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STUDY OF ETHNO-CARNIVORE RELATIONSHIP IN DHIRKOT, AZAD JAMMU AND KASHMIR (PAKISTAN)

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ABSTRACT

Human-carnivore conflict is the major issue for the carnivore conservation in Azad Jammu and Kashmir. Due to the habitat degradation of the wildlife, the natural prey of carnivore species is declined resulting into the increased depredation of livestock, which in turn causes the human-carnivore conflicts. This paper presents the results of the study of the human-carnivore relationship in Tehsil Dhirkot, Azad Jammu and Kashmir, Pakistan during 2009-2010. Study was aimed to explore the extent of depredation (injuries and deaths) of livestock and human beings by different carnivore species, estimation of the economic loss of the local villagers, perceptions of the locals and retaliatory killings of carnivores during the last three years. A sum total of 150 affectees were interviewed using structured questionnaires and discussions were made with the local community during 40 surveys conducted in 20 villages of eight union councils of the study area. Three main carnivore species were found to be responsible for livestock killing and human injury. Common Leopard was responsible for the majority (70.8%) of such livestock killing; mainly goats (20%) and donkeys (18%). Jackals were responsible for about 80% of the poultry killings. These livestock depredations by carnivore species lead to a financial loss of about US$ 23529.41 to the local community during 2009-2010. Four persons were also injured during the leopard attacks at Surang, Hill, Munhasa and Sohawa. In response, four leopards were killed by the local community at Ghaziabad, Narakot, Surang and Rangla. Most (85%) of the people dislike predators and about 90% respondents recommended that predators should be conserved in zoos and wildlife parks while 10% respondents were in favor of predator conservation in natural habitat. The study revealed that leopards along with other carnivore species were widely involved in depredation of livestock and has been heavily persecuted by the rural communities. This issue is the major threat to the conservation of large carnivore species. To improve both large carnivore population and local livelihood prospects around study area, conservation and management projects with conflict mitigation strategies should be initiated.

Key words: Ethno-carnivore relationship, livestock depredation, Azad Jammu and Kashmir, Pakistan

INTRODUCTION

Human and carnivores are living together in a close relationship for millions of years. This relationship plays a fundamental role in the co-existence of the partners positively or negatively. When the needs and behavior of wild carnivore exert negative impacts on human lives or vice versa, then human-carnivore conflicts arise which ultimately affects both. Human-carnivore conflict is now very common global phenomenon in rural areas and has become common on the urban fringe in both developing and developed countries (Dickman, 2008). Damage to crops, orchards, livestock, other property and people themselves generally lead to conflicts between carnivores and human. Other most common reasons are competition for resources at different levels, fear as a threat to local people, and trade of body parts of animals (Sillero-Zubiri and Laurenson, 2001). The frequency of conflicts has increased in recent decades as a result of increased human activities in wildlife areas or on natural habitats (Graham *et al.*, 2005).

Livestock holding is an integral part of the local economy of the most developing countries around the protected areas and forests. The large home ranges of carnivores often resulted into competition with humans, particularly in areas associated with extensive livestock management. Furthermore, many large carnivore species are specialized on natural or domesticated ungulate prey, and some individuals seek and readily kill large livestock as well as posing risks to humans when opportunities arise (Polisar *et al.*, 2003). Such damage to local livelihoods and human beings angers farmers towards retaliatory killings of the carnivores. The high economic value exaggerates the level of anger toward predators and fuels feelings for retribution among the affected herders (Conforti and de Azevedo, 2003). Aside from the direct impact of depredation, as people have to invest more

heavily in strategies such as livestock herding, guarding and predator control (Thirgood *et al.,* 2005).

Although predation upon livestock and humans is the most common issue cited as causing conflict between humans and carnivores in recent studies (Sillero-Zubiri and Laurenson, 2001). However, despite clear evidence of a link between stock depredation and human-carnivore conflict, there is not a simple, consistent relationship between the level of stock loss and negative perceptions towards large carnivores (Mishra, 1997; Stander, 1997). Attacks upon humans are likely to be extremely important drivers of conflict with wildlife, particularly where attacks occur with alarming regularity (Baldus, 2004).

Large carnivore species play indispensable roles in long term maintaining a healthy ecosystem, for instance by controlling numbers of meso-predators through competition, regulating numbers of prey species (many of them crop pests), and maintaining a biodiversity balance in a local communities (Terborgh *et al.,* 1999; Logan and Sweanor, 2001). Removing top predators from habitat patches often results in significant changes in community structure, which can have marked negative impacts in terms of local ecology (Terborgh *et al.,* 2002). Hence, the persistence of carnivore populations is of central concern to conservation biologists for proper regulation of natural ecosystems. Thus, human–carnivore conflict is an urgent challenge to carnivore conservation, especially in the remote rural population adjacent to the protected areas and forests. Furthermore, most of the large carnivore species are experiencing global declines driven almost entirely by human activities and/or conflict with humans (Mizutami, 1999).

Above mentioned facts reveal that the carnivores are highly important with the conservation point of view, as they have vital role in the ecology and socioeconomics of an area. Attempts to mitigate human–carnivore conflict and improve the conservation of the culprit species, and possibly other wildlife also, should be based on an explicit understanding of the conflict patterns. The leopards along with other carnivore species are widely distributed across the Azad Jammu and Kashmir, and have been heavily persecuted, partly because of increasing levels of conflict with rural communities. This issue has attained the status of national priority because it is the major threat to the conservation of large carnivore species and the government is under intense pressure from rural communities who are vociferously and frequently complaining and demanding compensation for their livestock losses to leopards, as well as other carnivore species (Dar *et al.,* 2009). Thus keeping in view the importance of the issue in question, the present study was carried out in Dhirkot (proposed Nature Reserve) District Bagh, Azad Jammu and Kashmir to assess the human-carnivore conflicts in terms of livestock depredation, injuries and deaths of humans and the direct and indirect economic loss of local community in these conflicts by different carnivore species.

MATERIALS AND METHODS

Study area: The study was carried out in 20 villages of eight union councils in Tehsil Dhirkot, District Bagh, Azad Jammu and Kashmir (Pakistan) (Fig. 1). Dhirkot is located at 55km southeast of Muzaffarabad (the capital city for Azad Jammu and Kashmir) and 132 km from Islamabad. It is bounded on the north by District Muzaffarabad, on the south by District Poonch, on the west by Abbotabad and Murree, and on the east by Occupied Kashmir. It lies on latitude 33^{o} – 57 N and longitude 73^{o} – 36 E, covering an area of 150 km^2 at 600-2000m above the mean sea level (Khan, 2002).

The study area lies in humid region in the access of monsoon. There is a lot of variation in humidity and rainfall in different parts of the area with the differences in the altitudes. The winters are severely cold while the summer is moderate; winters are followed by spring, which brings the blooming of vegetation with it. In summer, the day temperature reaches up to 37ºC during the months of May and June. In winter the maximum temperature drops down to 04ºC and snowfall occurs at higher elevations. However, sometimes, snowfall also occurs in lower areas (Munhasa, Salian, Mendri and Dhar), but it does not stay on the ground. The average rainfall during the year 2009 was 150mm with maximum intensity during the months of July and August (Meteorological Observatory Muzaffarabad).

Most of the study area is characterized by the Himalayan mixed temperate forests and Sub-tropical pine forests. Himalayan mixed temperate forests are composed of mainly Blue pine (*Pinus wallichiana*) and Deodar (*Cedrus deodara*) forests while the Subtropical pine forests are characterized by *Pinus roxburghii* forests. Faunal composition of the study area includes about 20 mammals and 15 bird species, which also include some endangered and globally threatened species such as common leopard (Khan, 2002).

Because of poverty, lack of alternate subsistence means and heavily dependence on the land resources, the people keep large number of livestock of different kinds for agriculture, domestic and commercial purposes. The major land use in the area is subsistence farming and range lands. The land of valley bottoms and gentle slopes are used to raise crops which mainly include maize, potatoes and other vegetables for domestic use (Khan, 2002).

Questionnaire survey: The information about the ethno-carnivore relationship was collected from the affected households using a combination of methods (semi-structured interviews, participatory observation and focus group discussions). Keeping in view the objectives of the

study, questionnaire was developed through rigorous process of consolation with supervisor and other experience persons. Respondents were asked a series of questions about the circumstances surrounding their livestock-carnivore attacks, the number of livestock and carnivore predators. Along with focal persons interviews and personal observations, the government officials and field staff of the Wildlife and Forest departments, other agencies involved directly or indirectly in the wildlife conservation, community representatives and people who had experienced conflict with carnivores were also contacted and information were collected.

Field surveys: Field surveys were also conducted of all the study area for mapping the settlements, to determine the status of accuracy of the information provided by the local community about human-large carnivore conflict. During the field surveys, group discussions and meetings were carried out with the local community members (livestock owners) for the strengthening of information regarding the frequency of livestock predation, their perceptions about the carnivores and other problems of their animals etc. Data was also collected about the livestock holding by the households for monitoring cattle population in future.

RESULTS AND DISCUSSION

A total of 150 respondents in the study area experienced attacks of mammalian predators on their livestock from January 2009 to December 2010. Most of these respondents reared goats (31%), cows (34%), equines (2%), bulls (9%), dogs (10%) and buffalos (6%) (Table 1). The major occupation of the villagers was the farming and they were mostly depending on natural resources for their daily requirements. Leopard *(Panthera pardas)*, Jackal *(Canis aurius)* and Red fox *(Vulpus vulpus)* were involved in killing of about 216 livestock heads.

Leopard and Jackal were major predators, responsible for the majority of livestock killing in the area while Red Fox was also involved in poultry killing. This study highlights predators as the main agent responsible for livestock loss. Leopard, the main livestock predator, caused relatively larger loss and was perceived by the pastoralists to be a major threat to their livelihood. Human-carnivore conflict studies conducted in many other areas also reported Leopard as the main livestock predator (Wang and Macdonald, 2006). Conflicts between humans and carnivores are expected to have increased with the 17–26% livestock increase in Azad Jammu and Kashmir over the past 20 years (Dar *et al.,* 2009).

Type of livestock killed: Goats, cows, buffaloes, donkeys, and dogs were the common prey of leopard in these areas while poultry was preferably killed and injured by Jackal and Red fox in the study area. In 2009 and 2010 predation rate of various livestock included, cows (11%, n=23) dogs (18%, n=38) buffalos (3%, n=8) donkeys (19%, n=40) goats (20%, n= 44) and Poultry (29%, n=63). Depredation rate of goats was high (n =44) followed by donkey (n=40). Goat was the common prey of leopard in these areas (Fig. 3).

Present study indicated that the percentage killings of goats and donkeys by leopard were the highest during winter months. In a study conducted in Machiara National Park, the percentage of goats and sheep killed by leopard was greater than the other livestock forms (Dar *et al.,* 2009). Goats are ideal leopard prey because these are smaller animals (25–50 kg) can be quickly dragged to a secluded and safer place after killing. In Sariska Tiger Reserve, India, goats, sheep and calves comprised 88% of leopard livestock killings (Sekhar, 1998). Livestock due to their reduced escape abilities compared to wild herbivores, become especially vulnerable to predation (Nowell and Jackson, 1996). In Pakistan leopards have been known to kill adult cows, besides calves, donkeys, ponies, goats and sheep (Roberts, 1997).

Spatial patterns of livestock depredation: During year 2009 and 2010, livestock killings were reported from different union councils including Hill (18%, n=39), Chirala (17%, n=37), Makiala (17%, n=36), Rangla (12%, n=25), Chamiati (11%, n=24), Malot (7%, n=21), Dhirkot (8%, n=18), Salian (17%, n=16). At Union Council Hill maximum livestock killings were reported (n=39) while minimum killings were reported at Salian (n=16) (Fig. 2). Similarly, at village Sohawa Shareef maximum livestock killings were observed (n=37) and minimum number of killing were reported at village Narwal (n=3) (Table 2).

The maximum killing of livestock occurred near the forest at distance from 0-100m (46% in 2009 and 40% in 2010) as the livestock were left for grazing in or near forests. Conflict with local people and wildlife in many parts of the world have been reported where people are living in or near adjacent to the protected area (Newmark *et al.,* 1994).

Temporal patterns of livestock killing: The majority (36%, n=78) of livestock killing by carnivore occurred during the winter season followed by the summer (31%, n=69), autumn (13%, n=29) and spring (18%, n=40) (Fig. 4). For the year 2009 and 2010 season the results were analyzed by Correlation Coefficient. The winter (36%) and autumn (29%) values have significant difference (n=4, df=3, p=0.05, r=0.99). The spring (18%) and winter (36%) values have significant difference (n=4, df=3, p=0.05 r=3.42). Positive correlation was found between summer and spring values (r=0.904).

The study revealed that 36% (n=79) of livestock were killed during night followed by morning (27%,

n=60), evening (17%, n=37) and day time (18%, n=39). The night 36% and day time 18% values have significant difference (n=4, df=3, p=0.05, r=0.98) (Fig. 4).

In 2009, about 14% of livestock killing was recorded in the month of January followed by February (13%), December (12%), November (11%), July (11%), September (10%), May (8%), October (7%), April (4%), March (2%) and August (3%) while no incident was recorded during the month of June. Similarly, 12% of livestock killing was recorded in the month of January followed by February (12%), December (11%), November (11%), July (12%), September (10%), May (5%), October (6%), April (6%), March (1%), August (0%) and June (8%) (Fig. 5).

For the year 2009 and 2010, monthly results were analyzed by Correlation Coefficient. The January 14% and March 2.7% values have significant difference (n=6, df=5, p=0.05, r=6.82). The January 14% and August 3.2% values have significant difference (n=6, df=5 p=0.05, r=3.22). The January 14% and April 5.5% values have significant difference (n=6,df=5, p=0.05, r=1.93). The January 14% and June 4.6% values have significant difference (n=6, df=5, p=0.05, r=1.89). The November 11.1% and March 2.7% values have significant difference (n=6, df=5, p=0.05, r=3.89). The July 11.5% and August 3.2% values have significant difference (n=6, df=5, p=0.0, r=2.99). Positive correlation found between January, February, November December and July values (0.704).

The availability of wild prey and herding practice in the study area was also influenced by season. During autumn and spring due to the good weather condition predator's natural prey becomes more abundant in the study area and peoples guarded their livestock. Some people also work in jungle for fuel wood and fodder collection for livestock which has resulted in the lower depredation during these days. A lower availability of wild prey in Africa, which was often associated with rainfall patterns and seasonal movements of these prey, has also been found to increase the risk of livestock attacks by carnivores (Patterson *et al.,* 2004; Kolowski and Holekamp, 2006).

This study also showed low livestock killings during the day time as villagers guarded their livestock and some people use dogs for guarding strategies. Dogs might have alerted pastoralists to the presence of an approaching predator. Killings of 38 dogs by leopard attacks during present study might make dogs reluctant to alert leopard of their presence. From Kenya, dogs were also ineffective in deterring leopard attacks, as well as those by hyena (Kolowski and Holekamp, 2006).

Goats were most vulnerable to attacks, especially during the winter season. The reason of high killing in winter is due to the absence of herder because of severe climatic conditions or keeping livestock in open places without any herder becoming easy prey for predators. However, in Machiara National Park the availability of wild prey was more likely to influence by temperature and during the winter months the leopard's natural prey becomes more abundant in the study area as heavy snowfall at higher elevations forces the prey descend (Dar *et al.,* 2009).

In the present study, predator attacks at night time were higher because the livestock were often left unattended in the poorly constructed pens. As leopard tends to be a shy, solitary and nocturnal hunter, thus it is widely believed that leopards are opportunistic and nocturnal predators that hunt their prey in proportion to abundance (Bailey, 1993). The majority of large carnivore attacks were occurred at night, as has been found in East Africa (Ogada *et al.,* 2003).

Financial valuation of livestock loss: The total financial loss of villagers arising from livestock killing during the study period was estimated as US$23529.512. The financial loss due to the depredation of goats was US$823.52, buffalos US$470.58, cows US$470.58, donkeys US$117.64, poultry US$470.58. These financial losses were attributed to Leopard (40.0%), Jackal (30.0%) and Red Fox (30 %).

Carnivore attacks on humans: Four leopard attacks were recorded on humans resulting in serious injuries to the victims. These attacks were recorded at Surang (06-12-2009), Hill (05-02-2009), Munhasa (04-05-2010) and Sohawa (03-04-2008). All the attacks occurred during evening and night timings. The increase in human-leopard conflict was also due to greater resilience and adaptability of the leopard compared to other carnivores (Table 3).

Local tolerance and retaliatory killing of carnivores: Majority of the local villagers (84%) dislike the predator while 16% like the predator. About 90% of the respondent supported that the predator should be conserved in wildlife parks and zoos while only 10% supported that predator should be conserved in natural habitat. All the people were unsatisfied with conflict management and compensation by Government as nothing is being done in this regard.

During 2009-2010, four leopards were killed by the local community at different localities. These incidents were reported at Ghaziabad (02-01-2009) at night followed by Narakot (23-07-2010) at evening, Surang (02-09-2010) and Rangla (08-03-2011) at night. Similarly, such killings of four jackals were also reported in different localities i.e., two incidents were reported from Chiralla (06-05-2009) during night, Hill (03-04-2010) and from Chamiati (05-09-2010) during day time and four Red Foxes were also reported to be killed by the locals from Chiralla (04-08-2010) and Malot (04-03-2010) during night.

In the study area, four persons were injured by predators, and in retaliation, four leopards, four jackals and four red foxes were killed. In the recent past (winter 2005), 7 leopard were killed by community in different parts of the Abbottabad Wildlife Division. This is in addition to the killing that might have done without being noticed or reported (Dar *et al.,* 2009). Although not as common as attacks upon livestock or game species, wild animal attacks upon humans clearly have particularly significant impacts in terms of causing intense conflict (Quigley and Herrero, 2005).

Whether the future survival of leopard or other carnivores is dependent on alleviating their conflict costs to rural communities is debatable, because four leopards' four jackals and three red fox were known to have been killed in retribution in the study area. It is very essential to take participatory initiatives to improve local livelihoods through cost-effective guarding strategies, and tolerance towards wildlife.

Although, there were three carnivore species (Leopard, Jackal and Red fox), however, the greatest financial losses from livestock mortality were due to conflicts with leopard. In the study area the total financial loss of villagers arising from livestock killing by the carnivores during the study period was estimated as US$23529.41. Leopard and Jackal were responsible for the greatest overall costs amongst wildlife-related attacks. Living alongside wildlife can incur a substantial economic price-tag: in the United States, agricultural producers spent US$2.5 billion to manage wildlife problems during the 1990s, while metropolitan households spent US$5.5 billion over the same period (Conover, 1997, 1998; Bruggers *et al.*, 2002).

In Hill and Chirala, villagers were against the predator as well as carnivore conservation. Wild carnivores commonly generate negative attitudes among rural residents in many regions of the world where they prey upon domestic animals (Oli *et al.*, 1994). In study area, the leopard was perceived as the major livestock predator and its attacks were thought to have increased, suggesting that the perceived threat of leopard attacks resulted in negative attitudes towards them. Similar findings have been reported by many other studies (Dar *et al.,* 2009). In Study area, 85% people are against the predator some said predator should be managed properly. Those who were less tolerant towards leopard tended to have suffered a greater financial loss, as has been found from human–snow leopard conflict studies in India (Oli *et al.*, 1994; Mishra, 1997), which further emphasizes the need to mitigate conflict.

Conclusions: About 216 livestock heads were killed by carnivore predators in Tehsil Dhirkot and its surrounding areas during 2009 and 2010. Maximum number of killings was reported in Union Council Hill (18%) while minimum number in Union Council Salian (09%) during night timings (36%) in winter season (36%). Leopard was responsible for majority of livestock killing (70.8%), followed by Jackal (30%) and Red Fox (30%). Goats were the most preferably killed by the leopard due to their portable size. Four persons were injured by common leopard in study area. Accordingly most of the local people (85%) dislike predators. The main reason for increase in livestock depredation was unavailability of natural prey species and poor herding practice in the study area. Proper herding practices, removal of livestock from carnivore's habitats, presence of herders and improved animal husbandry measures can decrease livestock killing. Awareness programs should be organized for the herders to minimize the depredation incidents.

REFERENCES

Bailey, T. N. (1993). The African Leopard. Columbia University Press, New York.

Baldus, R. D. (2004). Lion Conservation in Tanzania Leads to Serious Human-Lion Conflicts, with a Case Study of a Man-eating Lion Killing 35 People. Tanzania Wildlife Discussion Paper, 41:1-63.

Bruggers, R. L., R. Owens and T. Hoffan (2002). Wildlife damage research needs: perceptions of scientists, wildlife managers, and stakeholders of the USDA/Wildlife Services program. International Biodeterioration and Biodegradation, 49:213-223.

Conforti, V.A. and F.C.C. de Azevedo (2003). Local perceptions of Jagurs *(Panthera onca)* and pumas *(Puma concolor)* in the Iguacu National Park area, south Brazil. Biological Conservation, 111:215–221.

Conover, M. R. (1997). Wildlife management practices by metropolitan residents in the United States: practices, perceptions, costs, and values. Wildlife Society Bulletin 25:306-311.

Conover, M. R. (1998). Perceptions of American agricultural producers about wildlife on their farms and ranches. Wildlife Society Bulletin, 26:597-604.

Dar, N.I., R.A. Minhas, Q. Zaman, and M. Linkie (2009). Prediction of pattern, perception and causes of human-carnivore conflict in and around Machiara National Park, Pakistan. Biological Conservation, 142:2076-2082.

Dickman, A. J. (2008). Key Determinants of Conflict between People and Wildlife, Particularly Large Carnivores, Around Ruaha National Park, Tanzania. PhD Thesis, University College London (UCL) and Institute of Zoology, Zoological Society of London. pp. 373.

Graham, K., A.P. Beckerman and S. Thirgood (2005). Human-predator-prey conflicts: ecological correlates, prey losses and patterns of management. Biological Conservation, 122: 159-171.

Khan, R.N. (2002). Distribution and habitat preference of small mammals in Dhirkot, AJK. M.Sc. Thesis. University of AJK, Muzaffarabad.

Kolowski, J. M. and K. E. Holekamp (2006). Spatial, temporal and physical characteristics of livestock depredation by large carnivores along a Kenyan reserve border. Biological Conservation, 128, 529–541

Logan, K. A. and L.L. Sweanor (2001). Desert Puma: Evolutionary Ecology and Conservation of an Enduring Carnivore. Island Press, Washington D.C.

Mishra, C. (1997). Livestock depredation by large carnivores in the Indian trans-Himalaya: conflict perceptions and conservation prospects. *Environmental Conservation*, 24:338-343.

Mizutami, F. (1999). Impact of leopards on a working ranch in Laikipia, Kenya. African Journal of Ecology, 37, 211–225.

Newmark,W.D.D.N., D.G. Manyanza, M. Gamassa and H.I. Sariko (1994). The Conflict between Wildlife and Local People Living Adjacent to Protected Areas in Tanzania: Human Density as a Predictor. Conservation Biology , 8:249-255.

Nowell, K. and P. Jackson (1996). Wild Cats: status survey and conservation action plan. Burlington Press, Cambridge.

Ogada, M.O., R. Woodroff, N.O. Oguge and M. Frank (2003). Limiting predation by African carnivores: The role of livestock husbandry. Conservation Biology, 17, 1521–1530.

Oli and M. K., I. R. Taylor and M. E. Rogers (1994). Snow leopard (*Panthera uncia*) predation of livestock-an assessment of local perceptions in the Annapurna Conservation Area, Nepal. Biological Conservation, 68 1:63-68.

Patterson, B. D., S. M. Kasiki, E. Slempo and R.W. Kays (2004). Livestock predation by lions (*Panthera leo*) and other carnivores on ranches neighbouring Tsavo National Park, Kenya. Biological Conservation, 119, 507–516

Polisar, J., Matix, I., Scognamillo, D., Farrell, L., Sunquist, M.E. and Eisenberg, J.F., 2003. Jaguars, pumas, their prey base, and cattle ranching: ecological interpretations of a management problem. Biological Conservation, 109: 297–310.

Quigley, H.B. and Herrero (2005). Characterization and prevention of attacks on humans. Pages 27-49 in R. Woodroffe, S. Thirgood, and A. Rabinowitz, editors. People and Wildlife: Conflict or Coexistence? Cambridge University Press, Cambridge, U.K.

Roberts, T. J. (1997). The mammals of Pakistan (revised edition). Oxford University press Karachi. pp. 525.

Sekhar, N.U. (1998). Crop and livestock depredation caused by wild animals in protected areas: the case of Sariska Tiger Reserve, Rajasthan, India. Environmental Conservation, 25(2):160-171.

Sillero-Zubiri, C., M. and K. Laurenson (2001). Interactions between carnivores and local communities: conflict or co-existence? In: Gittleman, J., Funk, K., Macdonald, D. Wayne, R., eds. Carnivore Conservation. Cambridge University Press, Cambridge. 85: 282-312.

Stander, P. E. (1997). The ecology of lions and conflict with people in north-eastern Namibia. Pages 10-17 in B. L. Penzhorn, editor. A Symposium of Lions and Leopards as Game Ranch Animals. Wildlife Group of the South African Veterinary Association, Onderstepoort, South Africa.

Terborgh, J. J., A. Estes, P. Paquet, K. Ralls, D. Boyd-Heger, B.J. Miller and R. F. Noss (1999). The role of top carnivores in regulating terrestrial ecosystems. Soule ME, Terborgh J, editors. Continental Conservation*:* Scientifisc Foundations of Regional Reserve Networks. Island Press, Washington. Pages 39-64.

Terborgh, J., L. Lopez, P. Nunez, M. Rao, G. Shahabudin, G. Orihuela, M. Riveros, R. Ascanio, R. Adler, T. D. Lambert and L. Balbas (2002). Ecological melt down in predator-free forest fragments. Science, 294:1923.

Thirgood, S. R. and A.Woodroffe, Rabinowitz (2005). The impact of human-wildlife conflict on human lives and livelihoods. Pages 13-26 in R. Woodroffe, S. Thirgood, and A. Rabinowitz, editors. People and Wildlife: Conflict or Coexistence? Cambridge University Press, Cambridge, U.K.

Wang, S.W. and D.W. Macdonald (2006). Livestock predation by carnivores in sygme Singye Wangchuck National Park, Bhutan. Biological Conservation, 129:558-565.