



Universiteit
Leiden

The Netherlands

**Human-wildlife interactions in the Western Terai of Nepal.
An analysis of factors influencing conflicts between
sympatric tigers (*Panthera tigris tigris*) and leopards
(*Panthera pardus fusca*) and local communities around
Bardia National Park, Nepal**

Upadhyaya, S.K.

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Summary

Large carnivores and humans, along with their livestock, have co-existed for thousands of years. However, human population growth and an increase in economic activities are modifying the landscape for large carnivores and their prey. Large cats, which are regarded as keystone species for maintaining a healthy ecosystem through the balance between predator and prey, are now often locally on the verge of extinction. Large predators are sensitive to human activities and have been actively persecuted from all over the world, because of their conflicts with local people. The number of tigers (*Panthera tigris*) has declined rapidly in the past century and now they are confined to 7 % of their historical range. Similarly the range of leopards (*Panthera pardus*) has also declined significantly, although they are more widespread and adaptive than tigers. Since these carnivores require large habitats, degradation and fragmentation of their habitat over past decades are regarded as the major threats for their survival. The other factors responsible for their decline include poaching for illegal trade of body parts, loss of prey species and conflicts with local communities. Local farmers often face negative interactions with wild predators thereby experiencing economic loss by the killing of livestock. These conflicts in combination with a poor understanding of the ecological role which predators play may lead to local resentment against predators and negative attitude towards predator conservation projects.

Nepal is one of the 13 countries to ratify the Global Tiger Recovery Plan at the meeting of world leaders held in St. Petersburg in 2010, aims at doubling the number of wild tigers by 2022. In order to achieve this goal the Government of Nepal has focused on better conservation practices in and around tiger conservation landscape. Tigers are found in five National Parks of the lowland plain (Terai). This area is a part of the greater Terai Arc Landscape which is located in India and Nepal. There has been an increase in the tiger population after the end of civil war in Nepal, as well as a decrease in poaching, due to new government policy which included strict protection measures in national parks and the involvement of youths in anti-poaching campaign. As a result of a significant increase in the population of tigers inside Bardia National Park they are now showing more interaction with leopards. As tigers and leopards are elusive species it is difficult to study their interaction in the field. Therefore, using camera trap data obtained during 2013

and 2016, I studied the interaction between tigers and leopards in Bardia National Park. I found that there is a significant level of spatial avoidance of leopards towards tigers in the core zone of the park whereas in the boundary zone the spatial avoidance is not significant. I found that the temporal activities of leopards in grids of the core zone where tigers and leopards both are present are significantly different compared to grids where tigers are absent. The temporal activities of tiger are not significantly different in grids with leopards present in the core zone. However, the temporal activity of tigers is significantly different in the boundary zone when leopards were present, whereas the activity of leopard does not change. This can probably be explained by the suggestion that leopards approach human settlements more easily, while tigers show strong avoidance of human settlements. This also suggests that habitat partitioning and space use may play an important role in the co-existence of tigers and leopards in Bardia National Park. In general leopards show more avoidance to tigers than the other way round.

I also compared the diet and prey preference of tigers and leopards using their scats. However, due to lower number of leopard scats, I could not process it further and had to limit my study to the diet and prey preference of tigers only. I was able to identify male and female tigers based on DNA analysis of scat. I found that both male and female tigers were relying on medium sized prey (10 kg to 40 kg) namely chital (*Axis axis*) and wild pig (*Sus scrofa*) which was the most abundant prey in Bardia. However the Jacobs index for prey preference of male tiger was for sambar (*Cervus unicolor*) and wild pig whereas for female tiger the preference was for chital and wild pig, however the results were not statistically significant. The diet of tigers showed mostly the presence of wild prey species which suggests that they are generally not involved in the killing of livestock. For the long term conservation of the tiger in Bardia National Park we need to focus on increasing the population of larger prey species in the park, so that the available prey species are energetically beneficial for tigers and there is less competition with leopards.

I also looked into the spatiotemporal pattern of the conflict incidence in Bardia NP for a period of five years, on the basis of compensation paid to the villagers for the damage caused by wildlife. I found that four animals were mainly involved in causing damage to local communities, namely elephant (*Elephas maximus*), leopard, tiger and wild boar. The elephant was responsible for most of the damage. During the five years elephants killed 14 people and wild boar killed one person. Elephants also caused serious damage to the crops, destroyed houses and raided store houses for grains. Leopards and

tigers particularly caused depredation of livestock. Elephants caused more damage during the autumn season when the crops (mainly paddy) had matured. Leopards killed more livestock during the rainy season compared to dry season, while tigers did not showed seasonal pattern of predation. Tigers and leopards were involved in significantly more killing of livestock during the new moon phase compared to the full moon phase. The conflict incidence for elephants, wild boar and leopards was higher in the southern and the western part of the buffer zone, whereas tigers had a similar level of conflict all over the park.

To know more about the attitude and knowledge of local people living in the buffer zone towards conservation, I conducted a questionnaire survey by dividing the park into four different regions. I found that the loss of livestock was significantly related to number of livestock owned, the distance to the park boundary and the ethnicity of the respondent. The attitude of the respondent towards wildlife conservation was dependent on i) knowledge about the species, ii) (higher) educational level, iii) gender (male/female) and iv) level of self-sufficiency of the respondents, with a positive attitude related to more knowledge, male gender, higher education and higher self-sufficiency level of respondents. The sharing of conservation benefits also resulted in a positive attitude among the people living in the buffer zone.

In conclusion, it can be said that, due to the increase in number of tigers inside the park leopards may be pushed out of the park, where they become involved in conflicts while there may also be a spill-over of young tigers moving to the buffer zone. For future conservation of these large cats, additional habitats need to be sought and the community forest of the buffer zone can provide such habitat. Similarly, Banke National Park which has been established to provide a sink for the Bardia source population, which can help in accommodating the dispersed population of Bardia NP. Therefore, for future conservation programs we need to focus on the conservation of tiger and leopard in human dominated landscape. Due to interaction with tigers, the leopards are living in close proximity with people and thereby get more involved in conflicts with local communities. Tigers enjoy a religious and cultural tolerance among the people living in the buffer zone whereas leopards lack such religious and cultural tolerance.

