari, 1996).

Times and livestock depredation

Highest depredation (65%) was observed during mid-night (from 11 p.m. to morning) followed by 18 % during early night (from 5 to 11 p.m.) (Fig. 4). On the

whole 76 % depredation occurred during night. This is due to nocturnal habit of wolves and the unprotected livestock. Twelve percent (12 %) attacks were observed during the day; time of 5% depredation was not known. Day depredations occurred in pastures, mainly on horses and cows. It is a common practice among the herders that they do not herd their cows and horses during summer and they are left unattended on the pastures and monitored on weekly or monthly basis or opportunistically. Several studies (Andelt, 2001; Ashenafi *et al.*, 2005; Distefano, 2005) supported the nocturnal predation behavior of wolf; some however suggested it as diurnal predator (Bjorge and Gunson, 1983; Forbes and Theberge, 1996). In our opinion, wolf behavior in the study area is crepuscular rather than strictly nocturnal or diurnal. However, its preferred predation time is after midnight due to factors such as no human interference, successive camouflage provided by the dark of night and presence of livestock in the form of herd or groups in a pen (which may be scattered in the pasture).

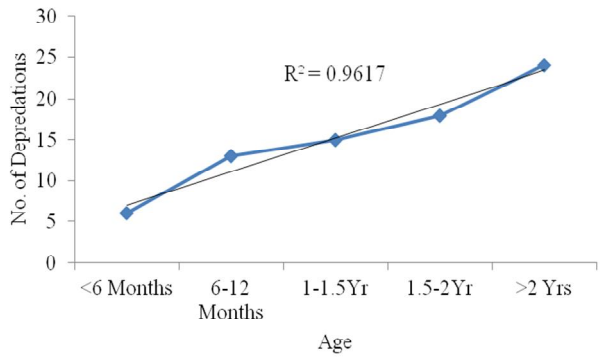

Fig. 3. Depredation of grey wolf on different age groups of livestock in the study area during summer 2011.

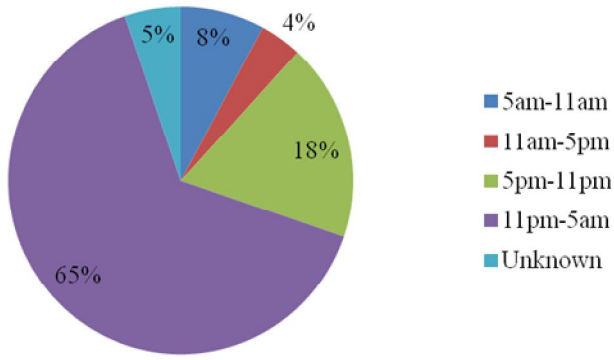

Fig. 4. Livestock depredation at different times in the study area during study period.

Livestock depredation and watch and ward conditions

Depredation varied with respect to the watch and ward condition, highest (61%) depredation happened in the absence of any watch and ward condition. Twenty five percent (25%) of depredation was recorded in the presence of watch dogs and 9% in the presence of both human and guard dogs. Surprisingly minimum depredation (5%) was recorded when only the humans were watching their cattle (Fig. 5). Minimum wolf attacks were noted during day time (Fig. 4) when most of the human watch was during day time and in pastures; the nocturnal behavior of the wolf is due to the non-vigilance of herders who take rest after a day's hard work. Many herders have watch dogs, but the practice seemed ineffective in the case of wolves. It was generally observed that watch dogs were shy of attacking the wolves, however, their intense barking helped raise alarm to the herders and awoke them to take measures to ward off the wolf attack.

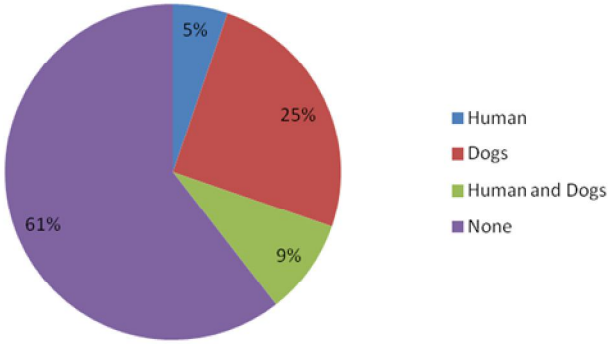

Fig. 5. Livestock depredation by grey wolf with respect to the watch and ward conditions in the study area during study period.

Peoples' behavior towards wolf attacks on livestock

As most of the attacks were during night, people did not show their response, or in other words, before they reached the pens, wolves would have already escaped (Fig. 6). However, during day time the herders made noise to ward off the attack. Two fires were also recorded, that killed a wolf. Historically wolves in Asia are known to attack humans or lift children (Blanford, 1891; Jhala and Sharma, 1997; Rajpurohit, 1999; Singh and Kumara, 2006); not a single case was reported in the study area regarding wolf attacks on human beings. However livestock loss eroded local attitude and support for the presence of wolf in the area, as documented by earlier studies (Gadd, 2005). People try to control wolves by shooting with the guns or poisoning the depredated animals. An alternative to this lethal control, other

preventive measures such as compensation to the herder, improvement in the merits of guarding, fencing and corralling, deterrent devices documented in earlier studies (Coppinger *et al.*, 1988; Andelt, 2001; Bangs and Shivik, 2001) could be adopted to reduce the damage. A simple deterrent device used by the herders in the study area is lantern or charged lamps which remained switched on the whole night. Wolves avoided attacks on such a fence but the use of such deterrent devices to the wolves remained limited or little-studied (Musiani *et al.*, 2003; Shivik *et al.*, 2003; Treves and Karanth, 2003).

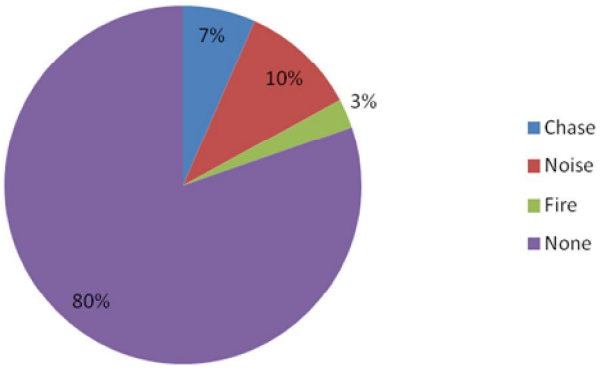

Fig. 6. Peoples behavior to the wolf' attacks on livestock in the study area during study period

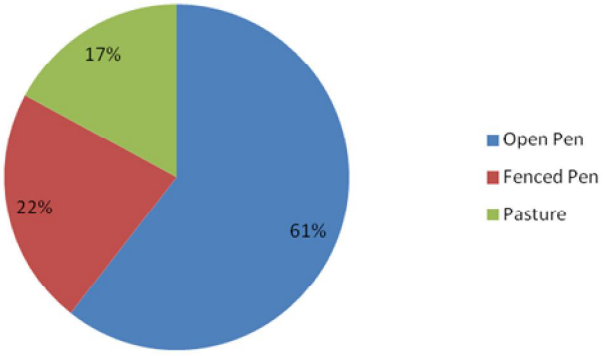

Fig. 7. Livestock depredation by grey wolf at different attacking sites in the study area during study period.

Attacking spots

Highest depredation (61%) was recorded at open pens followed by fenced pens (22%), whereas minimum depredation (17%) was recorded at pastures (Fig. 7). Open pens have no protective measure, while fenced pens means a 2-3 feet high, mostly circular stone wall around a pen. The primary purpose is to avoid dispersal of livestock heads at night rather than preventing attacks from the predator. Once wolf attacks in this type of pen, it usually succeeds in hunting because sheep and goats cannot escape through the wall and become easy prey. Losses in such pens could also be heavier as quite a few of the sheep and goats could also be killed inadvertently. Depredation was low in pastures due to watch and ward, during the day time, human interference in the habitat (for the collection of medicinal plants, fuel wood, forage for calves etc.) and nocturnal behavior of the wolf, as reported in various previous studies (Fritts *et al.*, 1992; Fritts *et al.*, 2003; Breck and Meier, 2004). In conclusion, wolf is opportunistic in predation and prefers to attack where risk and interruption are the minimum.

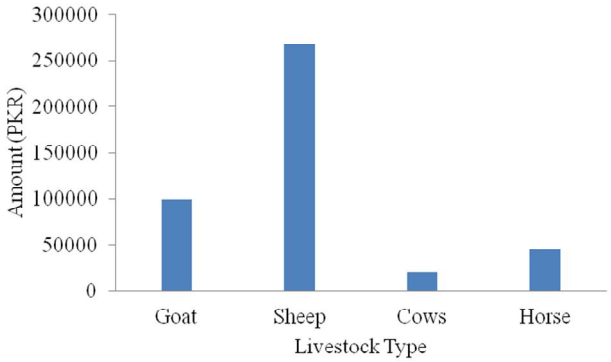

Fig. 8. Estimated economic loss due to livestock depredation of grey wolf in the study area during summer 2011.

Estimated economic losses

A total of 433,000 PKR losses were faced by 26 local people due to overall livestock depredation by the wolf. Sheep loss amounted to 268,000 PKR followed by goats (100,000 PKR) and horses (45,000 PKR) while cow depredation amounted to 20,000 PKR (Fig. 8). Such huge economic losses raise a rage among local people towards the wolves' presence in the area. The herders are not paid any compensation by the Wildlife and Fisheries Department or any other conservation agency. Conversely the department imposes fines on the people who kill the wolves. In an instance, 5500 PKR fine was imposed on the person who killed a wolf at the pen. This approach seems to be negative and would not be supportive of the conservation of the species in the area. People then poison the depredated animal and the wolf consuming that animal dies. In Bhedian study site where huge depredation was recorded, nomads poisoned the dead sheep that resulted in the death of a wolf. One wolf was killed by guard dogs during its attack on livestock at Shounther.

Wolf sighting

Eight wolves were seen during the study period, out

of which three (one mother and two cubs) were observed at Neeli Baraf site, three adult wolves (one male, one female in group and one solitary) were recorded in Bhedian, and two solitary adult males in Shounther study site. All these groups shared their home range, because sites were closely situated.

CONCLUSION

Livestock holdings form an integral part of the local pastoral and agricultural economy and grazing of substantial herds is widespread in the study area. Wolf depredation on livestock angers farmers who may resort to retribution, thereby proliferating a conflict of interest between local communities and wildlife department. Compensation programs should be started that help to reduce public resistance to the presence of wolf and help increase public acceptance of livestock depredation by wolves. Removal of predator species (particularly top trophic level species) results in imbalance of ecosystem that thereafter reduces ecosystem services to the mankind. This conflict will grow in future and could force wolf population to extirpation. Preventive measures such as improved livestock husbandry techniques, preventing habitat degradation to increase natural prey of wolf should be taken through conservation agencies and government of AJ&K.

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