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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

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Activity patterns of co-existing tigers and leopards

"Interaction between sympatric tiger and leopard in Bardia National Park, Nepal."
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Abstract

We studied spatiotemporal activity patterns between tigers (*Panthera tigris*) and leopards (*Panthera pardus*) in Bardia. For this we used camera trap data from 2013 and 2016 which were placed inside grid cells of 2 × 2 km. We divided the park surface into a core zone and a boundary zone. We hypothesized that leopards are pushed towards the park boundary, which could be caused by the increase in tiger abundance in the core zone of the park. First, we tested if there is spatial avoidance between the two species. Second, we analyzed the temporal overlap and temporal activity between different time periods of the day to detect temporal avoidance. We found that there was a significant level of spatial avoidance between the two species in the core zone grid cells whereas in the boundary zone grid cells no such avoidance was detected. The overall temporal overlap was around 0.8 in both core zone and boundary zone grid cells, which is substantial. When all grid cells for the entire park were incorporated, the Fisher's test showed that temporal presence of leopards in grid cells where both leopard and tiger are present is significantly different from the activity of leopards in grid cells where tigers are absent. For the core zone specifically however, the presence of tigers was not significantly different in grid cells with the leopard in the core zone. The activity of the tigers in the boundary zone was significantly different when the leopard was present, while the activity of leopards did not change. Our findings suggest that leopards avoid tigers spatially and that leopards avoid tigers temporally in the core zone, but this pattern is different near the human-dominated area i.e. in the boundary zone.

Keywords

avoidance, boundary zone, camera traps, competition, core zone, species interaction, top predators.

2.1 Introduction

Top predators have been described as a flagship or umbrella species for their role in biodiversity conservation and maintaining a healthy ecosystem (Morrison et al., 2007; Ripple et al., 2014). The species interactions responsible for maintaining ecological integrity are eroding as animal populations are declining due to over-exploitation or habitat loss (Steinmetz et al., 2013). Managing populations of large carnivore species that are threatened, but in competition with each other, presents a conservation challenge over species prioritization (Rayan & Linkie, 2016).

Some studies pointed out that in optimal habitat, with sufficient prey, in combination with low densities of leopards and tigers, both predators can successfully co-exist, even with a certain overlap in spatiotemporal activity (Amarasekare, 2008; Lovari et al., 2015; Ramesh et al., 2012). In areas of high tiger density, tigers generally out-compete leopards and in extreme cases, tigers have been observed to attack and kill leopards (McDougal, 1988; Mondal et al., 2012b). Karanth & Sunquist (2000) reported leopards showing behavioral avoidance of tigers by hunting at different times of the day. Harmsen et al. (2009) pointed out from their study on puma (*Panthera concolor*) and jaguar (*Panthera onca*) that there was spatial overlap but no temporal overlap among them.

Some other studies also indicate that leopards avoid tigers in time and space (Odden et al., 2010; Steinmetz et al., 2013). Spatial segregation between tigers and leopards could be attributed to a general ecological dominance of tiger over leopard (Steinmetz et al., 2013). Intra-guild competition over prey has been reported to result in a change in feeding behavior (McDougal, 1988; Mondal et al., 2012b; Palomares & Caro, 1999; Ramesh et al., 2017). In this process, subordinate members of the guild have evolved activity patterns that minimize overlap with dominant predators (Hayward & Slotow, 2009). Seidensticker (1976) and Seidensticker et al. (1990) suggested that leopards consequently avoid areas frequented by tigers and often occupy the periphery of parks close to human settlements. As a catholic predator with a large prey base, leopards can adapt to a wide range of habitats, even in close proximity to human settlements (Athreya et al., 2013).

In Bardia National Park (henceforth Bardia) the number of tigers has been increasing since 2009, when about 18 tigers had been recorded. In 2014 their

number had increased to 50 individuals (Dhakal et al., 2014) and to 87 in 2018 (unpublished results).

In the present study we test the hypothesis that leopards would actively avoid tigers in Bardia as a consequence of this increase in tiger numbers. Due to the elusive nature of the tiger and leopard, which makes research based on direct observations impracticable, we used a presence and absence record in grid cells by compiling camera trap data from 2013 and 2016. We tested the following hypotheses: (1) activities of tigers and leopards show distinct patterns when comparing the year 2013 to 2016; (2) activity patterns of tigers and leopards are characterized by spatiotemporal variation; and (3) populations of tigers and leopards show different levels of overlap in the core zone versus the boundary zone of Bardia.

We expected that with the increase of tigers inside the park leopards are pushed towards the park edges. The results of this study are expected to provide a scientific basis for ecological restoration efforts for tigers and leopards. They could be used by e.g. park officials to formulate actions which would promote successful co-existence of these two apex predators in a human-dominated landscape.

2.2 Methods

2.2.1 Study Area

This study was carried out in Bardia which covers a surface area of 968 km^2. The buffer zone of the park covers an area of 507 square km (Figure 2.1). This park is one of the major sites for the conservation of large carnivores and is designated under category II by IUCN. The park is part of the Terai Arc Landscape (TAL), a trans-boundary tiger conservation landscape in India and Nepal, and is regarded as a level-1 tiger conservation unit (Wikramanayake et al., 2008). Carnivorous mammals present in the park include large carnivores (tiger and leopard) and meso-carnivores: grey wolf (*Canis lupus*), striped hyena (*Hyaena hyaena*), golden jackal (*Canis aureus*) and fox (*Vulpes vulpes*). The two major rivers flowing inside the park, Karnali river in the west and Babai river in the east, have created an alluvial floodplain grassland that is rich in biodiversity (Bhattarai & Fischer, 2014). Prey species in the park include chital (*Axis axis*), which is most abundant followed by hog deer (*Axis pornicus*), muntjac (*Muntaicus muntjak*) and wild boar (*Sus scro-*

fa) (Wegge et al., 2009). Larger prey ungulates which occur in lower densities include barasingha (*Cervus duvauceli*), nilgai (*Boselaphus tragocamelus*) and sambar (*Cervus unicolor*) (Wegge et al., 2009). The overall density of prey species is 92.6/km^2 with chital at 53.99/km^2, sambar at 4.45/km^2, wild boar at 4.79/km^2, muntjac at 1.97/km^2, rhesus monkey (*Macaca mulatta*) at 5.47/km^2 and langur (*Semnopithecus entellus*) at 21.35/km^2 (Dhakal et al., 2014).

The vegetation in Bardia National Park, mainly consists of Sal forest *Shorea robusta* and patches of grasslands dominated by *Imperata cylindrica*. Along the river alluvial tall grassland and variety of successional forest type is dominating (Odden, 2004). The forest types included: Sal forest, Khair-Sisso forest, Riverine forest and Hardwood forest (Dinerstein, 1979).

The land included forest patches, river and water bodies, agricultural lands, settlements, cultural heritages, village open space and other types of land use (Budhathoki, 2003). Subsistence farming is practiced by villagers in which crop production is supplemented by the use of forests and grasslands for livestock grazing (Studsrød & Wegge, 1995).

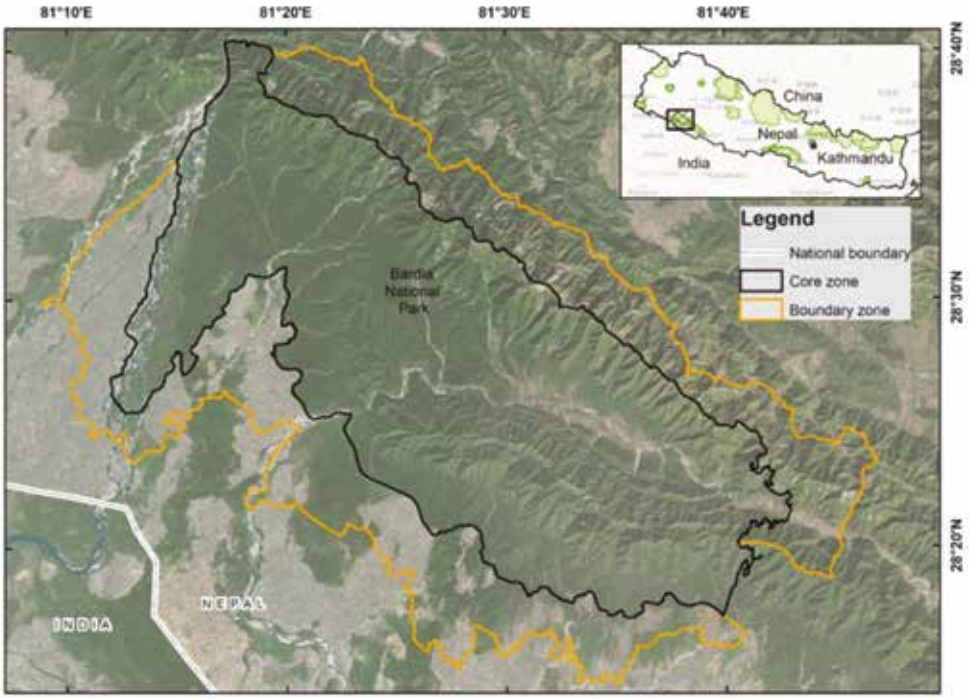

Figure 2.1
Study area showing the core zone and the boundary zone.

2.2.2 Study species

Tigers and leopards are sympatric in most of their shared habitat type, which mainly includes woodland and grassland with patches of thick vegetation (Seidensticker, 1976). Tigers and leopards coexist in the riverine forest and tall-grass vegetation of the Terai (Seidensticker et al., 2015). Co-existence of tigers and leopards are often associated with low densities of both species (Linnell & Strand 2000)

Leopards generally feed on small (< 50 kg) to medium-sized (50-100 kg) prey and other smaller prey items that are too small for tigers (Odden et al., 2010). Tigers generally feed on medium to larger (>100 kg) prey species. Nonetheless, tigers and leopards can prey on different size classes of the same species (Seidensticker et al., 2015). Where large prey occurs at very low densities, tigers have been observed to switch to smaller prey species, which could lead to more intense competition with leopards over prey (Støen & Wegge, 1996; Odden et al., 2010).

2.2.3 Data collection

Our study is based on camera trap data collected during 2013 and 2016 by the Department of National Parks and Wildlife Conservation (DNPWC) in technical collaboration with the National Trust for Nature Conservation (NTNC) and World Wildlife Fund (WWF), Nepal. In 2013, the camera trapping survey covered 72 days (17 February - 28 April 2013) with cameras placed at 238 locations, or the equivalent of 3570 trap nights. In 2016, the camera trapping survey covered 71 days (18 January- 28 March 2016) during which cameras were placed at 264 locations, or equivalent of 4215 trap nights.

The survey area was selected based on intensive sign survey prior to the deployment of camera in order to identify potential survey sites to increase probability of a tiger or a leopard being photographed. The study was done in the dry season mostly due to better accessibility of the study area and better visibility as a result of reduced vegetation cover. The survey area covered the whole park area including part of the buffer zone as well as the corridors, and was divided into grid cells of 2 × 2 km. A total of 238 grid cells were surveyed in 2013, with 175 grid cells in the core zone and 63 grid cells in the boundary zone. Grid cells which were at least partly extending beyond the park boundary were marked as boundary zone (henceforth BZ) grid cells. Grid cells which were located entirely inside the park boundaries were assigned as

core zone (henceforth CZ) grid cells. In 2016, 264 grid cells were surveyed, of which 175 grid cells in the core area and 89 grid cells in the boundary zone. A pair of motion sensor digital cameras (Bushnell Trophy Cam HD, Reconyx HC500 and HC550) facing each other, spaced at a distance of 6-8 m, was placed in each cell. The cameras were mounted on trees or wooden poles 45 cm above the ground, and placed on either side of the game trails, forest roads, and riverbeds without using a lure, for a period of 15 days at each grid cell (Dhakal et al., 2014). The CZ grid sample size was 175 for both 2013 and 2016 whereas 63 grids and 89 grids were sampled in the BZ in 2013 and 2016 respectively.

2.2.4 Spatial overlap

The presence of tigers and leopards in the designated grid cells was analyzed by camera capture records. Presence was scored for each tiger or leopard captured by the camera. To determine the presence of any spatial overlap we analyzed the data presented in Table 2.1. We performed a Chi-square test to analyze the level of spatial overlap between tigers and leopards.

2.2.5 Temporal overlap

Temporal overlap between tigers and leopards was calculated by comparing the times at which individual leopards and tigers had been captured on camera in the CZ versus the BZ. For estimations of inter-specific temporal interactions between tigers and leopards, two strategies were followed. For the first strategy, the temporal activity (diel time scale) was estimated using the non-parametric circular kernel-density function of activity derived from the camera trap captures and the coefficient of overlap (Dhat) to measure the extent of overlap between two kernel-density estimates (Carter et al., 2015; Linkie & Ridout 2011; Ridout & Linkie, 2009). The coefficient of overlap ranges from 0 (no overlap) to 1 (complete overlap). Overlap was defined as the area under the curve, taking the minimum of two kernel-density estimates at each point in time (Carter et al., 2015). As per the recommendation by Meredith & Ridout (2018), we used a coefficient of overlap estimator Dhat1 when the sample size was less than 50 and Dhat4 when the sample size was more than 75. For estimating the overlap, the time span for each independent detection was pooled to 30 minutes (only photographs taken at an interval of at least 30 minutes at one camera trap location were used) (Linkie & Ridout, 2011). We calculated the 95% confidence interval index using smoothed bootstrap with 10,000 resamples (Carter et al., 2015; Linkie

& Ridout 2011; Meredith & Ridout, 2018). We performed a density overlap test with (1) all grids of 2013 and 2016 combined, (2) grids of CZ of 2013 and 2016 combined, (3) grids of BZ of 2013 and 2016 combined. Temporal overlap analysis was performed in R using the '*overlap*' package (Meredith & Ridout, 2018).

For the second strategy, we combined 2013 and 2016 data and compared the temporal activity of tigers and leopards within certain periods of the day. Grid cells were marked as 'overlap grids' whenever both tiger and leopard were present and 'non-overlap grids' when either tiger or leopard was present. We did this comparison also for grid cells of CZ and BZ separately. For testing the temporal overlap, we divided the 24 hours of a day into dawn (05h01-08h00), day (08h01-17h00), dusk (17h01-20h00) and night (20h01-05h00), and counted the number of grid cells in which either tiger or leopard was caught on camera trap during these periods. We tested differences in activity with the Fisher's exact test. All statistical tests were performed in R.

2.3 Results

Table 2.1 provides a summary of tiger and leopard presence. We observed an increase in camera trap captures of tigers and a decrease in captures of leopards in 2016 compared to 2013.

Table 2.1
Number of camera trap grid cells showing tiger and leopard presence or absence during 2013 and 2016.

Number of grids		**2013**			**2016**		
				Tiger			
		Absent	Present	Sum	Absent	Present	Sum
	Absent	96	97	193	110	115	225
Leopard	Present	29	16	45	25	14	39
	Sum	125	113	238	135	129	264

Leopards were captured in 18.9% of the grid cells in 2013 and in 14.8% of the grid cells in 2016. Tigers were captured in 47.5% of the grid cells in 2013 and in 48.9% of the grid cells in 2016. Concurrent presence of both tiger and leopard was recorded for 6.7% and 5.3% of the grid cells in 2013 and 2016, re-

spectively. In 40.3% and 41.6% of the grid cells in 2013 and 2016, respectively, neither tiger nor leopard had been captured.

2.3.1 Spatial overlap of activity between tigers and leopards

After classifying grid cells as either core zone (CZ) or boundary zone (BZ), a significant level of spatial avoidance was found between tigers and leopards in the CZ grid cells of the park, but not in the BZ grid cells. In 2013, spatial overlap between tigers and leopards was recorded in five CZ grid cells (2.9%) and in 11 BZ grid cells (17.5%). In 2016, spatial overlap was observed in six CZ grid cells (3.4%) and eight BZ grid cells (9.0%).

Table 2.2
Spatial overlap between tigers and leopards in 2013 versus 2016 and for each zone (T1: tiger presence, T0: tiger absence, L1: leopard presence, L0: leopard absence, df: degree of freedom; p-value of Chi-square test shown).

Year	A(L1/T1)	B(L0/T1)	C(L1/T0)	D(L0/T0)	Sum	χ^2	df	p-value
Whole park (All grid cells combined):								
2013	16	97	29	96	238	3.16	1	0.075
2016	14	115	25	110	264	3.08	1	0.079
Difference between years						1.57	3	0.667
Grid cells in CZ:								
2013	5	75	20	75	175	7.77	1	0.005
2016	6	88	14	67	175	5.11	1	0.023
Difference between years						2.64	3	0.451
Grid cells in BZ:								
2013	11	22	9	21	63	0.08	1	0.777
2016	8	27	11	43	89	0.08	1	0.780
Difference between years						4.43	3	0.219

There was spatial overlap between tigers and leopards in both years, with greater overlap (p=0.219) in the BZ grid cells compared to the CZ grid cells (p=0.451). There was no difference between years in the number of presence/absence grid cells for leopards and tigers in the CZ and BZ (Table 2.2). When testing how the presence of leopards is different when tigers are present and vice versa, we found a significant difference between 2013 and 2016 for the CZ grid cells (p = 0.005, p = 0.023, Table 2.2).

2.3.2 Temporal overlap of activity between tigers and leopards

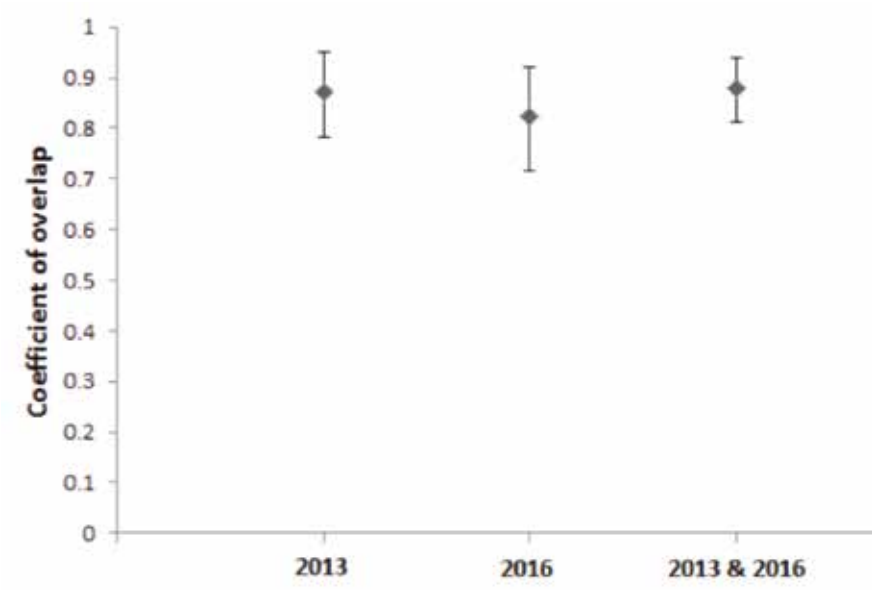

Figure 2.2
Temporal overlap with smoothed bootstrap confidence interval (95%) in all grid cells combined.

We found a considerable temporal overlap in tiger and leopard activity in both 2013 and 2016. Although the overlap estimator shows that the overlap in temporal activity between tigers and leopards had slightly (Δ=0.82) decreased in 2016 as compared to 2013 (Δ=0.87) for both zones combined, it showed an increase for the BZ in 2016 (Δ=0.83). The lowest temporal activity overlap between tigers and leopards was recorded in overlap grids during 2016 (Δ=0.69) and the highest in combined grids during 2013 and 2016 (Δ=0.88) (Table Appendix 2.1).

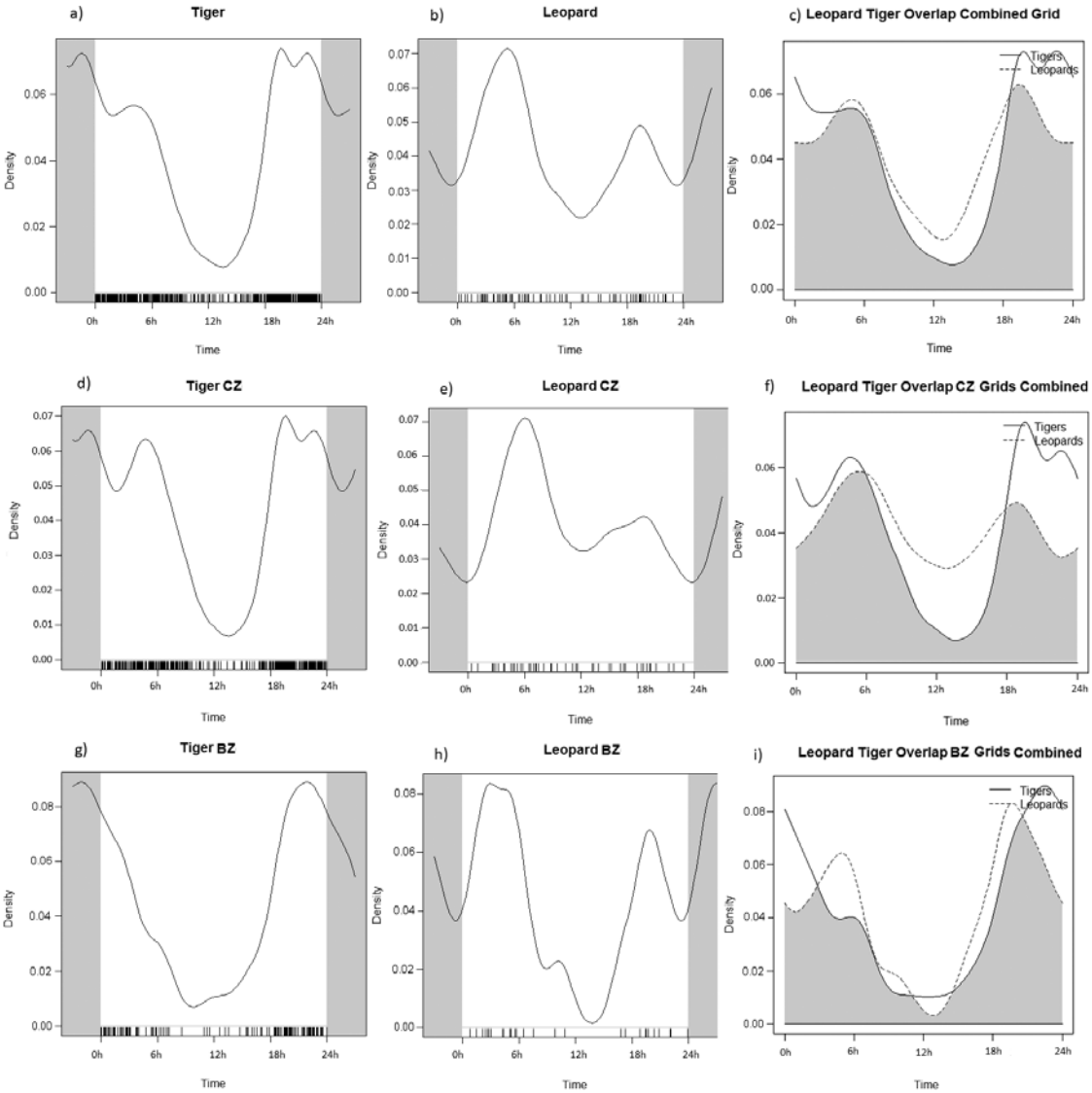

Figure 2.3
a) Activity curves of tigers in the absence of leopards, b) Activity curves of leopards in the absence of tigers, c) Activity curves of leopards and tigers in combined grid cells of 2013 and 2016, d) Activity curves of tigers in the CZ in the absence of leopards, e) Activity curves of leopards in the CZ in the absence of tigers, f) Activity of leopards and tigers when both were present in combined grid cells of the CZ for 2013 and 2016, g) Activity curves of tigers in the BZ in the absence of leopards, h) Activity of leopards in the BZ in the absence of tigers and i) Activity of leopards and tigers when both were present in combined grid cells of the BZ for 2013 and 2016. The coefficient of overlap is equal to the area below both curves, shaded grey in the diagram.

The activity of tiger in the 'tiger only' grid cells shows that they were most active during dawn and dusk, with less activity during the daytime for both zones combined (Figure 2.3a) as well as in the CZ (Figure 2.3d) while they were most active at night with less activity during the daytime in the BZ (Figure 2.3g). The activity of leopards in 'leopard only' grid cells shows that leopards were also active at dawn while less activity was seen during the dusk period for both zones combined (Figure 2.3b) and in the CZ (Figure 2.3e), and that leopards were more active than tigers during dawn and dusk but slightly less active during the daytime in the BZ (Figure 2.3h).

In general, leopards were more active during the daytime compared to tigers (Figure 2.3b). There was no significant difference in activity between tigers and leopards for grid cells where both tigers and leopards were present (Figure 2.3c); both tigers and leopards were more active during the night. There was a marked difference in activity between tigers and leopards in the overlap grid cells of the CZ, with leopards being more active during the day (Figure 2.3f). In the overlap grid cells of the BZ, leopards were more active during dawn and dusk and tigers were more active during the night (Figure 2.3i).

Table 2.3
Fisher's exact probability test comparing the number of times leopards and tigers were captured on camera in different time periods (dawn, day, dusk and night) between overlap grids and non-overlap grids and between CZ and BZ. More detailed data on each specific Fisher's test is provided in Table Appendix 2.2.

Temporal activity (2013 and 2016 combined grid cells)	**Fisher's test**	
	Leopard	**Tiger**
Overlap grid cells and non-overlap grid cells of the park	0.097	0.321
Overlap grid cells and non-overlap grid cells of CZ	0.024	0.975
Overlap grid cells and non-overlap grid cells of BZ	0.420	0.072
Overlap grid cells of CZ and overlap grid cells of BZ	0.386	0.429
Non-overlap grid cells of CZ and non-overlap grid cells of BZ	0.146	0.131

Leopard activity during dawn, day, dusk and night was significantly different in overlap grid cells versus non-overlap grid cells of the CZ ($p= 0.02$, Table 2.3). The temporal presence of tigers was significantly different when comparing overlap and non-overlap grid cells of the BZ ($p = 0.07$, Table 2.3). None of the other comparisons of temporal activity data showed any significant differences.

2.4 Discussion

Our findings suggest that with the increasing number of tigers, especially in the core zone of the park, leopards may have started to show a certain level of avoidance by moving towards the park boundary, which is in support of our hypothesis (Harihar et al., 2011; Mondal et al., 2012b; Odden & Wegge, 2005). Our results are comparable with those of Rayan & Linkie (2016) who found that leopards avoided tigers on a fine spatial scale in areas with high tiger and prey density, mainly in the central area of a park in Malaysia. Linnell & Strand (2000) confirmed that certain species of carnivores may be forced to avoid habitats used by a more dominant carnivore. In our study leopard seemed to avoid tigers in the CZ, which is in accordance with earlier findings from Bardia (Odden et al., 2010) and Chitwan National Park (Carter et al., 2015). Although we did not find any changes in this avoidance between 2013 and 2016, the lower camera capturing rate for leopards in combination with the higher capturing rate for tigers between both years do suggest a general negative presence correlation between both species. Most of the temporal overlap in activity pattern between tigers and leopards in both 2013 and 2016 took place at night in both the CZ and BZ of the park. Tigers showed a bimodal peak of activity, with a peak from midnight until early morning and a peak just after sunset (Azlan & Sharma, 2006). This finding calls for further investigation, as it is different from results presented by e.g. Kawanishi & Sunquist (2004), who found that tigers and leopards in Taman Negara National Park, Malaysia were more diurnal than nocturnal and their activity pattern overlapped with crepuscular/diurnal prey species. Our finding that leopards in Bardia were more diurnal compared to tigers is in accordance with earlier findings (Azlan & Sharma 2006; Steinmetz et al., 2013) from leopards and tigers in Malaysia and Thailand. This suggests that leopards can co-exist with tigers by shifting their activity pattern (Seidensticker, 1976). Further, leopards become less active when tigers are around, both during the day as well as during the night time (Sunquist, 1981).

The temporal overlap between tigers and leopards we found, could have been facilitated by the abundant prey of various sizes present in Bardia, as was also suggested to be the case in Chitwan (Carter et al., 2015). Mondal et al. (2012a) suggest that when tigers and leopards are present in the same habitat, leopards would target the smaller females or fawns of large ungulate prey, while tigers would more often hunt the adult males of such larger ungulate species. However, in areas of low prey density leopard closely track prey as well as avoid tiger (Steinmetz et al., 2013).

We found that the level of temporal overlap near the park boundary was higher in 2016 compared to 2013. This may be a result of the growing tiger population in Bardia. The high temporal overlap in activity between the two cat species (Dhat4 >0.7) suggests that if tigers and leopards share the same forested habitat, their temporal activity is not driven by behavior aimed at avoidance (Karanth & Sunquist, 2000). Mondal et al. (2012a) also suggested that in order to co-exist with tigers, leopards either decreased their niche breadth or shifted to areas where tigers were absent.

Our research suggests that at least some mutual avoidance between tigers and leopards occurs, although not visible from the overlap coefficient (Dhat4). The proximity of human settlements in the BZ grids may have contributed to the avoidance we found for tigers. Another explanation could be that the tigers that were captured on camera in the BZ were mainly sub-adult tigers that may have been displaced from their core home range or could be too young and inexperienced to compete with leopards (e.g. Kolipaka et al. 2017).

As home ranges and prey availability change with season for both tigers and leopards (Odden & Wegge, 2005; Kapfer et al., 2011), the spatiotemporal activity pattern of the two sympatric carnivores could change accordingly if captured during a different time of the year. Although our study only covered the dry season, mostly due to better accessibility of the study area and better visibility as a result of reduced vegetation cover, a year-round study could help to determine whether or not spatiotemporal activity patterns are seasonally dependent.

The camera traps were primarily used for estimating the number of tigers in the national park and therefore were put in places where there was a frequent movement of tigers. This may have resulted in an underestimation of leopard presence and may have enhanced the 'avoidance effect' we found for leopards.

For park management to be effective and for top predators to successfully co-exist, effective protection measures, targeted at both the predator species and its habitat, should be formulated and enforced. In order to achieve this, the effects of interspecific interactions, such as described in this chapter, should be taken into consideration. The knowledge that leopards, at least to some extent, are being displaced by tigers in Bardia could help to predict the effect of top predators on each other, especially when certain populations are increasing (Sunarto et al., 2015).

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We are grateful to the Department of National Parks and Wildlife Conservation (DNPWC), Kathmandu, Nepal for providing us the camera trap data. We thank Mr. Ramesh Thapa and Mr. Ashok Bhandari for their support and permission to work in BNP. We are also thankful to the National Trust for Nature Conservation, Bardia Conservation Program for their technical support in gathering the information. And finally we would like to express our gratitude to all the technicians and team members who participated in the camera trapping for their contribution.

Appendix

Table Appendix 2.1
Temporal overlap estimates for different years and grids. Approximate 95% bootstrap confidence interval of overlap estimates are also shown (OL-overlap grids; NOL-non-overlap grids).

Grids	Overlap estimates	95% bootstrap confidence interval	Overlap estimator
2013 All	0.87	0.78 -0.95	Dhat4
2016 All	0.82	0.71-0.92	Dhat4
2013 & 2016 All	0.88	0.81-0.94	Dhat4
2013 CZ	0.80	0.67-0.92	Dhat4
2016 CZ	0.76	0.62-0.90	Dhat4
2013 & 2016 CZ	0.81	0.71-0.90	Dhat4
2013 BZ	0.76	0.62-0.87	Dhat4
2016 BZ	0.83	0.67-0.97	Dhat4
2013 & 2016 BZ	0.83	0.73-0.92	Dhat4
2013 OL	0.79	0.63-0.92	Dhat1
2016 OL	0.69	0.49-0.87	Dhat1
2013 & 2016 OL	0.79	0.65-0.91	Dhat4
2013 & 2016 NOL	0.81	0.72-0.90	Dhat4

Table Appendix 2.2
Temporal overlap between tigers and leopards in the overlap and non-overlap grids of park, CZ and BZ over different periods of the day (dawn, day, dusk and night).

Grids	Tiger				Leopard			
	Dawn	*Day*	*Dusk*	*Night*	*Dawn*	*Day*	*Dusk*	*Night*
Overlap- Park	23	11	16	65	5	10	13	28
Non-overlap- Park	79	66	101	296	18	20	12	32
Overlap- CZ	8	5	9	23	1	2	3	13
Non-overlap- CZ	66	51	76	210	11	17	8	16
Overlap- BZ	15	6	7	42	4	8	10	16
Non-overlap- BZ	13	15	25	86	6	3	5	14