STATUS OF TIGERS
CO-PREDATORS & PREY IN TADOBA-ANDHARI TIGER RESERVE

2024

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भारतीय वन्यजीव संस्थान
Wildlife Institute of India

Status of Tigers, Co-Predators and Prey in Tadoba- Andhari Tiger Reserve

Long-term monitoring of tigers, co-predators and prey in tiger reserves and other tiger bearing areas of Vidarbha, Maharashtra

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Executive Summary

Phase IV monitoring for the Tadoba Andhari Tiger Reserve (TATR) core and buffer was conducted from January — April 2024 covering an area of 1324 sq. km. as a part of the project "Long-term Monitoring of Tigers, Co-predators and Prey in Tiger Reserves and other Tiger bearing areas of Vidarbha, Maharashtra". The objective of the Phase IV Monitoring is to estimate the minimum number of tigers in the reserve using Capture-Recapture Sampling and density estimation of prey base using Distance Sampling.

Camera traps were placed in 628 grids of 2.01 sq. km. area each in the core and buffer area of TATR in two blocks. In each sampling block, camera traps were active for 35 days. During 72 days of camera trapping survey with a sampling effort of 18,862 trap nights, 95 adult individual tigers were photographed in the sampled area of TATR. Estimated population (N) of tigers based on the best fit (SECR Heterogeneity) model was 95 (SE ± 0.70). Tiger density per 100 sq. km. based on the Spatially Explicit Capture-Recapture (SECR) model was 7.18 (SE ± 0.74). Along with tigers 144 adult individual leopards were photographed in the sampled area of TATR and estimated population (N) based on the best fit (SECR Heterogeneity) model was 144 (SE ± 0.92). Leopard density per 100 sq. km. based on the Spatially Explicit Capture-Recapture (SECR) model was 11.02 (SE ± 0.92).

To estimate prey density, 132 line transects in core and buffer of TATR were sampled 7 times during the sampling period, with a total walking effort of 1919.53 km. During the sampling, a total of 776 animal/bird observations were made. The overall individual density per km^2 of major prey species in TATR was gaur 2.90 (SE ± 0.83), sambar 2.30 (SE ± 0.42), spotted deer 2.92 (SE ± 0.63), wild boar 2.33 (SE ± 0.84), langur 2.57 (SE ± 0.58), barking deer 0.64 (SE ± 0.41), nilgai 0.77 (SE ± 0.16), black-naped hare 0.31 (SE ± 0.11), peafowl 0.97 (SE ± 0.24) and grey junglefowl 5.27 (SE ± 0.77).

A basic understanding of sympatric carnivore ecology with asymmetric competition enables us to hypothesize that to coexist and not just co-occur there must be niche segregation on at least one of the three axes: space, time, and/or diet. To understand how three large sympatric predators co-occur in space and in time, camera trapping was carried out. Temporal activity overlaps were derived by using kernel density. All the sympatric predators were found to co-occur in the sampled area of TATR. There was a distinct difference in the space-use pattern observed for all three carnivores and a strong spatial segregation pattern found between Tigers, Dholes, and Leopards. It showed significant segregation and avoidance of each other's space. There was a significant overlap between the temporal activity pattern of tigers and leopards. While tigers and leopards show a strong, unimodal, nocturnal activity pattern, dholes show a bimodal, crepuscular activity pattern.

Figure (i): Minimum Convex Polygons of Tigers (Males and Females) from Tadoba Andhari Tiger Reserve during the year 2024 with respect to beat boundaries.

Figure (ii): Minimum Convex Polygons of Tigers (Males) from Tadoba Andhari Tiger Reserve during the year 2024 with respect to beat boundaries.
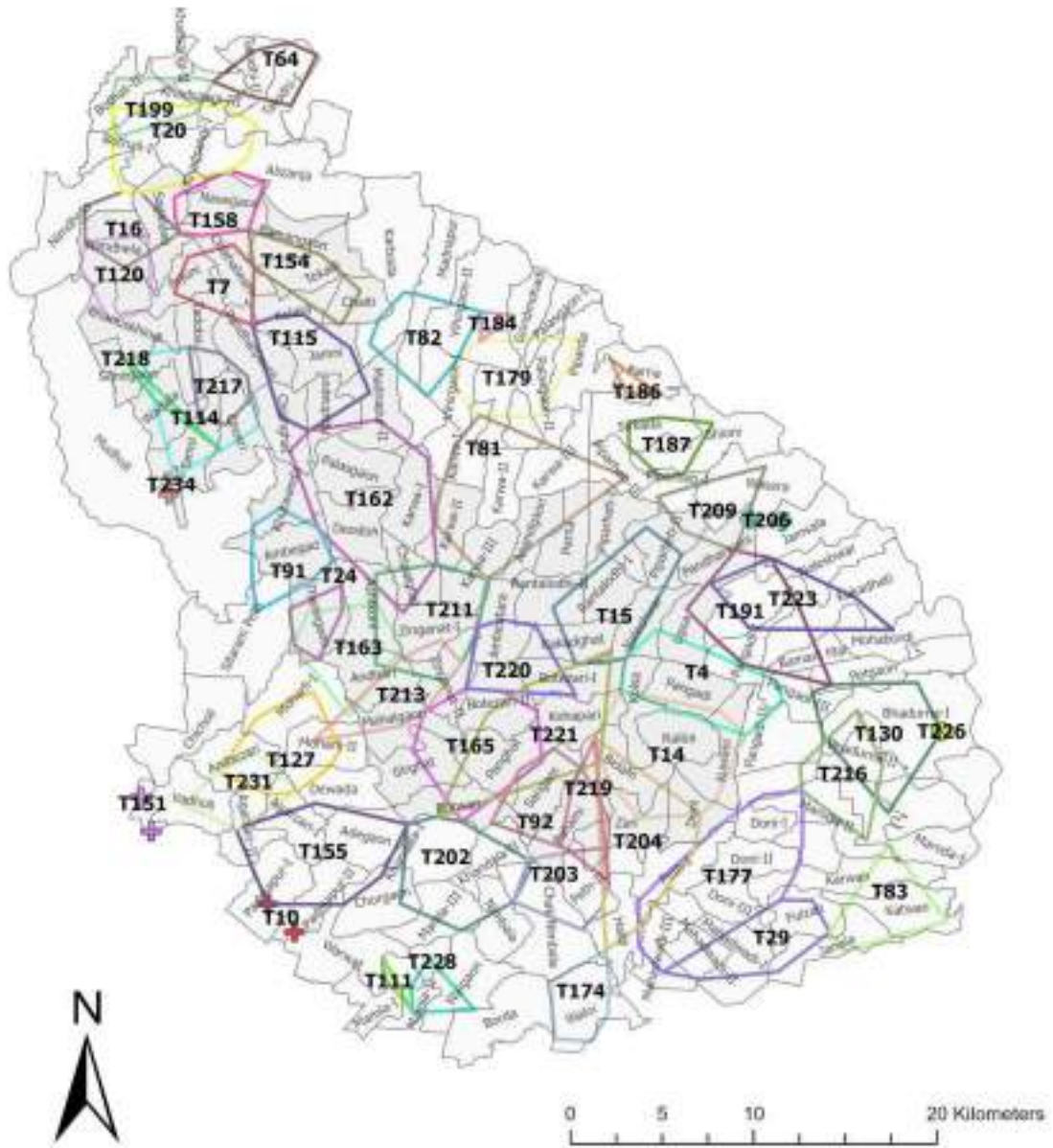
Figure (iii): Minimum Convex Polygons of Tigers (Females) from Tadoba Andhari Tiger Reserve during the year 2024 with respect to beat boundaries.
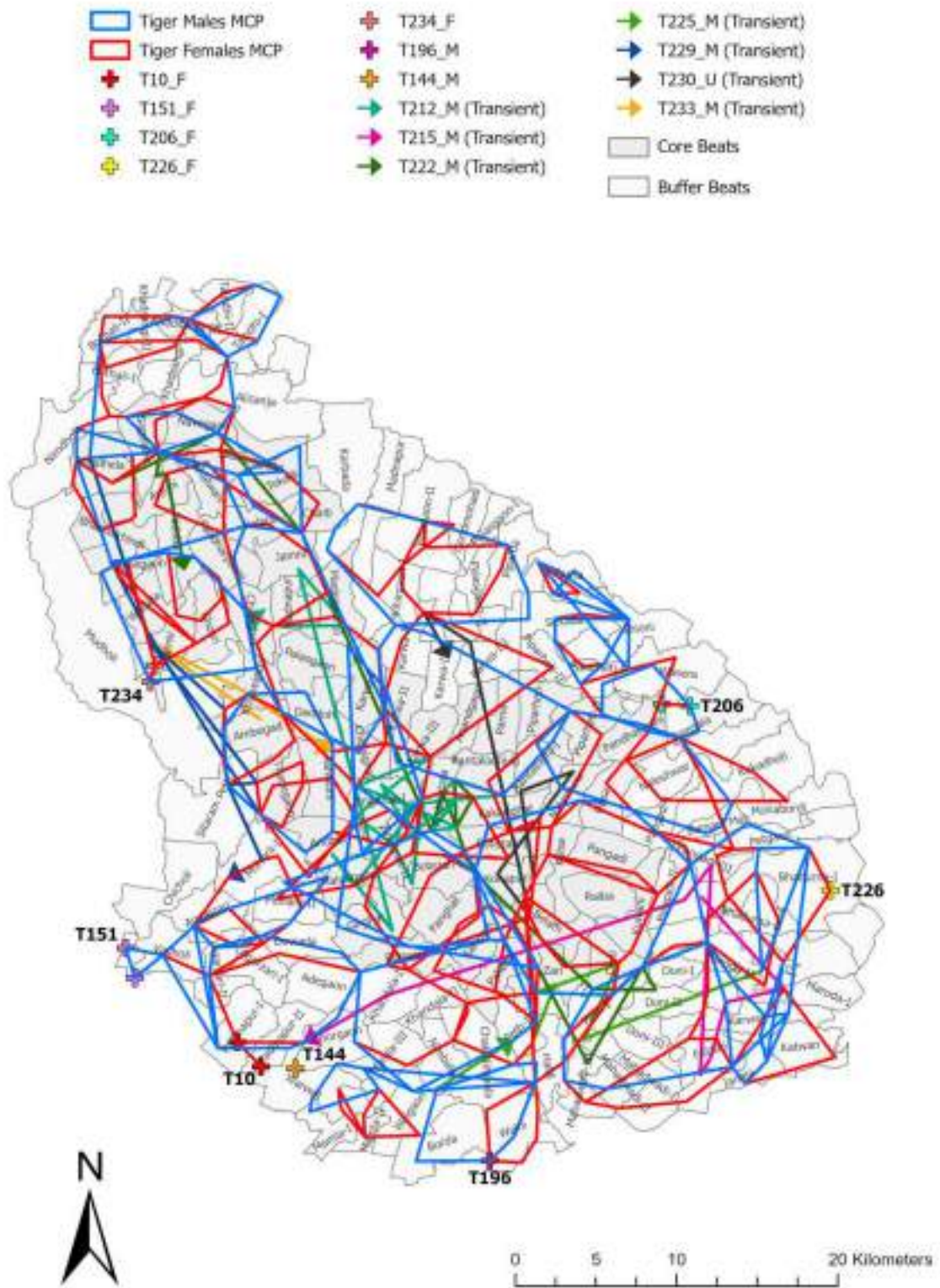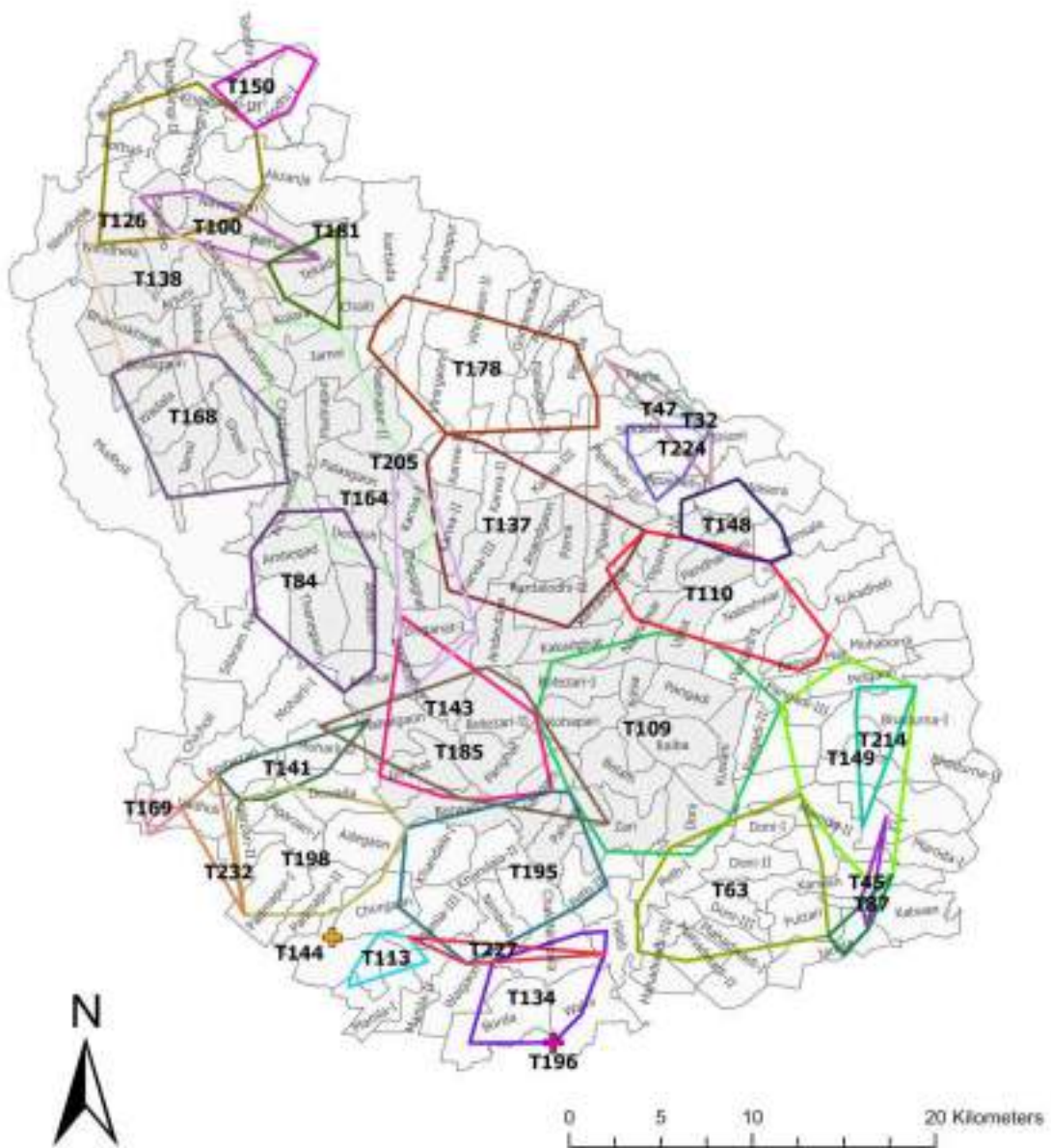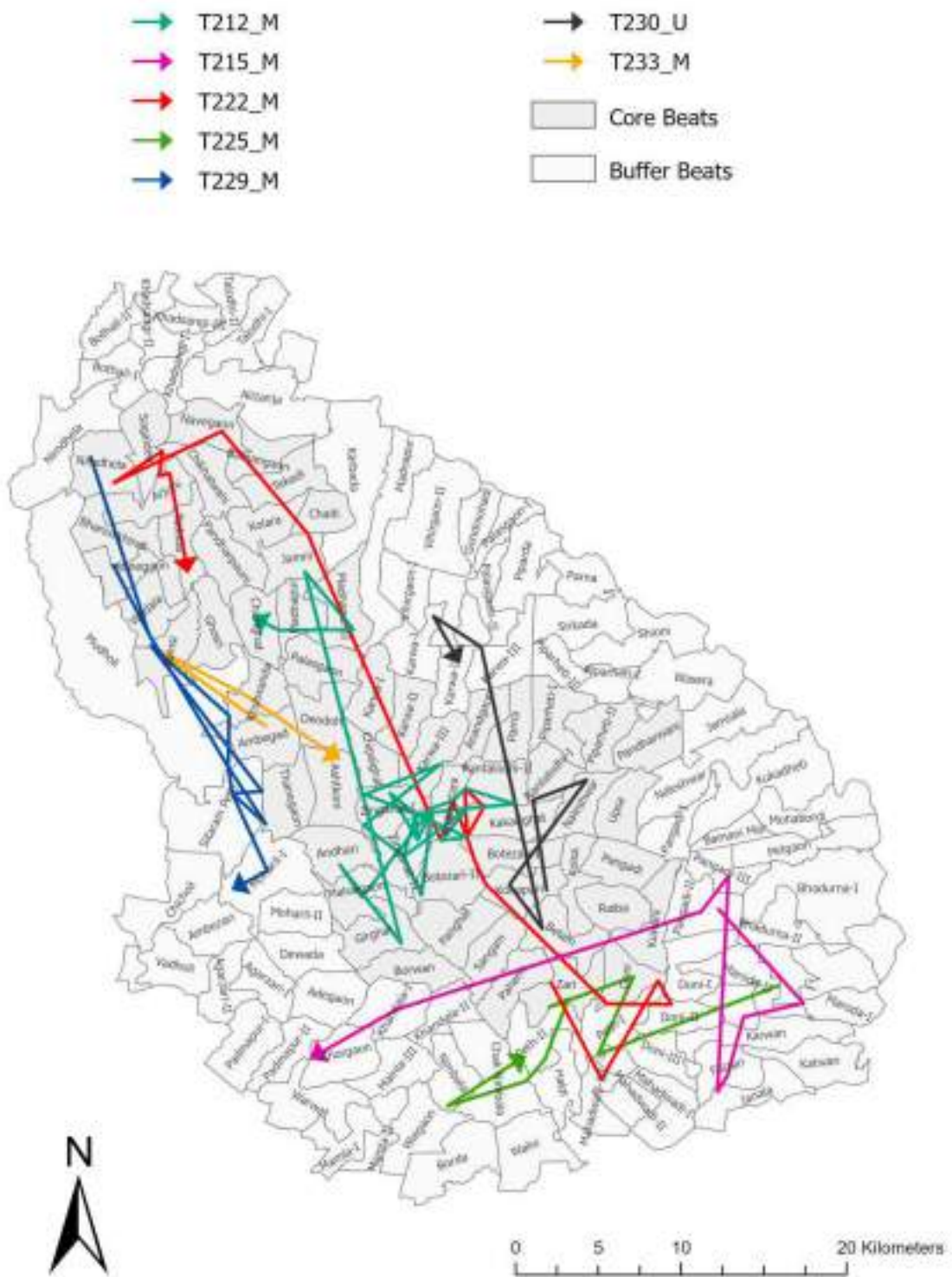
Figure (iv): Minimum Convex Polygons of Tigers (Transients) from Tadoba Andhari Tiger Reserve during the year 2024 with respect to beat boundaries.

Introduction

Tigers are one of the most charismatic and awe-inspiring species in our world. India holds around 75% of the global tiger population. One of the major reasons for this is the conservation efforts put in place by our country to bring this species back from the brink of extinction under the Project Tiger. This includes providing inviolate spaces for the tigers to live and breed along with maintaining a healthy prey population in these forests. For this purpose, healthy tiger habitats were identified from across the country and were declared as tiger reserves to provide them with the highest level of conservation status. These reserves have been intensively monitored year-round to prevent all illegal activities like poaching, illegal grazing, encroachment, *etc.* to provide a haven for tigers and other wildlife.

Tadoba Andhari Tiger Reserve (TATR) is one of the 57 tiger reserves currently present in our country. It is located in the Chandrapur district of Maharashtra, between 20°04' 53" to 20°25' 51" N and 79°13' 13" to 79°33' 34" E. It consists of the Tadoba National Park with an area of 116.55 km^2 (declared in 1955) and the Andhari Wildlife Sanctuary with an area of 508.85 km^2 (declared in 1983) which together form the core area of the tiger reserve with a total area of 625.4 km^2 along with a buffer area of 1101.7 km^2 around the core which was added in the year 2012. With a total area of 1727 km^2 it is amongst the largest tiger reserves in the state (Figure 1).

TATR acts as a major source population of tigers and leopards not just for the adjoining forest divisions of Bramhapuri, Chandrapur and Central Chanda but also for other protected areas such as Umred-Paoni-Karhandala Wildlife Sanctuary, Nawegaon-Nagzira Tiger Reserve, Bor Tiger Reserve, Pench Tiger Reserve and Kawal Tiger Reserve. The adjoining forests and other forest patches function as corridors and connect these protected areas with each other. Thereby helping in maintaining a healthy gene flow between these reserves.
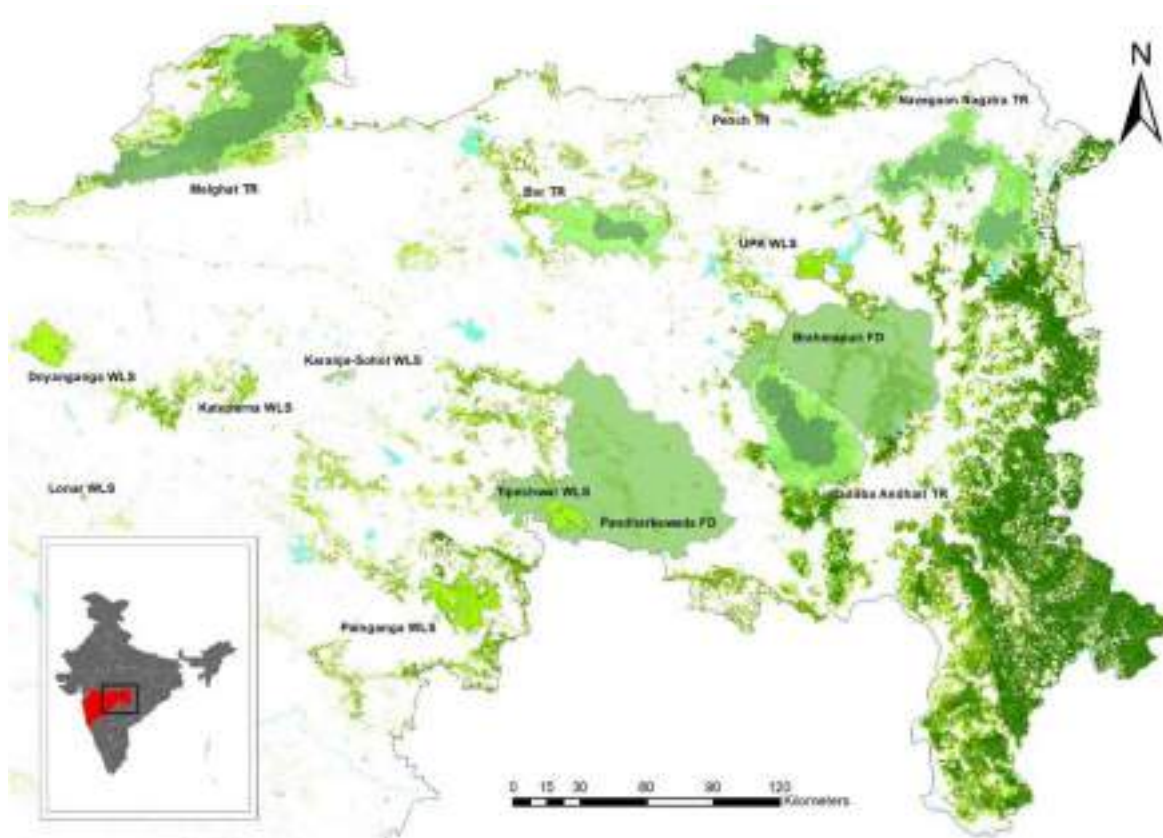
Figure 1: Map showing the location of Tadoba Andhari Tiger Reserve along with other tiger reserves and protected areas in the Vidarbha landscape of Maharashtra

Flora and Fauna of TATR

The tiger reserve harbours 61 species of mammals apart from tigers including leopard (*Panthera pardus*), dhole or asiatic wild dog (*Cuon alpinus*), sloth bear (*Melursus ursinus*), gaur (*Bos gaurus*), sambar deer (*Rusa unicolor*), chital or spotted deer (*Axis axis*), barking deer or Muntjacs (*Muntiacus muntjak*), chausingha or four-horned antelope (*Tetracerus quadricornis*), ratel or honey badger (*Mellivoora capensis*), jungle cat (*Felis chaus*), rusty-spotted cat (*Prionailurus rubiginosus*), *etc.* 34 species of reptiles are also found in the tiger reserve which includes mugger crocodile or marsh crocodile (*Crocodilus palustris*), Indian rock python (*Python molurus*), russell's viper (*Daboia russelii*), Indian cobra or spectacled cobra (*Naja naja*), *etc.* along with more than 250 species of birds and 174 species of butterflies.

According to Champion and Seth's classification (1968) the vegetation of TATR can be classified as Southern Tropical Dry Deciduous Forest. The vegetation of TATR can be further divided into dry deciduous forest, bamboo forest, open forest, riparian forest, and scrubland. The most dominant species of trees in TATR is Teak (*Tectona grandis*). Other dominant tree species include Ain (*Terminalia eliptica*), Arjun (*Terminalia arjuna*), Bhera (*Chloroxylon swietenia*), Dhawada (*Anogeissus latifolia*), Mahua (*Madhuca indica*), Salai (*Boswelia serrata*), Tendu (*Diospyros melanoxylon*), *etc.* Along with these species like Jamun (Syzigium cumini) and Mango (Mamgifera indica) can be seen in the riparian patches of the tiger reserve. According to a study by Paliwal & Mathur (2014), the tiger reserve is dominated by mixed bamboo forest which occupies 77.99% of the total area. Most dominant species of bamboo found in TATR is Dendrocalamus strictus.

As a part of the research project titled "Long-term monitoring of Tigers, Co-predators and prey in Tiger reserves and other Tiger bearing areas of Vidarbha, Maharashtra", the Wildlife Institute of India has initiated this study in 2019 having the objectives that are as follows:

Objective 1: Status of tigers, co-predators and their prey in the landscape

a) Field surveys will be conducted to detect the presence of tigers, co-predators and prey species using animal signs (tracks, scats, direct sightings, calls, *etc.*) in occupancy-based framework. The data will be analyzed in the occupancy framework to estimate the occupancy of the target species. Single season or multiple season occupancy models will be used depending on data collection approaches. These occupancy field surveys will be carried in all the tiger areas. The data collection will be followed by modelling and estimation approaches described in detail by Mackenzie *et al.* (2002, 2006).

b) Density, abundance and demography of tigers and co-predators will be carried by using camera traps in all the tiger areas followed by analyzing the data in capture—recapture framework. Rigorous field methods will be followed to achieve a small CV and high precision. These field surveys will be conducted in all the tiger areas.

c) Estimation of abundance and density of the key ungulate species will be conducted using distance sampling employing line-transect survey protocols. The survey protocols and analyses of this data set will be based on modelling and estimation approaches developed by Buckland *et al.* (2001, 2004).

d) Estimation of recruitment, survival, transience, temporary emigration, permanent emigration and dispersal rates of tigers and leopards will be based on data collected from camera trapping and radiotelemetry.

e) Scat analysis is indirect, non-invasive, and unbiased technique for recording frequency of occurrence of prey in the diet of large carnivores and hence it is most widely used (Johnson *et al.*, 1983; Leopold and Krausman, 1986; Jhala, 1993; Mukherjee *et al.*, 1994a, b; Spaulding *et al.*, 1997; Jethva, 2002; Biswas and Sankar, 2002). Scats will be collected at regular time intervals, generally every week. The scats will be collected in polythene bags, labelled and sun-dried in the field. Information on habitat, substratum where scat will be found, and its GPS location will also be recorded.

Objective 2: Development of database on tigers across the landscape

The photo database generated by the methodology delineated in 1b above will be collated at every tiger area level. Identification of unique individuals will be done from these collated photographs and a database of identified tiger individuals will be generated. New photographs from every camera trapping session will be compared with the existing database, whereby recaptured individuals will be noted, and any new individuals found will be added to the database.

Objective 3: Identification of tiger dispersal in the landscape

On an event when a previously captured individual goes missing in pictures from the current camera trapping exercise, or when a new individual is discovered, it will be cross-checked against tiger databases of adjoining areas. This will enable us to find out if a missing individual has dispersed to a new area.

Objective 4: Development of feedback for management intervention at reserve & landscape level

The outputs of the project will help in developing management feedback for the State of Maharashtra to effectively manage tiger populations.

Tadoba Andhari Tiger Reserve

Tadoba Andhari Tiger Reserve (TATR) falls in Chandrapur district of the Vidarbha region of Maharashtra, between 20°04' 53" N, 79°13' 13" E and 20°25' 51" N, 79°33' 34" E. The core area of TATR includes Tadoba National Park (116.55 sq. km.), declared in 1955 and Andhari Wildlife Sanctuary (508.85 sq. km.), declared in 1983 giving it a total area of 625.82 sq. km. Along with core the tiger reserve also has a buffer area of 1101.77 sq. km added in the year 2012. Total area of the tiger reserve comes out to 1727.59 sq. km (Figure 2).
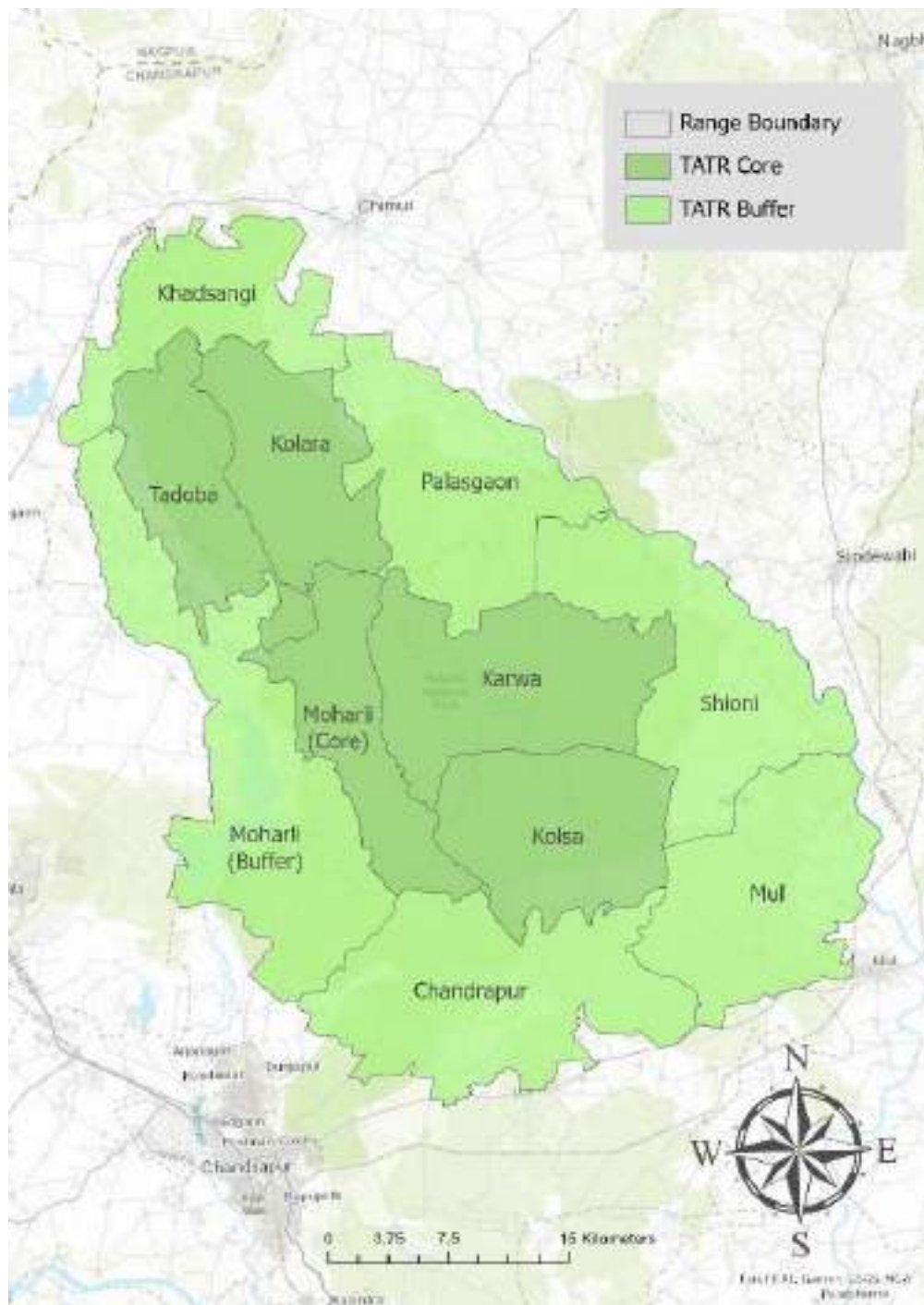

Figure 2: Map depicting Critical Tiger Habitat (core) and Buffer area of Tadoba Andhari Tiger Reserve, Maharashtra, India

The name of Tadoba national park comes from the Tadoba lake situated in the Tadoba range of core, whereas Andhari wildlife sanctuary gets its name from the Andhari river which flows through the sanctuary region and acts as the lifeline for the tiger reserve. The terrain is generally flat with small hills towards the northern and southern parts of the tiger reserve. The elevation varies from 145 to 425 meters above sea level (Figure 3). TATR is surrounded by Bramhapuri forest division towards the north and east and Chandrapur forest division and Central Chanda forest division towards west and south. These forests act both as connectivity corridors as well as buffer areas for the spill-over population of TATR. The tiger reserve is well connected with Umred-Paoni-Karhandala Wildlife Sanctuary, Navegaon-Nagzira Tiger Reserve and Kawal Tiger Reserve (Telangana).
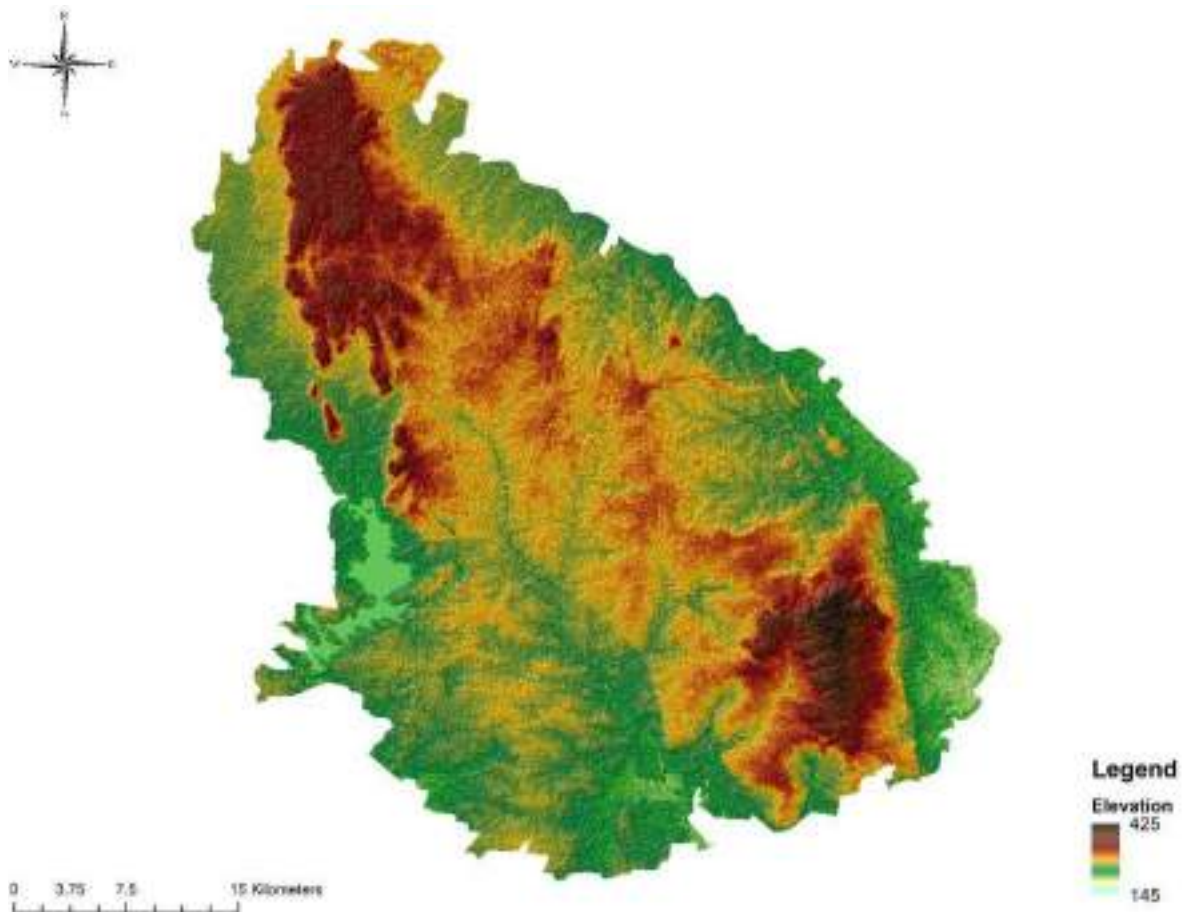
Figure 3: Map depicting the elevation gradient of Tadoba Andhari Tiger Reserve, Maharashtra, India

The forest can be classified as Southern Tropical Dry Deciduous forest, according to Champion and Seth's classification (1968). The vegetation of TATR can be further divided into dry deciduous forest, bamboo forest, open forest, riparian forest and scrubland (Figure 4). Teak (*Tectona grandis*) is the most common species along with Ain (*Terminalia eliptica*), Arjun (*Terminalia arjuna*), Bhera (*Chloroxylon swietenia*), Dhawada (*Anogeissus latifolia*), Mahua (*Madhuca longifolia*), Salai (*Boswelia serrata*), Tendu (*Diospyros melanoxylon*), Jamun (*Syzigium cumini*) and Mango (*Mangifera indica*), *etc.* According to Paliwal & Mathur (2014), the tiger reserve is dominated by mixed bamboo forest which occupies 77.99% of the total area. Dendrocalamus strictus is the most dominant species of bamboo found in TATR.

More than 61 species of mammals including tigers (*Panthera tigris*), leopards (*Panthera pardus*), asiatic wild dogs (*Cuon alpinus*), sloth bear (*Melursus ursinus*), gaur (*Bos gaurus*), sambar (*Rusa unicolor*), chital (*Axis axis*), barking deer (*Muntiacus muntjak*), four-horned antelope (*Tetracerus quadricornis*), wild boar (*Sus scrofa*), honey badger (*Mellivora capensis*), jungle cat (*Felis chaus*) and rusty-spotted cat (*Prionailurus*

rubiginosus), *etc.* are found in TATR. 34 species of reptiles are also found in the tiger reserve which includes mugger crocodile or marsh crocodile (*Crocodilus palustris*), Indian rock python (*Python molurus*), Russell's viper (*Daboia russelii*), Indian cobra or spectacled cobra (*Naja naja*), *etc.* along with more than 250 species of birds and 174 species of butterflies.
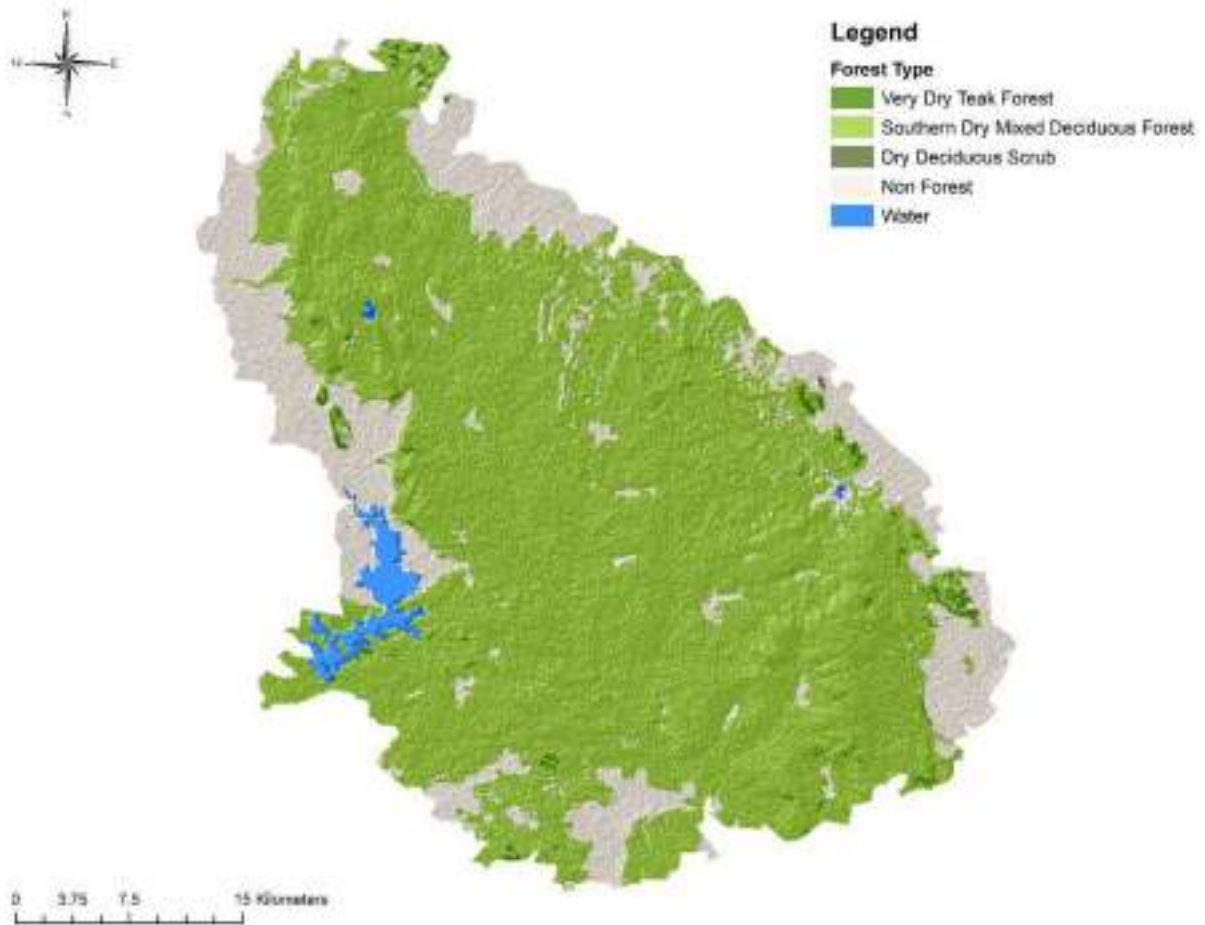
Figure 4: Map depicting the forest types and cover of Tadoba Andhari Tiger Reserve, Maharashtra, India

Status of Prey Species in Tadoba Andhari Tiger Reserve

Line transect based distance sampling survey was conducted in Tadoba-Andhari Tiger Reserve (TATR) between 1st-10th February, 2024. Each line transect was sampled 7 times during the sampling period. Figure 5 shows the distribution of line transects across the tiger reserve. The transects are well spread across the tiger reserve., covering almost all the vegetation types in the area.
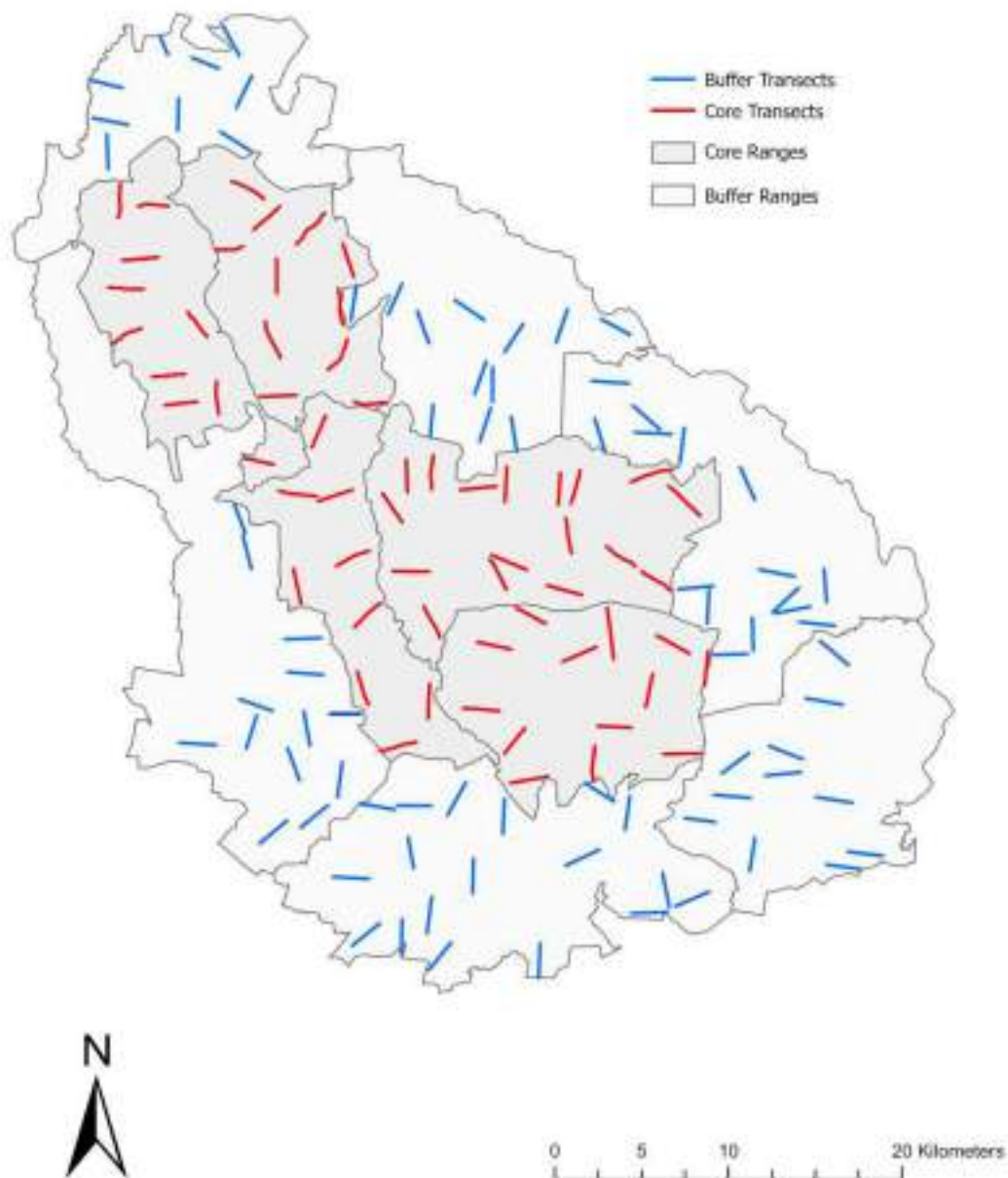
Figure 5: Locations of line transects in the Tadoba Andhari Tiger Reserve, Maharashtra, India

During the 7 days, a total of 132 transects of 2 km length were monitored, with an effort of 1919.53 km (Table 1), which generated a total of 776 observations of all prey species. This includes the major prey species like Sambar (*Rusa unicolor*), Barking Deer (*Muntiacus muntjak*), Gaur (*Bos gaurus*), Wild Boar (*Sus scrofa*), Nilgai (*Boselaphus tragocamelus*), Langur (*Semnopithecus spp.*), Spotted Deer (*Axis axis*), Indian Hare (*Lepus nigricollis*), Grey Junglefowl (*Gallus sonneratii*) and Peafowl (*Pavo cristatus*).

Table 1: Transect monitoring effort and species reported from Tadoba Andhari Tiger Reserve, Maharashtra, India during the year 2024

Survey Details	Core	Buffer
Number of transects	57	75
Length of each transect	2 km	2 km
Number of replicates	1-7	1-7
Total distance covered	815.81 km	1103.72 km
Beats	60	77
Number of species recorded	10	10

During the transect exercise of Tadoba Andhari Tiger Reserve in 2024, a total of 776 sightings of 10 major prey species were recorded. Grey junglefowl was the most frequently recorded species with 144 sightings in core and 79 sightings in buffer. The maximum number of individuals were recorded of Spotted deer in core (287 individuals) and Gaur in buffer (204 individuals) (Table 2).

Table 2: Details of species recorded in the Tadoba Andhari Tiger Reserve, Maharashtra, India during the year 2024

Species Recorded	Core		Buffer	
	Number of Sightings	Individuals recorded	Number of Sightings	Individuals recorded
Barking Deer & Chousingha	20	22	16	18
Gaur	27	78	40	204
Grey Junglefowl & Red Spurfowl	144	216	79	121
Hare	6	6	10	11
Langur	31	182	25	165
Nilgai	22	411	40	71
Peafowl	28	47	18	30
Sambar	71	157	40	84
Spotted Deer	49	287	48	159
Wild Boar	26	93	36	113

Density of all prey species (all the individual prey species combined) of TATR is estimated to be 20.98. The Individual Density, Group Density, Effective Strip Width, Average Group Size and Encounter Rate of species reported during the Phase IV Monitoring 2024 in the Core, Buffer and across Tadoba Andhari Tiger Reserve, Maharashtra, India is given in Table 3 (a-c) and 4 (a-c).

Table 3 (a): Individual Density, Group Density, Effective Strip Width, Average Group Size and Encounter Rate of various ungulate species reported from the Core of Tadoba Andhari Tiger Reserve, Maharashtra, India during the year 2024

Parameters	Barking Deer & Chous-ingha	Gaur	Grey Junglefowl & Red Spurfowl	Hare	Langur	Nilgai	Peafowl	Sambar	Spotted Deer	Wild Boar
Individual density (Animals/Km²)	0.85	0.72	9.04	-	2.67	0.60	3.32	3.47	2.92	1.66
Standard error	0.31	0.45	3.08	-	0.84	0.25	2.39	0.92	1.34	0.71
Percent CV	36.29	63.01	34.12	-	31.77	41.63	71.98	26.47	46.01	42.57
95% confidence interval	0.42-1.72	0.22-2.33	4.69-17.39	-	1.44-4.93	0.27-1.32	0.89-12.32	2.07-5.80	1.23-6.94	0.74-3.73
Group density										
(No of groups/Km²)	0.79	0.55	6.33	-	0.52	0.33	1.72	1.61	0.81	0.64
Standard error	0.28	0.15	2.14	-	0.15	0.13	1.22	0.40	0.31	0.22
Percent CV	35.83	27.82	33.89	-	28.58	39.10	71.10	25.10	38.74	34.75
95% confidence interval	0.40-1.58	0.32-0.94	3.30-12.13	-	0.30-0.91	0.16-0.70	0.47-6.29	0.99-2.64	0.38-1.70	0.32-1.24
Effective strip width	13.94	29.15	13.84	-	35.15	38.73	9.99	26.56	36.32	24.10
Standard error	2.57	4.52	4.18	-	5.62	8.95	6.59	4.18	9.94	3.74
Percent CV	18.42	15.51	30.24	-	16.0	23.13	66.05	15.76	27.37	15.52
95% confidence interval	9.48-20.50	21.22-40.05	7.71-24.84	-	25.39-48.66	24.05-62.36	2.90-34.41	19.43-36.30	21.14-62.39	17.53-33.13
Average group size	1.11	2.81	1.50	-	5.66	1.71	1.68	2.20	5.92	3.12
Standard error	0.07	0.57	0.07	-	0.55	0.31	0.22	0.21	0.75	0.87
Percent CV	6.86	20.44	4.71	-	9.77	18.51	13.38	9.32	12.76	27.96
95% confidence interval	1.0-1.28	1.85-4.25	1.37-1.65	-	4.64-6.91	1.17-2.51	1.27-2.21	1.83-2.65	4.58-7.64	1.77-5.49
Encounter rate	0.02	0.03	0.18	-	0.04	0.02	0.03	0.08	0.06	0.03
Percent CV	30.74	23.10	15.30	-	23.68	31.52	26.34	19.54	27.41	31.10
95% confidence interval	0.01-0.04	0.02-0.05	0.13-0.24	-	0.02-0.06	0.01-0.05	0.02-0.06	0.06-0.13	0.03-0.10	0.01-0.06
Probability of a greater chi-square value, P	0.91	0.94	0.86	-	0.86	0.99	0.73	0.82	0.91	0.90

Table 3 (b): Individual Density, Group Density, Effective Strip Width, Average Group Size and Encounter Rate of various ungulate species reported from the Buffer of Tadoba Andhari Tiger Reserve, Maharashtra, India during the year 2024

Parameters	Barking Deer & Chousingha	Gaur	Grey Junglefowl & Red Spurfowl	Hare	Langur	Nilgai	Peafowl	Sambar	Spotted Deer	Wild Boar
Individual density (Animals/Km²)	0.21	4.13	2.36	-	2.74	0.84	0.50	1.11	1.73	1.39
Standard error	0.08	1.66	0.48	-	1.03	0.21	0.18	0.32	0.58	0.43
Percent CV	38.43	40.19	20.44	-	37.73	24.94	35.66	28.85	33.60	31.37
95% confidence interval	0.10-0.45	1.92-8.88	1.58-3.53	-	1.33-5.65	0.52-1.36	0.25-0.98	0.64-1.96	0.90-3.30	0.75-2.54
Group density										
(No of groups/Km²)	0.19	1.04	1.49	-	0.40	0.45	0.28	0.57	0.54	0.64
Standard error	0.07	0.35	0.29	-	0.12	0.10	0.09	0.15	0.15	0.16
Percent CV	38.05	33.51	19.65	-	30.63	23.28	31.93	27.25	27.21	25.43
95% confidence interval	0.09-0.39	0.54-1.98	1.02-2.19	-	0.22-0.72	0.28-0.71	0.15-0.53	0.34-0.97	0.32-0.93	0.39-1.05
Effective strip width	32.81	16.34	23.04	-	28.17	39.82	26.76	30.46	37.67	25.02
Standard error	8.35	2.48	2.07	-	4.95	5.20	5.94	4.02	4.36	4.30
Percent CV	25.44	15.15	9.0	-	17.59	13.07	22.23	13.21	11.59	17.20
95% confidence interval	19.10-56.36	12.04-22.18	19.26-27.55	-	19.65-40.40	30.60-51.82	16.80-42.63	23.34-39.76	29.85-47.55	17.68-35.41
Average group size	1.07	4.92	1.54	-	6.60	1.78	1.71	2.10	3.40	3.14
Standard error	0.07	0.91	0.10	-	1.08	0.16	0.26	0.18	0.42	0.69
Percent CV	6.67	18.65	6.61	-	16.37	8.90	15.71	8.70	12.62	22.21
95% confidence interval	1.0-1.24	3.38-7.15	1.35-1.76	-	4.72-9.23	1.48-2.12	1.22-2.37	1.76-2.50	2.63-4.37	2.01-4.90
Encounter rate	0.01	0.03	0.07	-	0.02	0.04	0.02	0.03	0.04	0.03
Percent CV	28.30	29.89	17.47	-	25.07	19.26	22.92	23.83	24.62	18.72
95% confidence interval	0.007-0.02	0.02-0.06	0.05-0.10	-	0.01-0.04	0.02-0.05	0.009-0.02	0.02-0.06	0.02-0.07	0.02-0.05
Probability of a greater chi-square value, P	0.99	0.99	0.99	-	0.98	0.81	0.99	0.98	0.99	0.77

Table 3 (c): Individual Density, Group Density, Effective Strip Width, Average Group Size and Encounter Rate of various ungulate species reported from across Tadoba Andhari Tiger Reserve, Maharashtra, India during the year 2024

Parameters	Barking Deer & Chousingha	Gaur	Grey Junglefowl & Red Spurfowl	Hare	Langur	Nilgai	Peafowl	Sambar	Spotted Deer	Wild Boar
Individual density (Animals/Km²)	0.64	2.90	5.27	0.31	2.57	0.77	0.97	2.30	2.92	2.33
Standard error	0.41	0.83	0.77	0.11	0.58	0.16	0.24	0.42	0.63	0.84
Percent CV	64.36	28.77	14.78	36.40	22.74	21.08	24.59	18.55	21.70	36.23
95% confidence interval	0.19-2.09	1.66-5.05	3.94-7.04	0.15-0.63	1.65-4.00	0.51-1.15	0.60-1.57	1.60-3.31	1.92-4.47	1.16-4.66
Group density (No of groups/Km²)	0.58	0.70	3.46	0.29	0.42	0.42	0.58	1.06	0.63	0.74
Standard error	0.37	0.17	0.49	0.10	0.09	0.08	0.13	0.18	0.12	0.23
Percent CV	64.20	25.01	14.27	35.86	20.70	19.24	22.42	17.25	19.40	31.70
95% confidence interval	0.18-1.91	0.42-1.12	2.61-4.58	0.14-0.58	0.28-0.63	0.29-0.62	0.37-0.89	0.76-1.49	0.43-0.93	0.40-1.37
Effective strip width	15.01	24.67	16.33	13.31	33.65	37.85	20.16	26.24	39.11	20.85
Standard error	9.09	3.74	1.17	3.01	3.82	3.81	2.46	1.93	2.52	5.59
Percent CV	60.62	15.17	7.21	22.60	11.37	10.08	12.23	7.38	6.45	26.82
95% confidence interval	4.80-46.90	18.25-33.35	14.17-18.82	8.25-21.49	26.81-42.23	30.96-46.28	15.77-25.77	22.67-30.37	34.41-44.45	12.30-35.33
Average group size	1.08	4.19	1.52	1.07	6.10	1.80	1.69	2.17	4.61	3.13
Standard error	0.05	0.60	0.06	0.07	0.57	0.15	0.17	0.15	0.44	0.55
Percent CV	4.54	14.23	3.84	6.25	9.42	8.62	10.10	6.83	9.72	17.54
95% confidence interval	1.00-1.19	3.16-5.57	1.41-1.64	1.00-1.22	5.04-7.35	1.52-2.14	1.38-2.07	1.89-2.48	3.80-5.59	2.21-4.43
Encounter rate	0.02	0.03	0.11	0.01	0.03	0.03	0.02	0.05	0.05	0.03
Percent CV	21.13	19.88	12.32	27.84	17.30	16.39	18.79	15.59	18.29	16.90
95% confidence interval	0.01-0.03	0.02-0.05	0.09-0.14	0.005-0.01	0.02-0.04	0.02-0.04	0.02-0.03	0.04-0.08	0.03-0.07	0.02-0.04
Probability of a greater chi-square value, P	0.93	0.97	0.93	0.88	0.89	0.91	0.89	0.97	0.99	0.93

Table 4 (a): Comparison of prey density in the Core of Tadoba Andhari Tiger Reserve, Maharashtra, India during the years 2002 — 2024 (standard errors are given in the parenthesis)*

Species	2002	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Barking Deer & Chousingha	0.9	5.2 (±1.2)	-	0.9 (±0.23)	0.98 (±0.21)	1.16 (±0.29)	1.12 (±0.45)	1.26 (±0.42)	1.43 (±0.53)	0.49 (±0.17)	0.82 (±0.22)	0.44 (±0.21)	0.86 (±0.28)	0.85 (±0.31)
Gaur	1.8	6.6 (±1.4)	1.7 (± 0.3)	2.0 (±0.56)	1.58 (±0.45)	2.64 (±0.74)	2.12 (±0.46)	6.60 (±2.0)	7.30 (±2.43)	1.94 (±0.62)	1.91 (±0.57)	-	1.09 (±0.38)	0.72 (±0.45)
Grey Junglefowl & Red Spurfowl	-	-	-	1.43 (±0.53)	2.58 (±0.78)	3.19 (± 0.9)	2.93 (±0.19)	0.82 (±0.40)	0.6 (±0.20)	1.60 (±0.33)	10.10 (±1.74)	5.96 (±1.78)	13.44 (±3.00)	9.04 (±3.08)
Hare	-	-	-	1.70 (±0.36)	2.23 (±0.65)	0.49 (±1.15)	1.23 (±0.54)	2.62 (±0.65)	3.4 (±0.34)	0.71 (±0.29)	-	-	-	-
Langur	-	-	-	9.47 (±1.90)	9.70 (±2.42)	10.32 (±2.86)	9.89 (±1.72)	11.81 (±2.80)	20 (±6.11)	3.70 (±1.52)	3.70 (±1.22)	-	3.82 (±1.30)	2.67 (±0.84)
Nilgai	0.7	-	1.3 (± 0.5)	1.09 (±0.36)	1.01 (±0.37)	0.42 (±0.16)	0.33 (±0.12)	2.00 (±0.66)	3.25 (±0.89)	1.02 (±0.37)	0.56 (±0.21)	-	-	0.60 (±0.25)
Peafowl	-	-	-	3.92 (±0.72)	3.36 (±0.81)	3.25 (±0.67)	3.45 (±0.73)	6.87 (±1.59)	5.56 (±1.03)	2.38 (±0.67)	1.84 (±0.38)	2.08 (±0.75)	1.80 (±0.56)	3.32 (±2.39)
Sambar	3.33	6.5 (±1.1)	3.9 (±1.1)	4.68 (±0.76)	5.27 (±1.16)	3.47 (±0.74)	1.76 (±0.58)	7.0 (±1.62)	8.23 (±1.89)	2.51 (±0.49)	3.08 (±0.69)	3.20 (±0.96)	3.13 (±0.71)	3.47 (±0.92)
Spotted Deer	3.2	8.6 (±1.8)	6.3 (±1.5)	5.10 (±1.22)	7.42 (±2.36)	8.48 (±2.03)	6.69 (±1.71)	10.81 (±2.24)	13.82 (±3.23)	8.06 (±1.92)	3.98 (±1.21)	-	5.42 (±1.95)	2.92 (±1.34)
Wild Boar	2.6	7.3 (±1.6)	3.7 (±1.5)	5.42 (±2 .08)	4.49 (±1.73)	4.19 (±1.36)	3.97 (±0.46)	6.58 (±2.05)	7.23 (±2.87)	4.66 (±1.79)	5.50 (±1.87)	3.66 (±2.16)	4.90 (±2.56)	1.66 (±0.71)

*Variation in density between years cannot be directly attributed to the population of the species. It can be due to variations in effort or errors in measurements recorded.

Table 4 (b): Comparison of prey density in the Buffer of Tadoba Andhari Tiger Reserve, Maharashtra, India during the years 2015 - 2024 (standard errors are given in the parenthesis)*

Species	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Barking Deer & Chousingha	0.68 (± 0.31)	3.62 (± 1.11)	2.82 (±0.31)	1.42 (±0.80)	1.89 (±0.80)	0.22 (±0.08)	0.20 (±0.06)	0.85 (±0.53)	-	0.21 (±0.08)
Gaur	1.63 (± 0.59)	6.88 (± 1.87)	3.54 (±1.07)	1.65 (±0.50)	1.98 (±0.80)	1.94 (±0.55)	2.98 (±0.72)	-	1.92 (±0.66)	4.13 (±1.66)
Grey Junglefowl & Red Spurfowl	0.59 (± 0.41)	1.03 (±0.24)	1.43 (±0.54)	0.69 (±0.53)	0.98 (±0.98)	1.07 (±0.33)	4.99 (±0.76)	2.23 (±0.92)	2.61 (±0.72)	2.36 (±0.48)
Hare	0.99 (± 0.37)	1.51 (±0.43)	1.02 (±0.31)	1.73 (±0.46)	1.91 (±0.67)	0.40 (±0.16)	0.93 (±0.27)	-	-	-
Langur	14.64 (± 5.98)	28.52 (±8.75)	11.10 (±3.75)	18.93 (±5.16)	20.22 (±5.22)	1.18 (±0.50)	2.96 (±0.95)	2.55 (±1.25)	1.79 (±0.94)	2.74 (±1.03)
Nilgai	0.74 (± 0.29)	5.91 (± 1.96)	5.22 (±1.66)	4.37 (±1.35)	5.67 (±1.87)	0.98 (±0.25)	1.11 (±0.30)	0.67 (±0.26)	1.12 (±0.58)	0.84 (±0.21)
Peafowl	2.28 (± 0.79)	4.18 (± 0.9)	4.06 (±1.39)	2.37 (±0.69)	2.80 (±0.89)	0.92 (±0.24)	1.81 (±0.35)	1.37 (±0.51)	-	0.50 (±0.18)
Sambar	1.88 (± 0.71)	1.22 (± 0.76)	1.58 (±0.40)	2.83 (±0.89)	3.44 (±0.96)	0.93 (±0.25)	0.73 (±0.19)	2.54 (±0.97)	1.26 (±0.41)	1.11 (±0.32)
Spotted Deer	4.09 (± 0.92)	8.73 (± 1.93)	11.09 (±2.07)	8.86 (±1.58)	9.2 (± 1.98)	3.39 (±0.74)	1.69 (±0.43)	2.16 (±0.81)	2.93 (±1.38)	1.73 (±0.58)
Wild Boar	4.56 (± 1.73)	9.82 (±6.23)	11.82 (±2.98)	16.29 (±4.93)	18.23 (±1.87)	3.43 (±0.99)	2.70 (±0.75)	3.95 (±2.50)	3.50 (±1.24)	1.39 (±0.43)

*Variation in density between years cannot be directly attributed to the population of the species. It can be due to variations in effort or errors in measurements recorded.

Table 4 (c): Comparison of prey density across Tadoba Andhari Tiger Reserve, Maharashtra, India during the years 2015 - 2024 (standard errors are given in the parenthesis)*

Species	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Barking Deer & Chousingha	0.90 (±0.19)	1.16	1.12	-	-	0.29	0.42 (±0.08)	0.65 (±0.25)	0.53 (±0.17)	0.64 (±0.41)
Gaur	1.42 (±0.33)	2.64	2.12	-	-	1.96	2.16 (±0.39)	0.80 (±0.28)	1.41 (±0.37)	2.90 (±0.83)
Grey Junglefowl & Red Spurfowl	0.81 (±0.51)	-	2.93	-	-	1.79	8.19 (±1.02)	4.23 (±1.06)	7.17 (±1.35)	5.27 (±0.77)
Hare	1.80 (±0.45)	-	1.23	-	-	-	0.68 (±0.15)	-	-	0.31 (±0.11)
Langur	10.20 (±2.18)	10.32	11.09	-	-	2.42	3.35 (±0.71)	0.80 (±0.28)	0.55 (±0.18)	2.57 (±0.58)
Nilgai	0.80 (±0.24)	0.42	0.33	-	-	0.99	1.04 (±0.25)	0.80 (±0.27)	0.53 (±0.16)	0.77 (±0.16)
Peafowl	2.80 (±0.54)	-	3.45	-	-	1.45	1.79 (±0.25)	1.81 (±0.46)	1.32 (±0.29)	0.97 (±0.24)
Sambar	4.27 (±0.82)	3.47	1.76	-	-	1.53	1.71 (±0.29)	3.44 (±1.11)	2.13 (±0.44)	2.30 (±0.42)
Spotted Deer	6.56 (±1.49)	8.48	6.69	-	-	5.32	2.65 (±0.55)	3.06 (±0.82)	4.00 (±1.19)	2.92 (±0.63)
Wild Boar	3.63 (±1.13)	4.19	3.97	-	-	4.01	3.73 (±0.84)	2.26 (±0.75)	4.01 (±1.08)	2.33 (±0.84)

*Variation in density between years cannot be directly attributed to the population of the species. It can be due to variations in effort or errors in measurements recorded.

Status of Predators in Tadoba Andhari Tiger Reserve

Camera Trapping:

Potential locations of camera trap stations were mapped using ArcGIS 9.3 (ESRI, Redlands, CA, USA) based on data provided by the forest guards of TATR. Camera traps (pairs) were deployed in 628 locations across the forest area of Tadoba Andhari Tiger Reserve (Figure 6) in grids of size 2 sq. km each. The total area was covered in two blocks with a sampling period was 72 days between 10th of February — 21st of April 2024. One pair of camera traps were deployed in each location for 35 days that resulted in 18,862 trap nights.
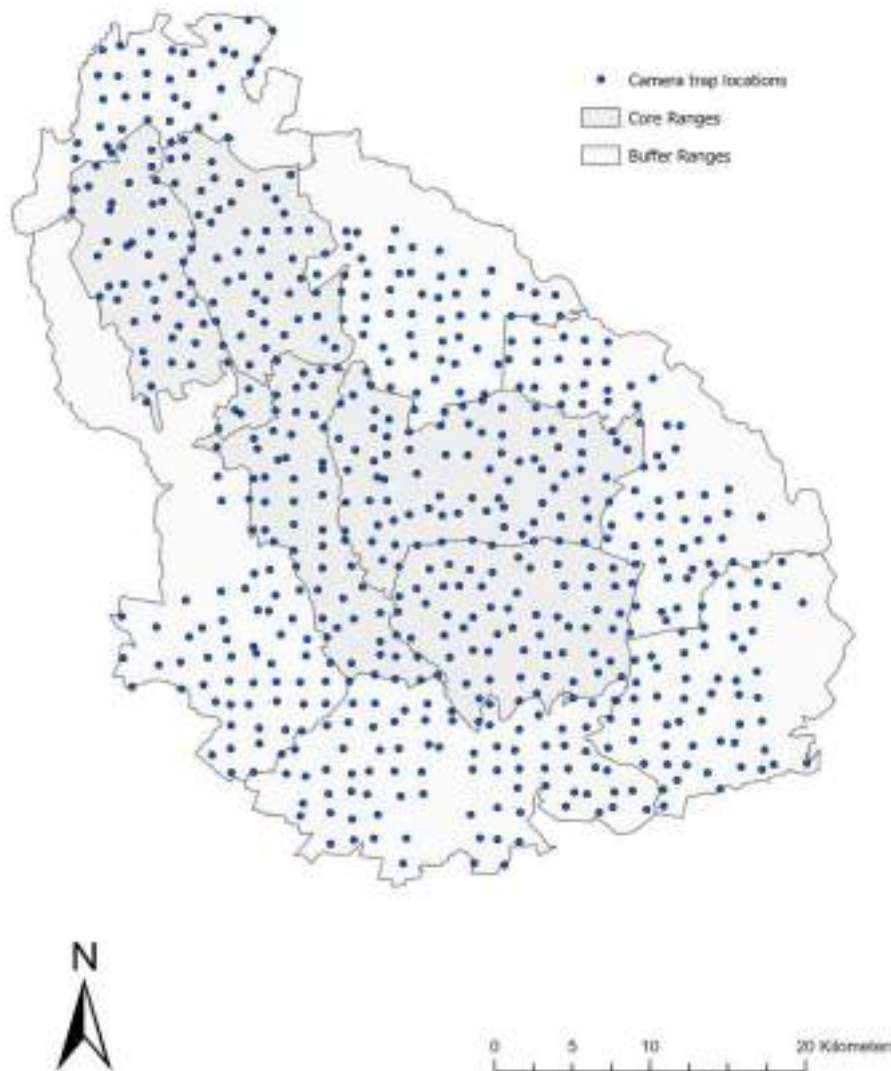
Figure 6: Map depicting camera trap placement locations in Tadoba Andhari Tiger Reserve, Maharashtra, India in the year 2024

Population Estimation for Tigers and Leopards:

During the 72 days of camera trapping 95 adult individual tigers were photographed within the core and buffer area of TATR along with 144 adult individual leopards. The MCPs of Tigers and Leopards are shown in Figure 7(a — f).

Tiger density per 100 sq. km. based on the SECR Heterogeneity (g0, σ) model was estimated to be 7.18 (SE ± 0.74) for TATR. Leopard density per 100 sq. km. based on the SECR Heterogeneity (σ) model was estimated to be 11.02 (SE ± 0.92) for TATR. The best model for the density estimate is chosen according to the AIC (Akaike Information Criterion). The details for tigers are provided in Table 5, 6, 7 and 8 and for leopards in Table 9, 10, 11 and 12.

Table 5: Density estimates of tigers using Spatially Explicit Capture-Recapture Models in Tadoba Andhari Tiger Reserve, Maharashtra, India for the year 2014-2024

Param-eters	Model	Detection Function	Density Estimate	Density SE	Density CI	g0 Estimate	g0 SE	g0 CI	Sigma Estimate	Sigma SE	Sigma CI
2014	Hetero-geneity	Half-normal	5.609	0.773	4.28 - 7.34	0.03	0.022	0.026-0.035	4.283	0.305	3.725-4.925
2015	Hetero-geneity	Half-normal	5.673	0.698	4.46 - 7.21	0.05	0.098	0.034-0.073	3.309	0.239	2.871-3.814
2016	Hetero-geneity	Half-normal	5.648	0.713	4.93 - 6.36	0.041	0.091	0.031-0.069	3.354	0.431	2.716-3.972
2017	Hetero-geneity	Half-normal	5.823	0.683	4.79 - 7.12	0.051	0.056	0.040-0.062	3.237	0.318	2.659-3.946
2018	Hetero-geneity	Half-normal	5.51	0.598	4.46 - 6.81	0.061	0.05	0.051-0.071	2.07	0.533	0.974-2.184
2019	Hetero-geneity	Half-normal	5.23	0.564	4.24 - 6.46	0.039	0.027	0.034-0.045	3.83	0.988	3.640-4.030
2020	Hetero-geneity	Half-normal	6.58	0.716	5.32 - 8.14	0.064	0.041	0.056-0.072	2.36	0.77	2.220-2.520
2021	Hetero-geneity	Half-normal	6.31	0.70	5.08 - 7.82	0.048	0.004	0.040-0.058	2.40	0.06	2.280-2.540
2022	Hetero-geneity	Half-normal	6.60	0.71	5.35 - 8.15	0.052	0.003	0.046-0.058	2.21	0.051	2.112-2.313
2023	Hetero-geneity	Half-normal	6.46	0.70	5.23 - 7.99	0.047	0.023	0.043-0.052	2.51	0.06	2.389-2.635
2024	Hetero-geneity	Half-normal	7.18	0.74	5.87 — 8.78	0.052	0.018	0.049-0.056	2.87	0.08	2.710-3.044

Table 6: Population estimates of tigers in Tadoba Andhari Tiger Reserve, Maharashtra, India for the year 2010-2024

Year	Effective trapping area (sq. km.)	No. of Individuals Captured	Estimate	Density per 100 sq. km.
2010	321	15	17 (± 3.6)	5.29 (± 1.12)
2012	603	47	49 (± 4.6)	5.40 (± 0.60)
2013	603	50	51 (± 7.5)	5.62 (± 0.82)
2014	1170	65	72 (± 5.37)	5.60 (± 0.77)
2015	1310	71	88 (± 4.91)	5.67 (± 0.69)
2016	1310	69	86 (± 8.7)	5.64 (± 0.71)
2017	1310	75	86 (± 4.42)	5.82 (± 0.68)
2018	1310	81	86 (± 3.5)	5.51 (± 0.59)
2019	1682	88	115 (± 12.42)	5.23 (± 0.56)
2020	1301	85	85 (± 0.94)	6.58 (± 0.72)
2021	1315	85	86 (± 0.71)	6.31 (± 0.70)
2022	1317	87	87 (± 0.72)	6.60 (± 0.71)
2023	1315	85	85 (± 0.71)	6.46 (± 0.70)
2024	1324	95	95 (± 0.70)	7.18 (± 0.74)

Table 7: Comparison of number of tigers utilizing core and buffer of Tadoba Andhari Tiger Reserve, Maharashtra, India for the years 2013-2024

Details	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Tigers (Exclusively Core)	50	51	51	48	50	39	44	27	15	11	13	18
Tigers (Exclusively Buffer)	NA	10	14	17	19	22	23	34	36	38	35	36
Tigers (Core and Buffer)	NA	04	06	04	06	20	21	24	32	38	37	41

Table 8: Comparison of number of individual tigers (adult males and adult females) captured in Tadoba Andhari Tiger Reserve, Maharashtra, India for the years 2018-2024

Year	2018	2019	2020	2021	2022	2023	2024
Adult Males	32	40	36	37	39	40	40
Adult Females	45	51	44	47	48	45	54
Adult (Sex Unknown)	4	6	5	1	0	0	1
Cubs & Sub-adults	NA	NA	32	44	41	42	41

Table 9: Density estimates of leopards using Spatially Explicit Capture-Recapture Models in Tadoba Andhari Tiger Reserve, Maharashtra, India for the year 2019-2024

Parameters	2019	2020	2021	2022	2023	2024
Model	Hetero-geneity	Hetero-geneity	Hetero-geneity	Hetero-geneity	Hetero-geneity	Hetero-geneity
Detection Function	Half-normal	Half-normal	Half-normal	Half-normal	Half-normal	Half-normal
Density Estimate	6.86	8.39	8.69	9.74	9.80	11.02
Density Standard Error	0.69	0.81	0.81	0.87	0.87	0.92
Density Confidence Interval	5.65-8.33	6.94-10.14	7.23-10.44	8.18-11.59	8.24-11.66	9.37-12.97
g0 Estimate	0.025	0.031	0.030	0.024	0.026	0.026
g0 Standard Error	0.0014	0.0016	0.0017	0.0017	0.0022	0.0016
g0 Confidence Interval	0.021-0.027	0.028-0.034	0.026-0.034	0.021-0.027	0.022-0.029	0.023-0.030
Sigma Estimate	5.41	2.14	2.21	2.03	2.10	2.08
Sigma Standard Error	0.15	0.56	0.06	0.06	0.08	0.05
Sigma Confidence Interval	5.12-5.72	2.03-2.25	2.10-2.33	1.92-2.14	1.94-2.26	1.98-2.19

Table 10: Population estimates of leopards in Tadoba Andhari Tiger Reserve, Maharashtra, India for the years 2019-2024

Year	Effective trapping area (sq. km.)	No. of Individuals Captured	Estimate	Density per 100 sq. km.
2019	1682	106	151 (± 15.29)	6.86 (± 0.68)
2020	1301	106	109 (± 1.64)	8.39 (± 0.81)
2021	1315	114	117 (± 2.17)	8.69 (± 0.82)
2022	1317	127	128 (± 4.56)	9.74 (± 0.86)
2023	1315	128	129 (± 1.21)	9.80 (± 0.87)
2024	1324	144	144 (± 1.18)	11.02 (± 0.92)

Table 11: Comparison of number of leopards utilizing core and buffer of Tadoba Andhari Tiger Reserve, Maharashtra, India for the years 2020 - 2024

Details	2020	2021	2022	2023	2024
Leopards (Exclusively Core)	28	30	40	31	35
Leopards (Exclusively Buffer)	50	46	56	62	72
Leopards (Core and Buffer)	28	38	31	35	37

Table 12: Comparison of number of individual leopards (adult males and adult females) captured in Tadoba Andhari Tiger Reserve, Maharashtra, India for the years 2019 - 2024

Year	2019	2020	2021	2022	2023	2024
Adult Males	36	42	40	46	44	58
Adult Females	71	59	72	79	78	84
Adult (Sex Unknown)	2	5	2	2	6	2
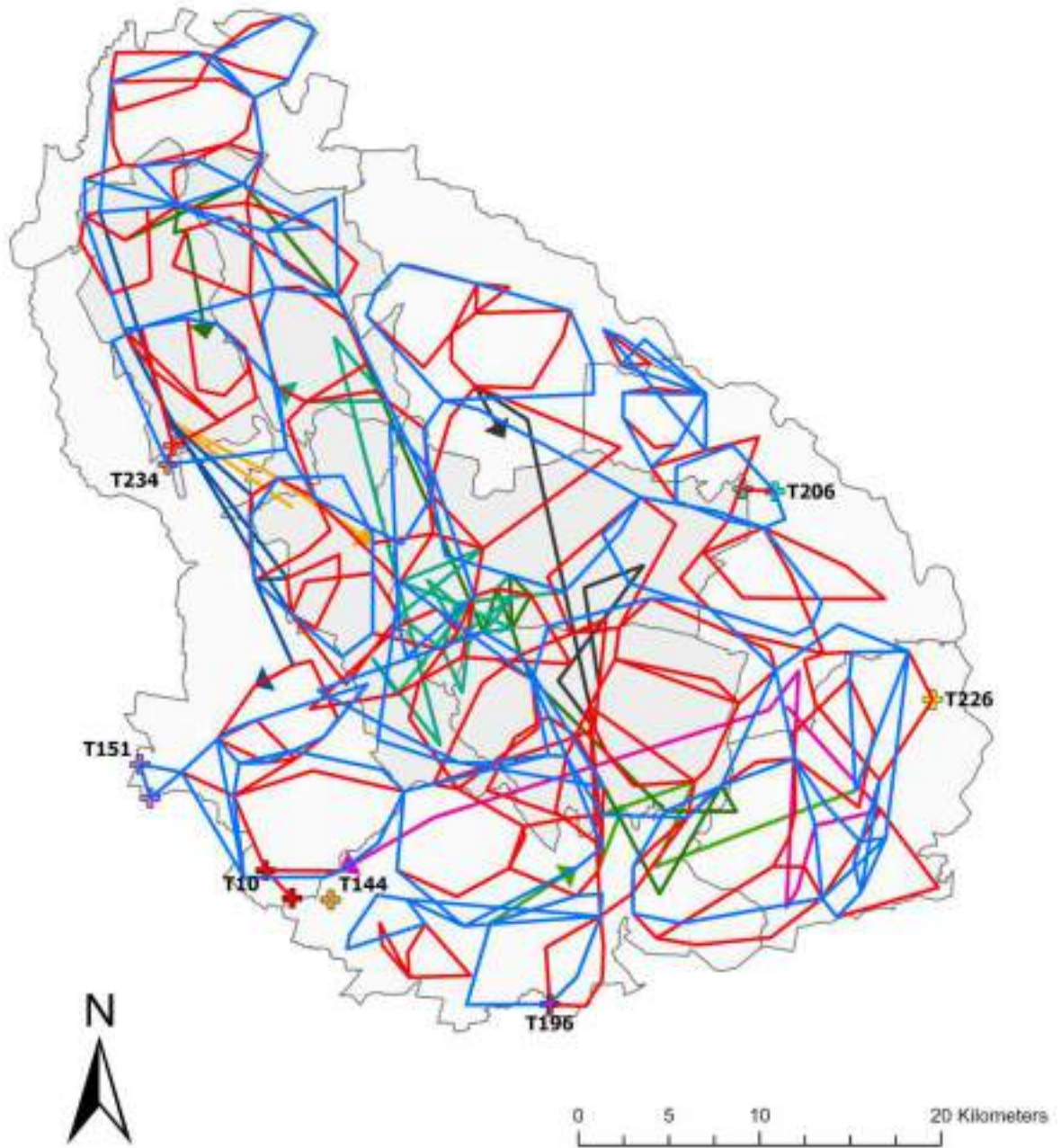
Figure 7(a): Minimum Convex Polygon of Tigers (Males and Females) in Tadoba Andhari Tiger Reserve, Maharashtra, India during the year 2024

Figure 7(b): Minimum Convex Polygon of Tigers (Males) in Tadoba Andhari Tiger Reserve, Maharashtra, India during the year 2024
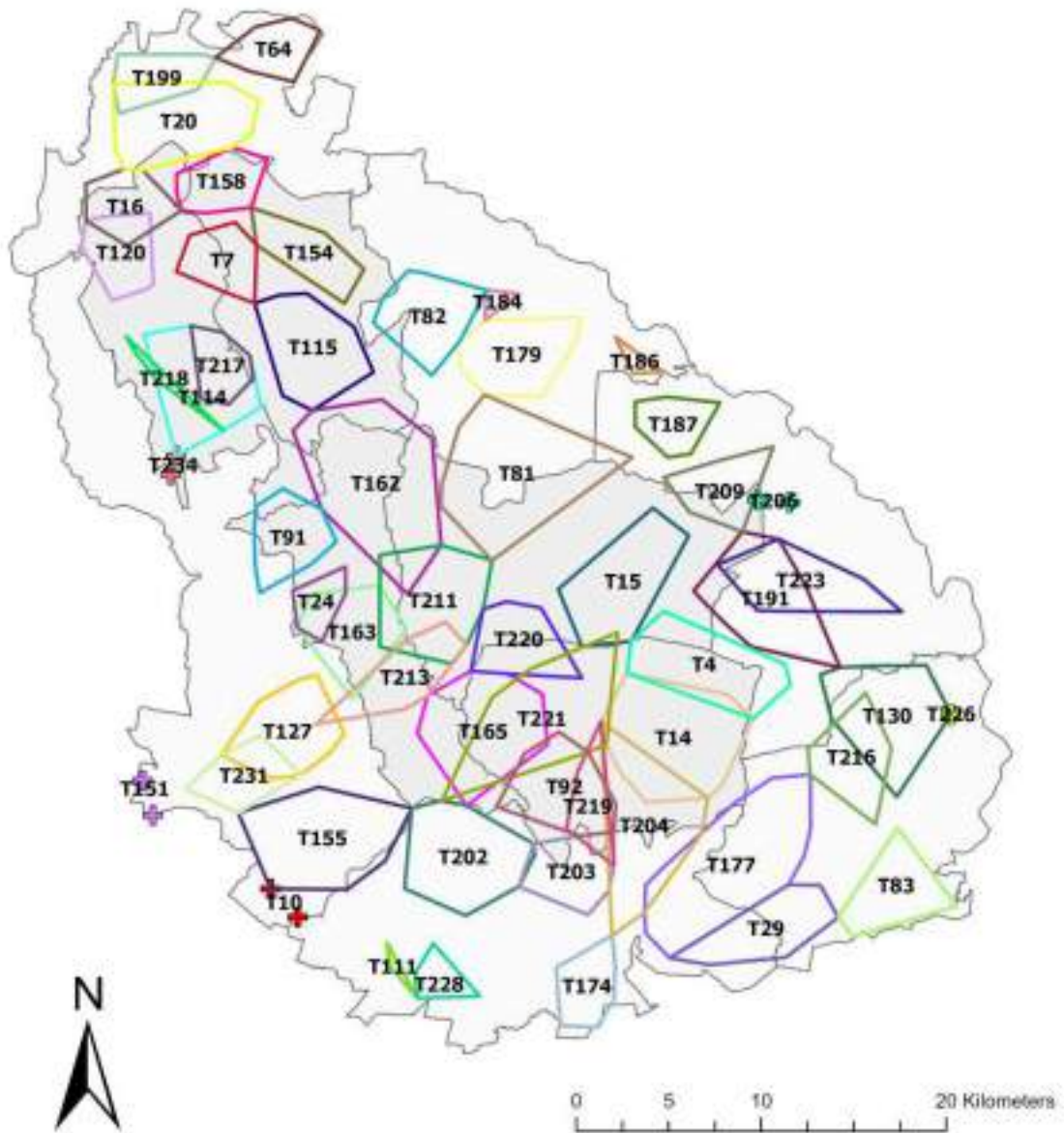
Figure 7(c): Minimum Convex Polygon of Tigers (Females) in Tadoba Andhari Tiger Reserve, Maharashtra, India during the year 2024
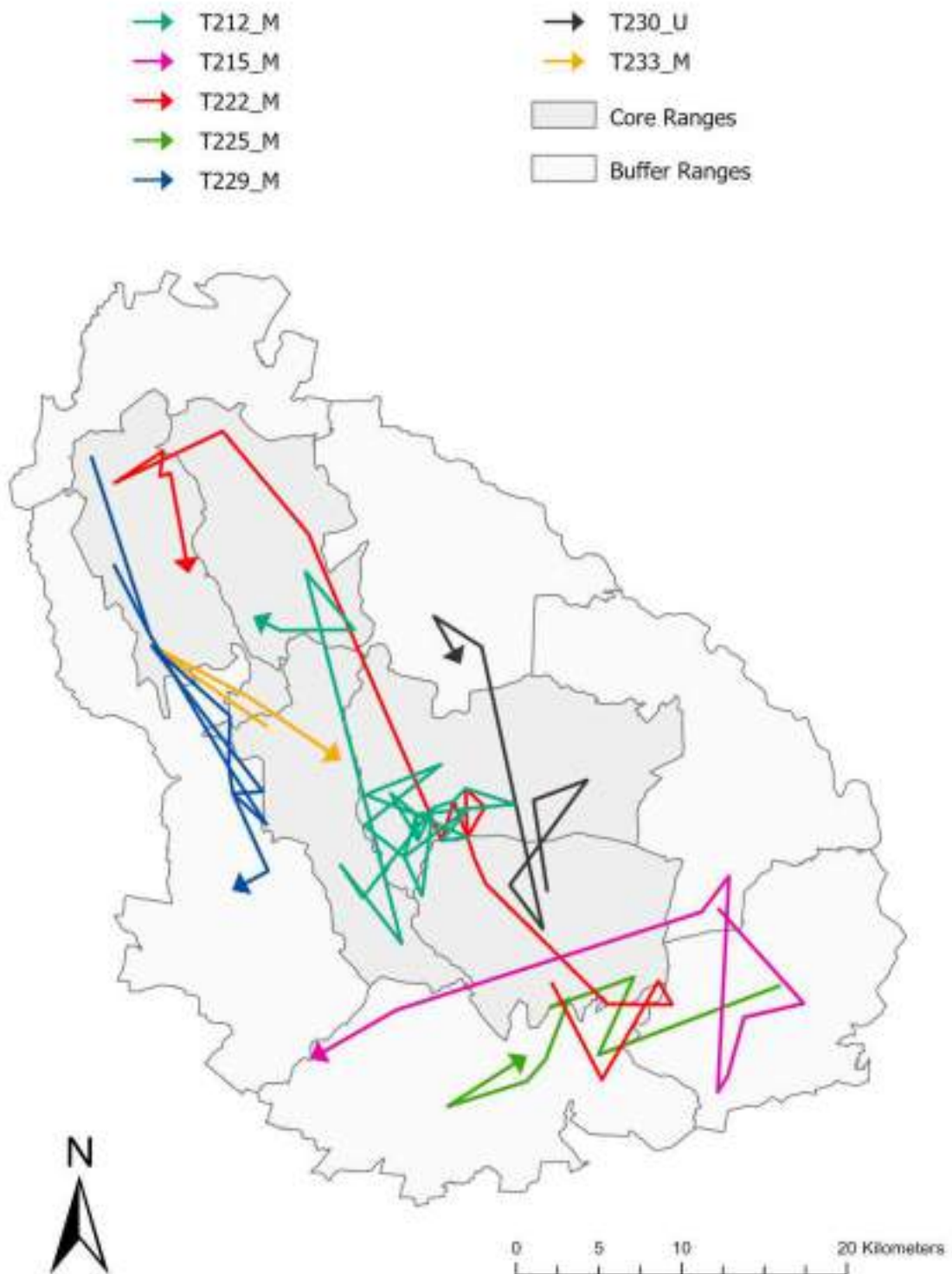
Figure 7(d): Minimum Convex Polygon of Tigers (Transients) in Tadoba Andhari Tiger Reserve, Maharashtra, India during the year 2024
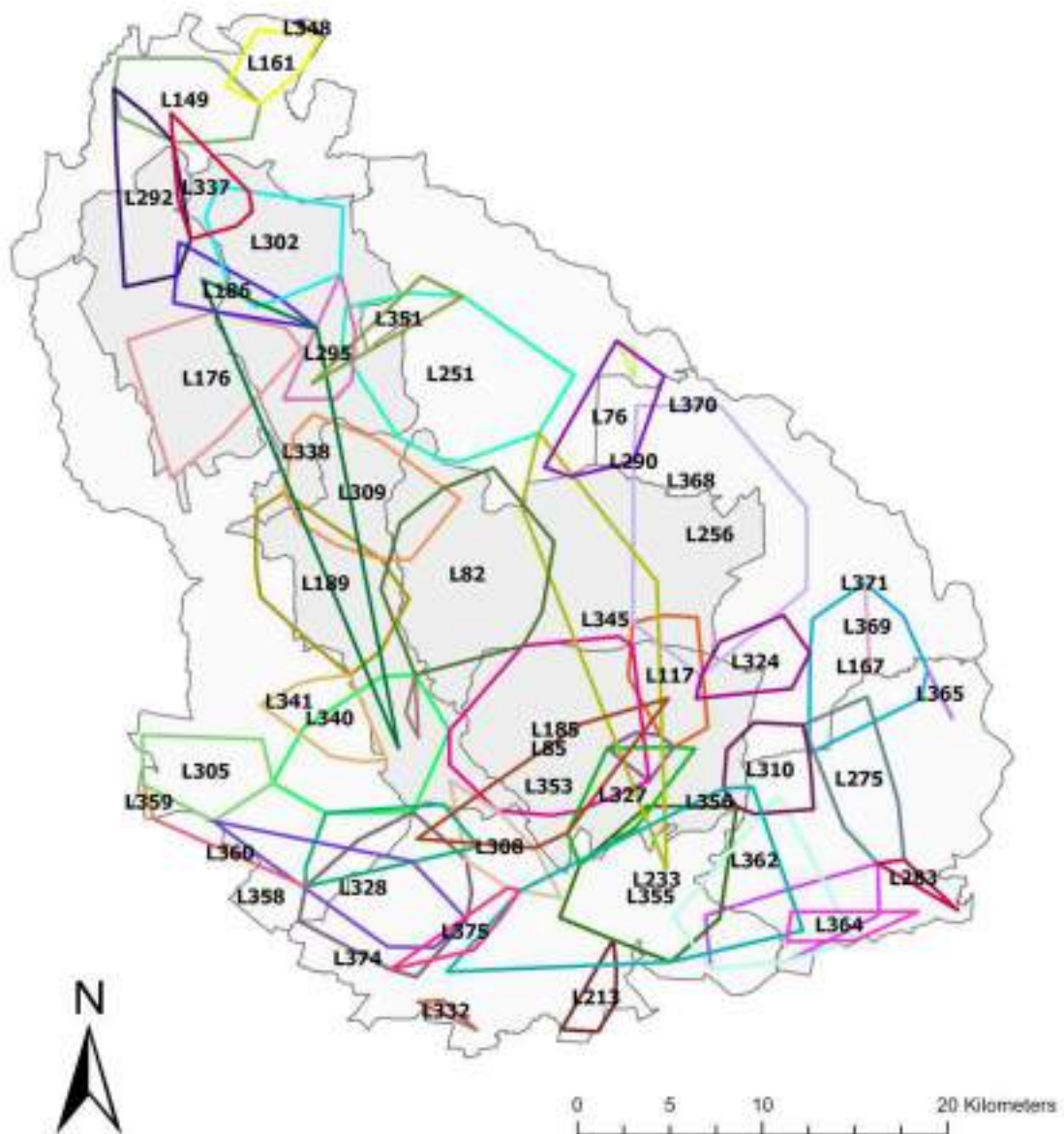
Figure 7(e): Minimum Convex Polygon of Leopards (Males & Unsexed) in Tadoba Andhari Tiger Reserve, Maharashtra, India during the year 2024

Figure 7(f): Minimum Convex Polygon of Leopards (Females) in Tadoba Andhari Tiger Reserve, Maharashtra, India during the year 2024

Temporal Activity of Predators and Prey Species in Tadoba Andhari Tiger Reserve

The Kernel density estimates of daily temporal activity patterns of different predator & prey species are shown in Figure 8 - 11. From the kernel density estimators, the tiger and leopard were observed to have a high degree (0.94) of overlap as indicated by the estimated overlap coefficients in Table 13.

Table 13: Temporal activity overlap of predator and prey species in Tadoba Andhari Tiger Reserve, Maharashtra, India during the year 2024

Species	Tiger	Leopard	Dhole
Sambar	0.86	0.88	0.61
Spotted Deer	0.52	0.53	0.75
Gaur	0.82	0.8	0.6
Wild Boar	0.54	0.54	0.8
Barking Deer	0.55	0.56	0.87
Four Horned Antelope	0.39	0.41	0.50
Nilgai	0.50	0.5	0.71
Langur	0.31	0.32	0.5
Grey Junglefowl	0.36	0.374	0.71
Indian Peafowl	0.37	0.37	0.73
Red Spurfowl	0.35	0.35	0.67
Ratel	-	-	-
Indian Porcupine	0.58	0.59	0.23
Indian Hare	-	-	-
Sloth Bear	0.89	0.86	0.67
Tiger	-	0.94	0.62
Leopard	0.94	-	0.61
Dhole	0.62	0.61	-
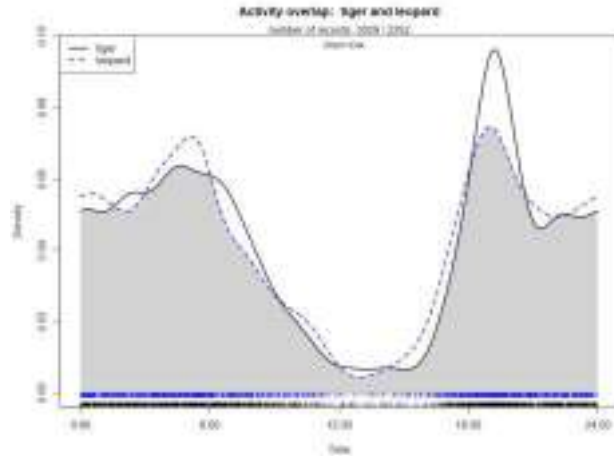
Figure 8(a): Tiger - Leopard
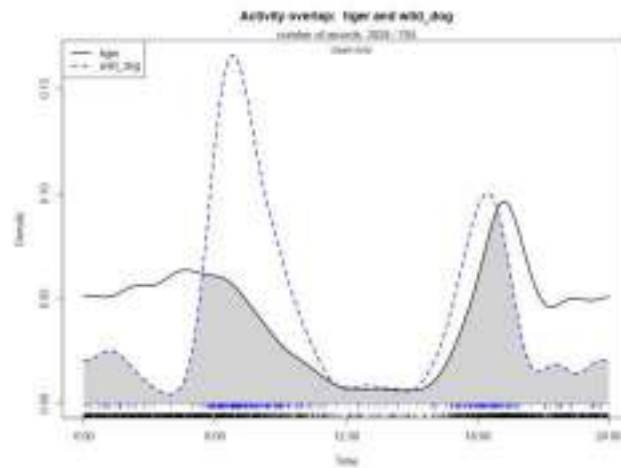
Figure 8(b): Tiger - Dhole
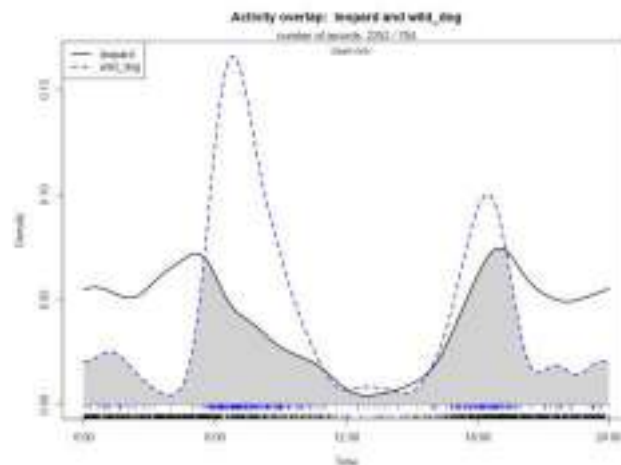
Figure 8(c): Leopard - Dhole

Figures 8(a-c): Daily temporal activity pattern overlap between co-predators a) tiger *vs.* leopard; b) tiger *vs.* dhole; c) leopard *vs.* dhole in Tadoba Andhari Tiger Reserve, Maharashtra, India during the year 2024. The lines represent the kernel density estimates based on individual photograph times. The overlap is shown by the shaded area in each plot.
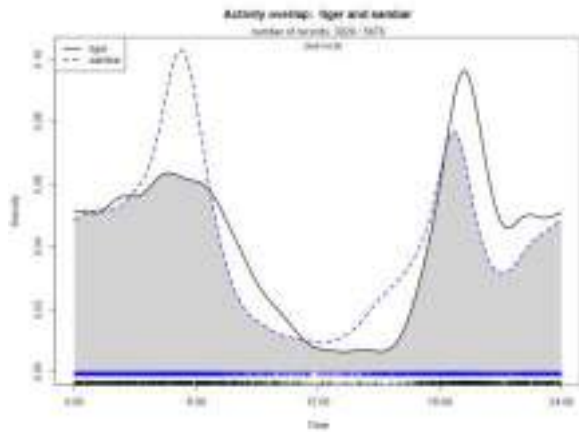
Figure 9(a): Tiger - Sambar
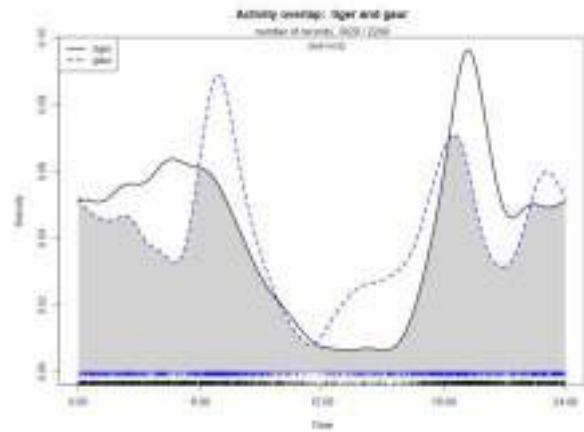
Figure 9(b): Tiger - Gaur
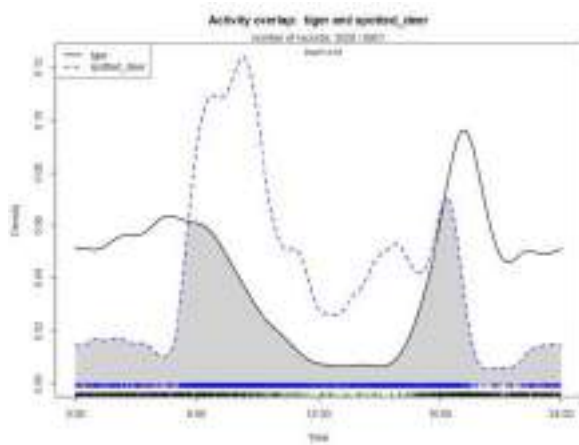
Figure 9(c): Tiger — Spotted Deer
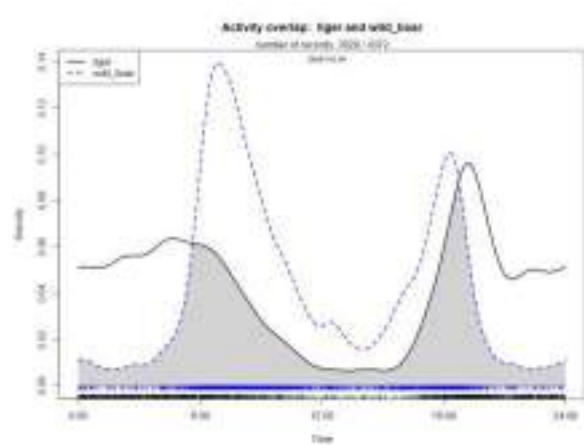
Figure 9(d): Tiger — Wild Boar
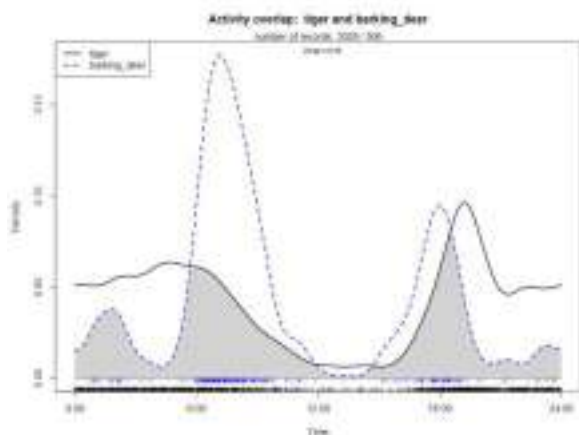
Figure 9(e): Tiger — Barking Deer
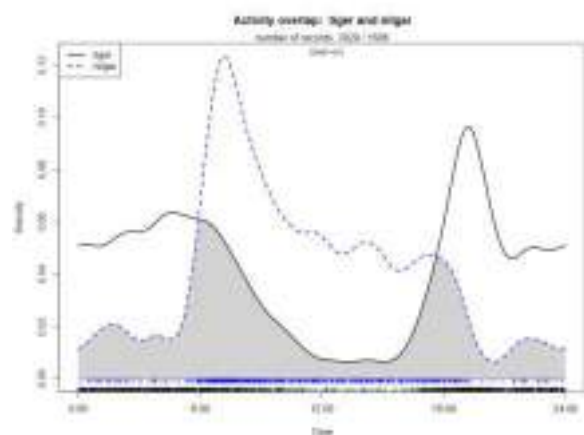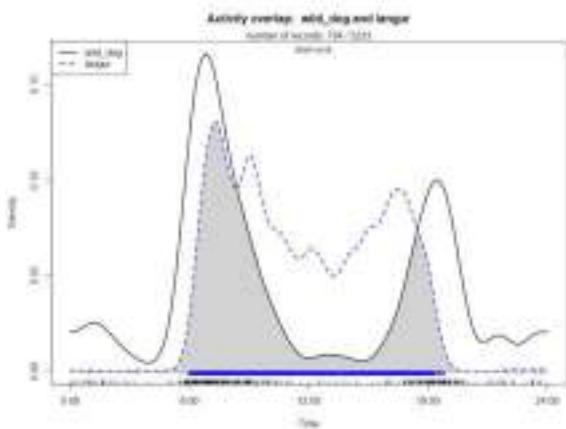

Figure 9(f): Tiger — Nilgai

Figures 9(a-f): Daily temporal activity patterns of the Tiger *vs.* prey species in Tadoba Andhari Tiger Reserve, Maharashtra, India during the year 2024. The lines represent the kernel density estimates based on individual photograph times. The overlap is shown by the shaded area in each plot.
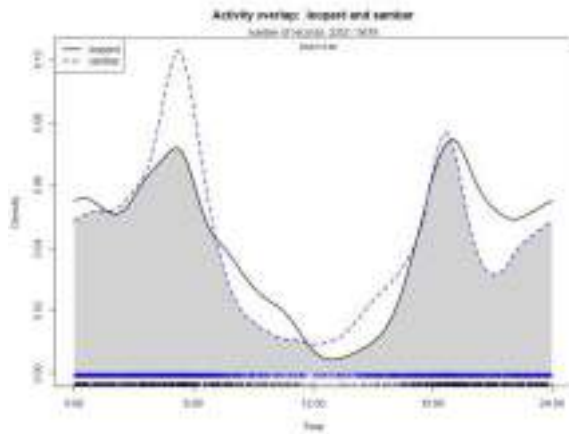
Figure 10(a): Leopard - Sambar
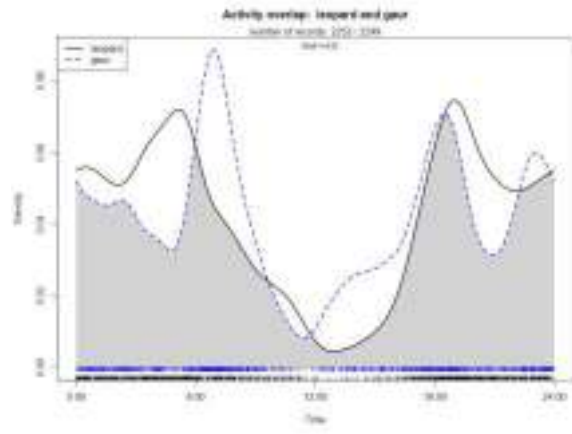
Figure 10(b): Leopard - Gaur
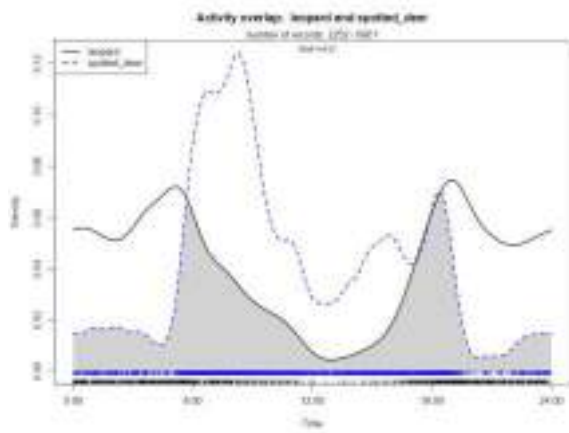
Figure 10(c): Leopard — Spotted Deer
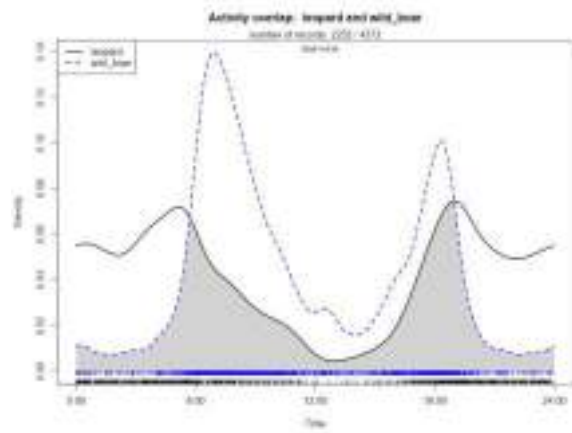
Figure 10(d): Leopard — Wild Boar
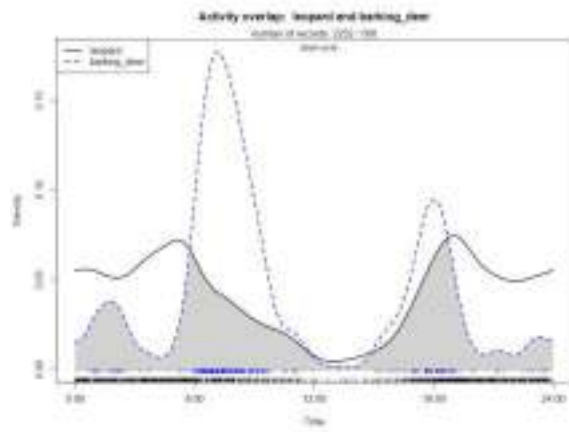
Figure 10(e): Leopard — Barking Deer
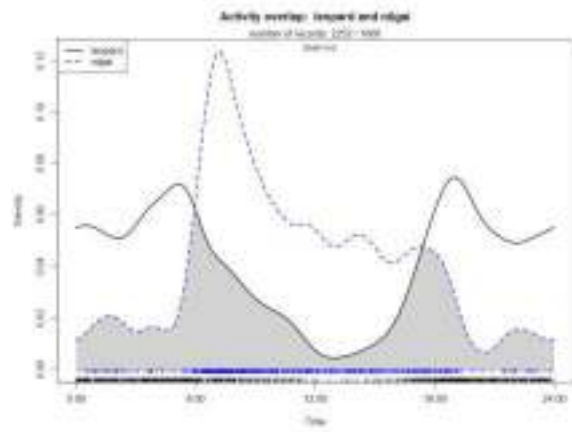
Figure 10(f): Leopard - Nilgai
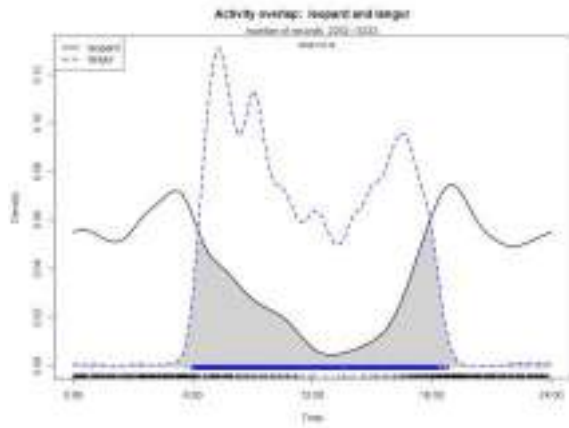
Figure 10(g): Leopard - Langur
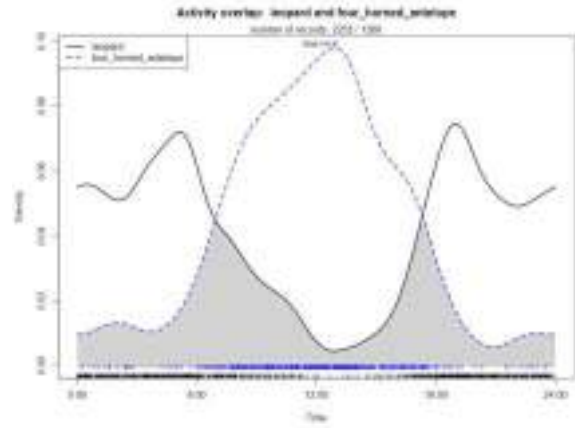
Figure 10(h): Leopard - Four-Horned Antelope
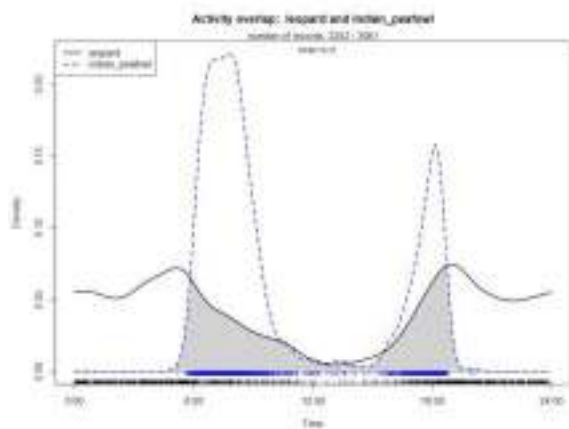
Figure 10(i): Leopard - Peafowl

Figures 10(a-i): Daily temporal activity patterns of the Leopard *vs.* prey species in Tadoba Andhari Tiger Reserve, Maharashtra, India during the year 2024. The lines represent the kernel density estimates based on individual photograph times. The overlap is shown by the shaded area in each plot.
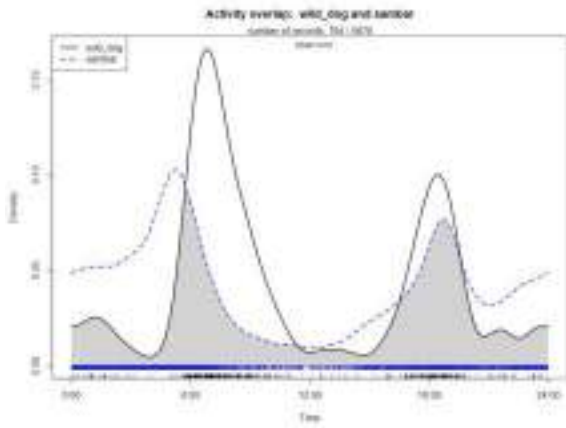
Figure 11(a): Dhole - Sambar
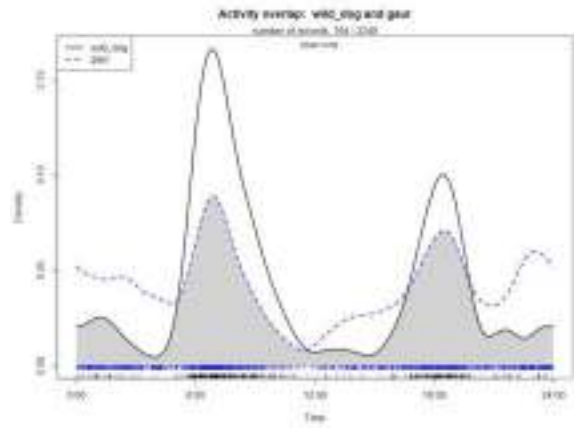
Figure 11(b): Dhole - Gaur
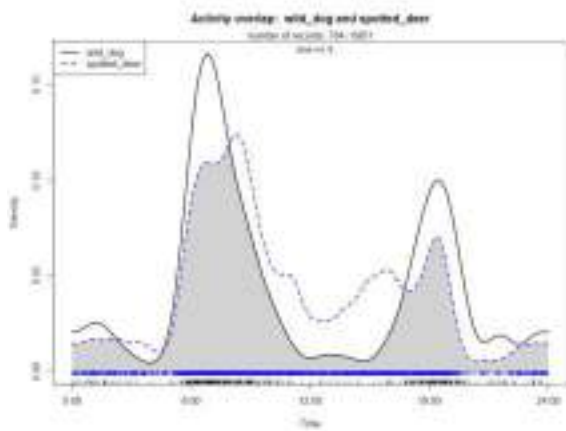
Figure 11(c): Dhole — Spotted Deer
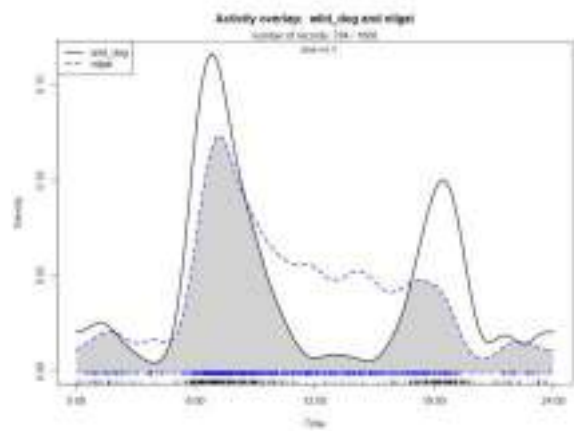
Figure 11(d): Dhole - Nilgai
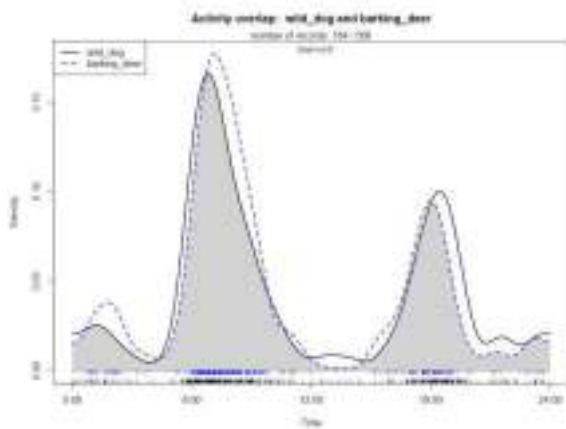
Figure 11(e): Dhole — Barking Deer
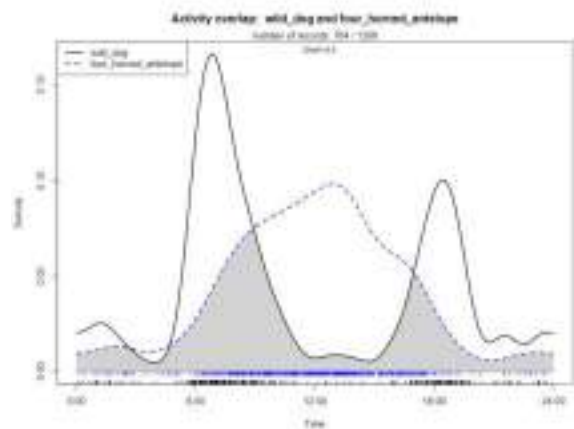
Figure 11(f): Dhole — Four-Horned Antelope
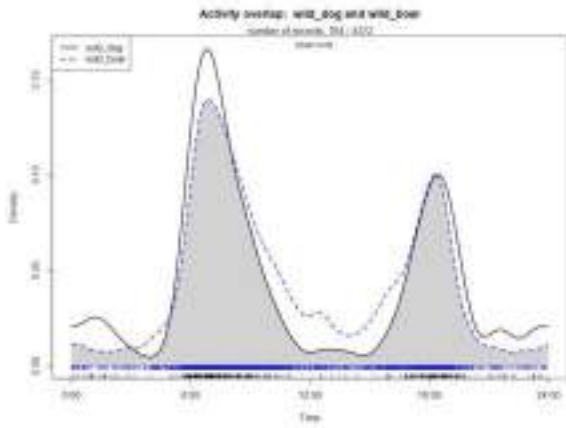
Figure 11(g): Dhole — Wild Boar
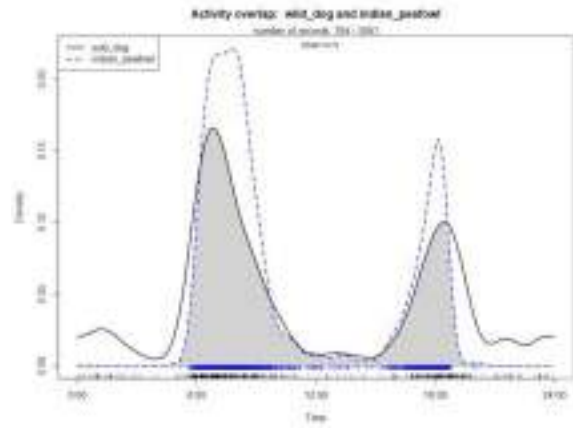
Figure 11(h): Dhole — Peafowl

Figure 11(i): Dhole — Langur

Figures 11(a-i): Daily temporal activity pattern of the Dhole *vs.* prey species in Tadoba Andhari Tiger Reserve, Maharashtra, India during the year 2024. The lines represent the kernel density estimates based on individual photograph times. The overlap is shown by the shaded area in each plot.

Modelling Spatially Explicit Intensive Use Areas: Predator & Prey Species

Using IDW technique spatially explicit intensive use area maps (based on camera trap location and number of photographs at each location) has been developed for predator and prey species. Figure 12 (a-p) shows intensive use areas by different wild species of Tadoba Andhari Tiger Reserve.
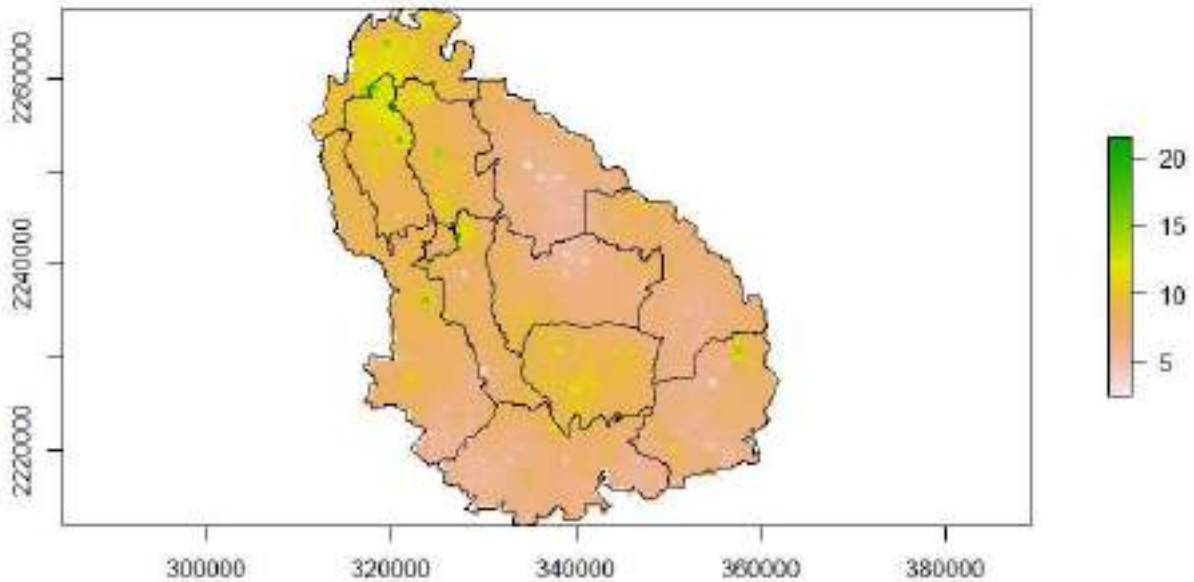
Figure 12(a): Intensive use area map for Tiger at TATR
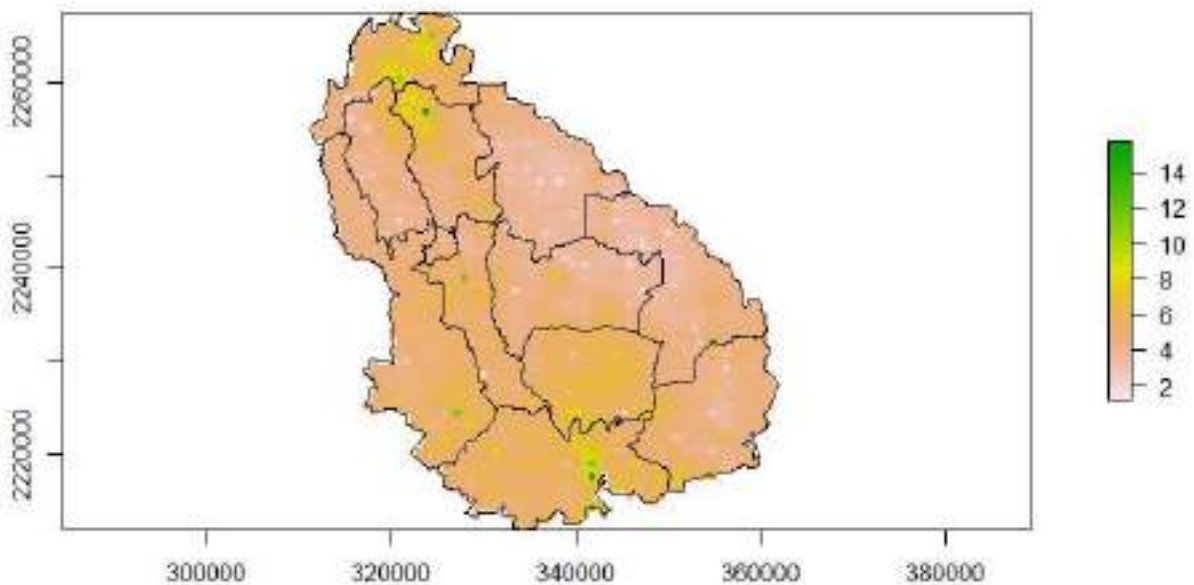
Figure 12(b): Intensive use area map for Leopard at TATR
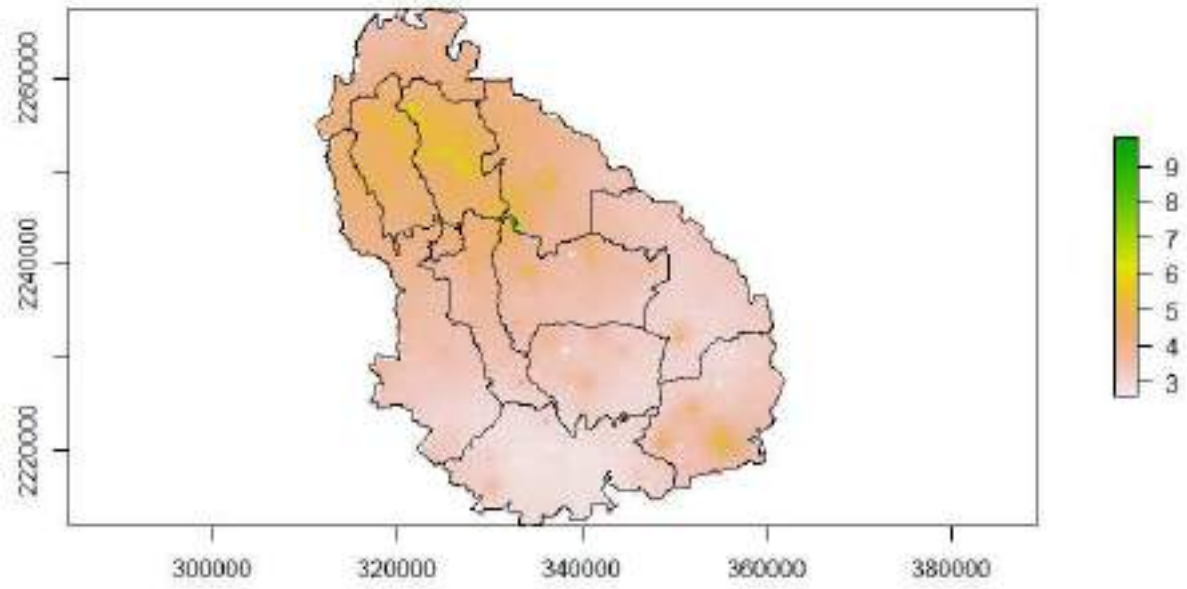
Figure 12(c): Intensive use area map for Dhole at TATR
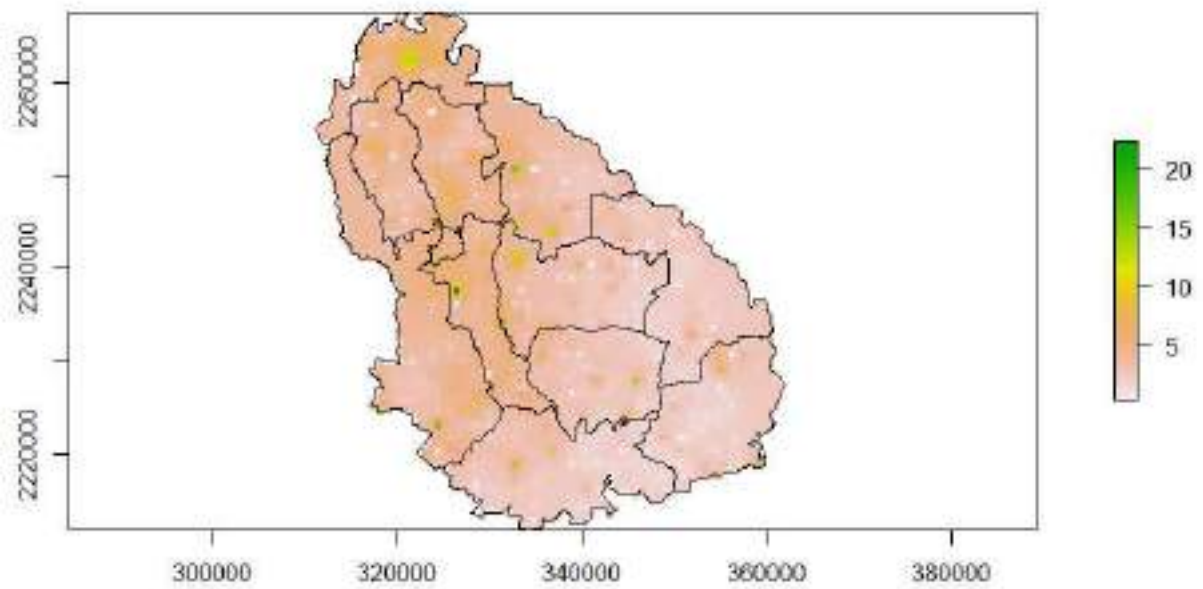
Figure 12(d): Intensive use area map for Sloth Bear at TATR
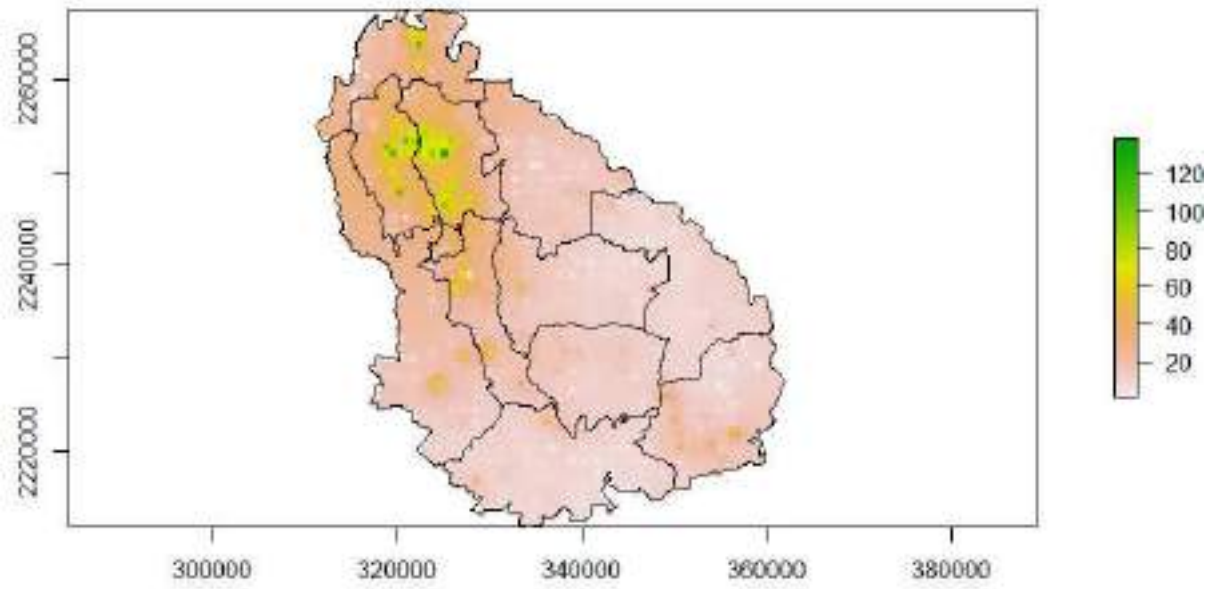
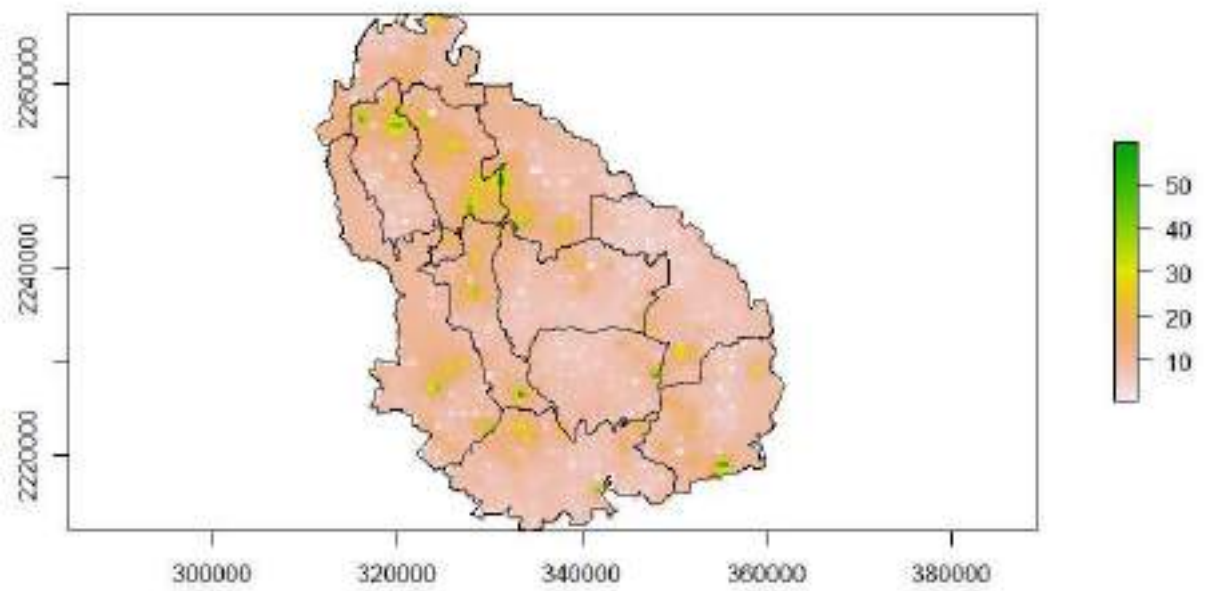Figure 12(e): Intensive use area map for Sambar at TATR

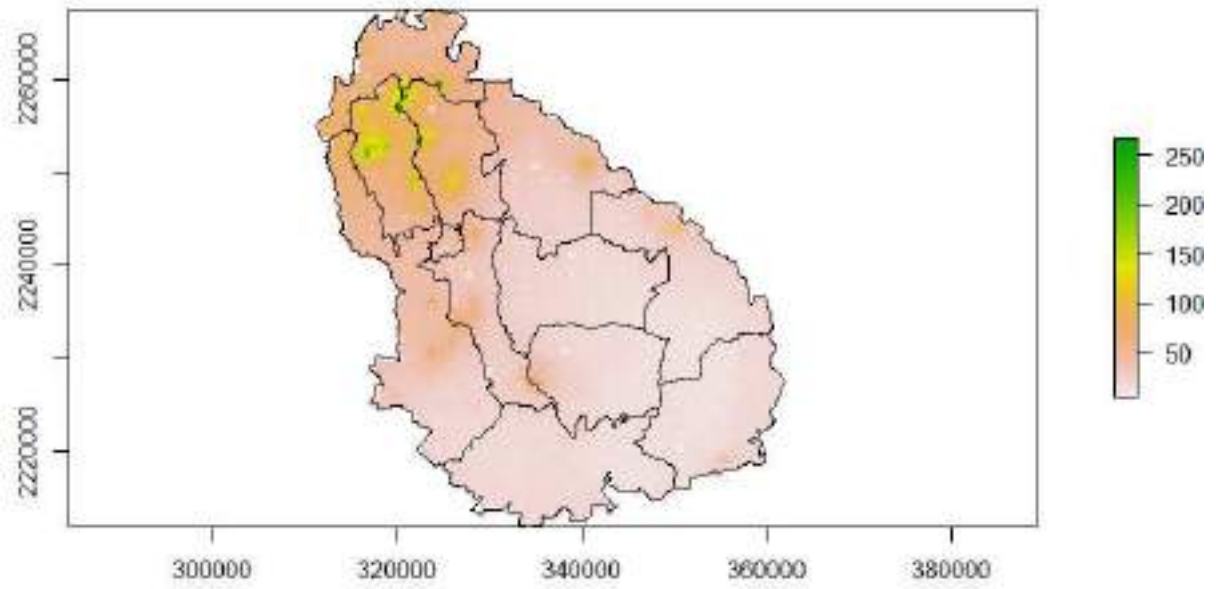Figure 12(f): Intensive use area map for Gaur at TATR

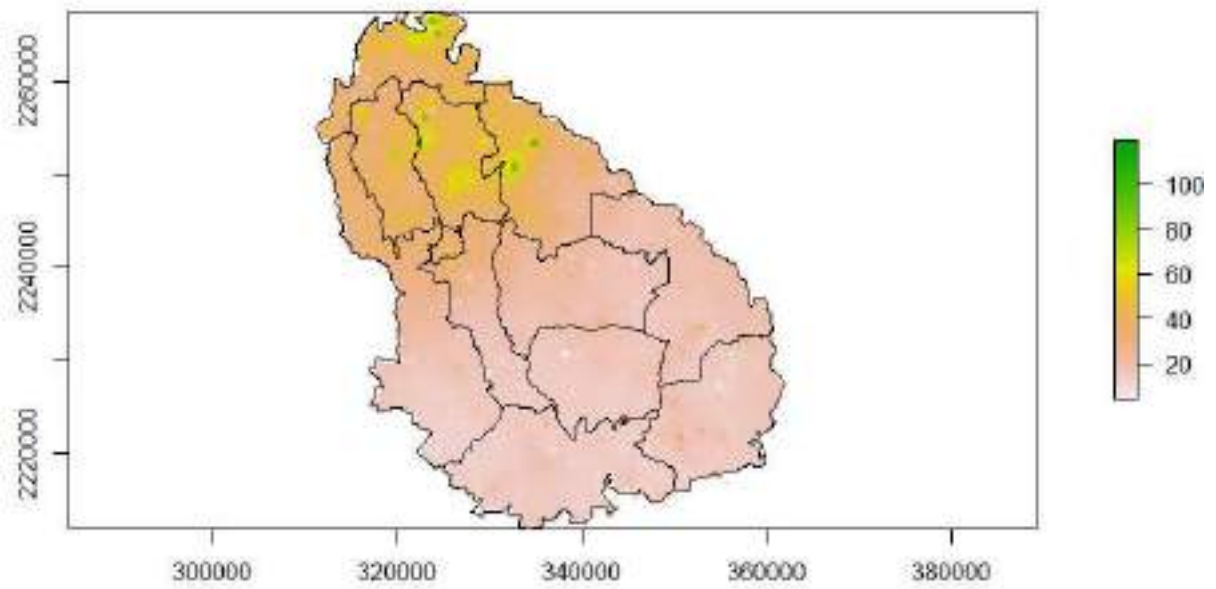Figure 12(g): Intensive use area map for Spotted Deer at TATR

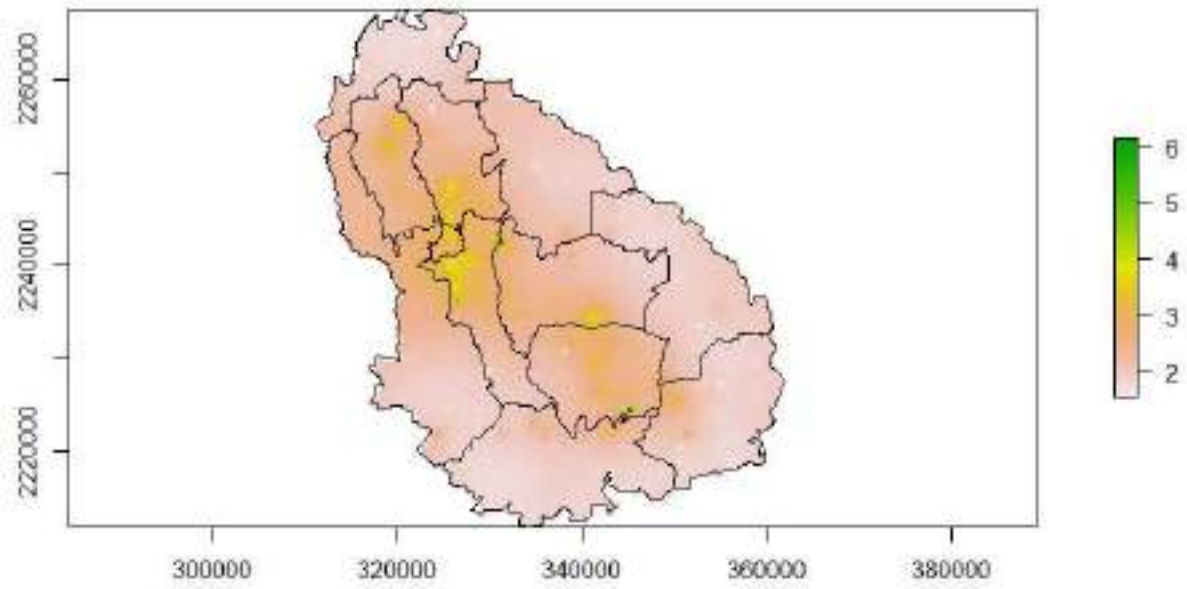Figure 12(h): Intensive use area map for Wild Boar at TATR

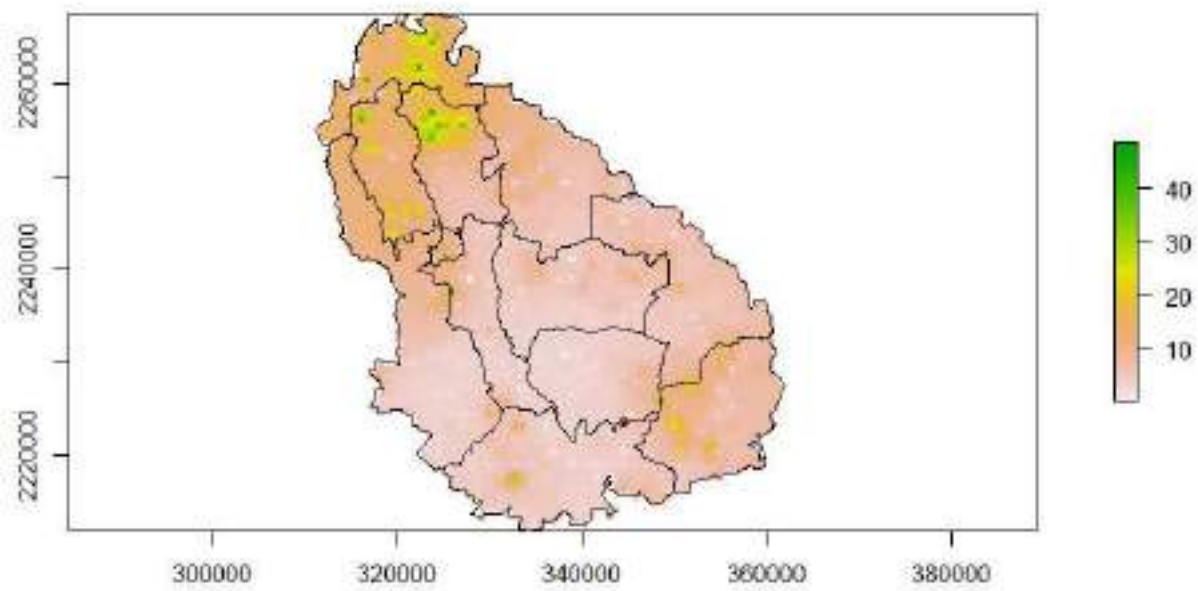Figure 12(i): Intensive use area map for Barking Deer at TATR

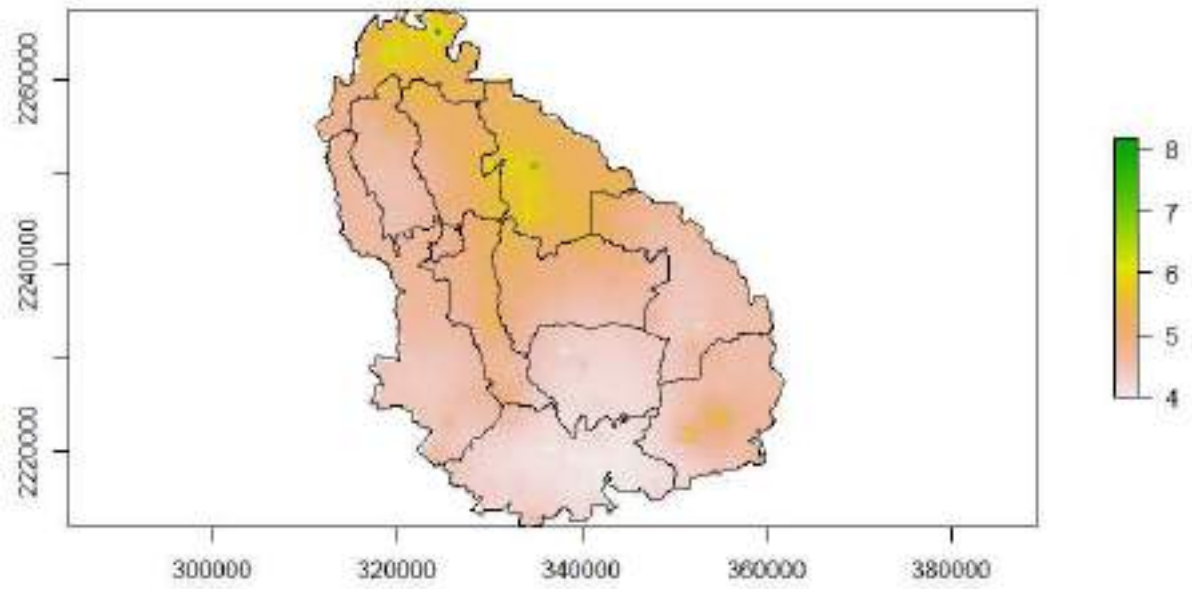Figure 12(j): Intensive use area map for Nilgai at TATR

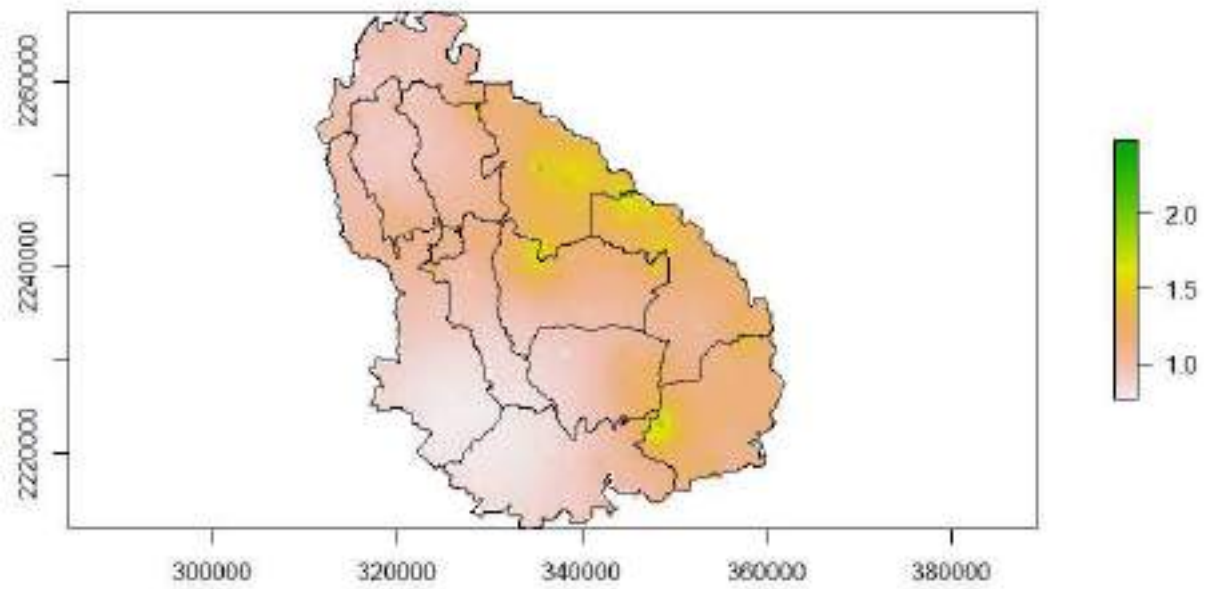Figure 12(k): Intensive use area map for Four-horned Antelope at TATR

Figure 12(l): Intensive use area map for Jungle Cat at TATR
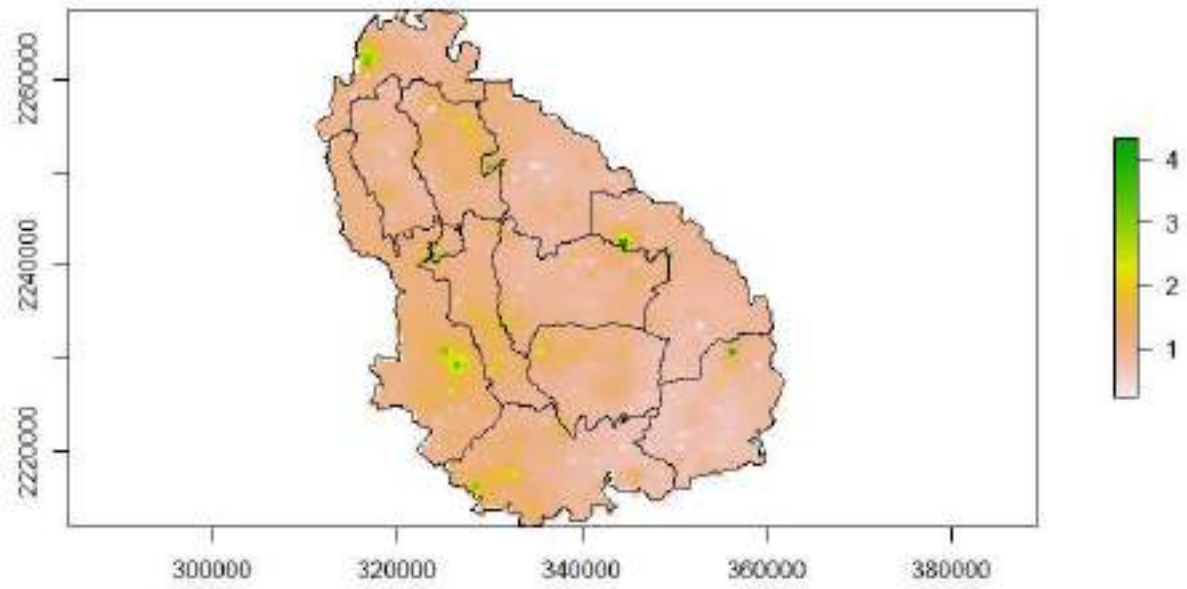
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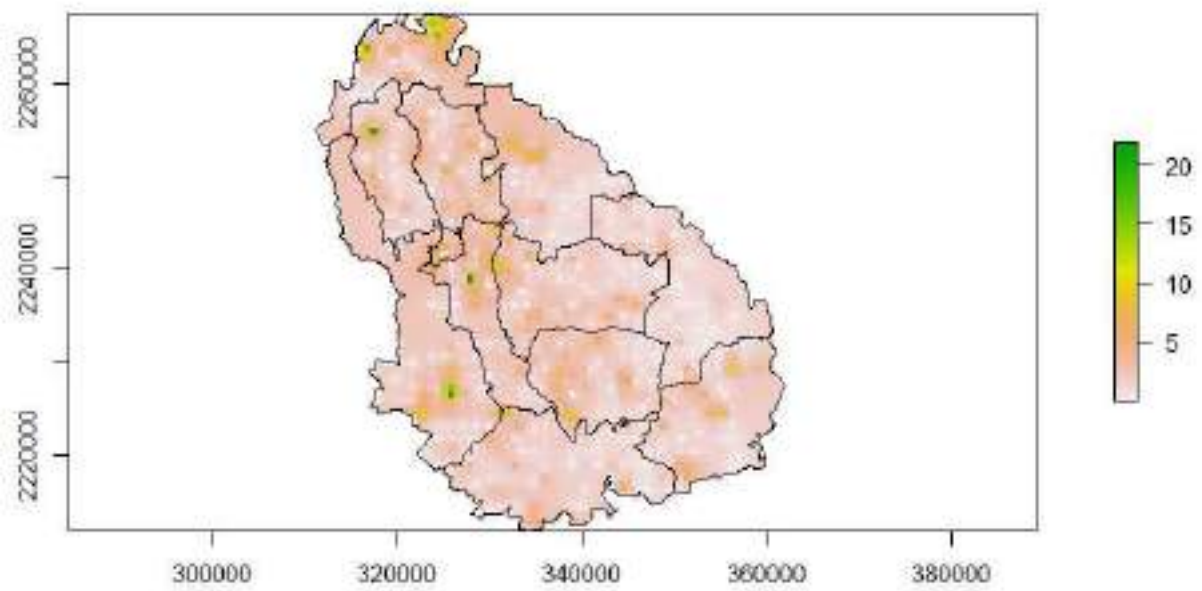Figure 12(m): Intensive use area map for Rusty-spotted Cat at TATR

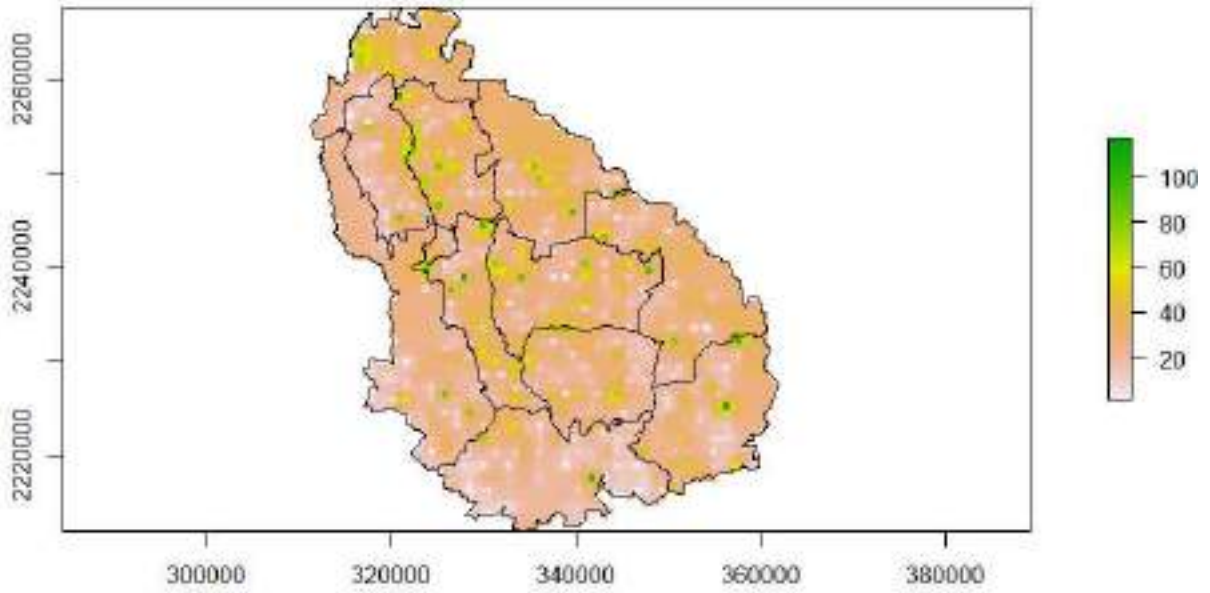Figure 12(n): Intensive use area map for Ratel at TATR

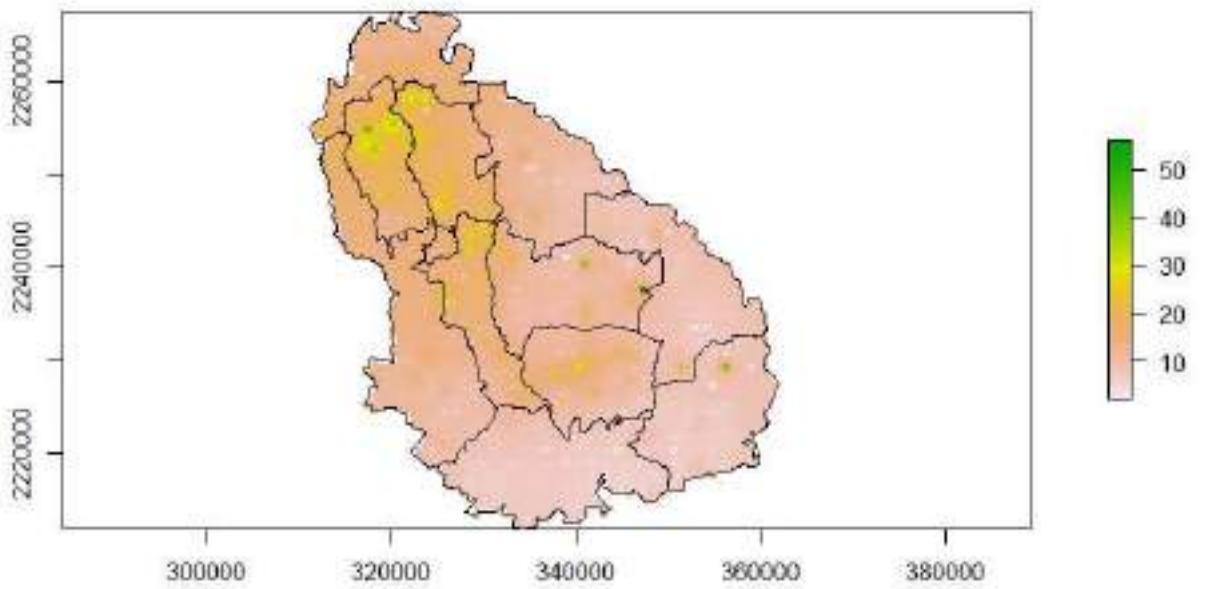Figure 12(o): Intensive use area map for Indian Hare at TATR

Figure 12(p): Intensive use area map for Indian Peafowl at TATR

Figures 12(a-p): Intensive use area of various species in Tadoba Andhari Tiger Reserve, Maharashtra, India during the year 2024

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Bibliography

ArcGIS 9.3 (ESRI, Redlands, CA, USA)- ESRI 2011. ArcGIS Desktop: Release 10. Redlands, CA: Environmental Systems Research Institute.

Bagchi,S., & Ricthie.,M.E. (2010). Introduced grazers can restrict potential soil carbon sequestration through impacts on plant community composition. Ecology letters.959-968.

Biswass, S & Sankar, K. (2002). Prey abundance and food habits of tigers (Panthera tigris) in Pench National Park, Madhya Pradesh, India. J. Zool. Lond. 256: 411-420.

Borchers, D. (2012). A non-technical overview of spatially explicit capture—recapture models. Journal of Ornithology, 152(2), 435-444.

Buckland, S. T., Anderson, D.R., Burnham, K.P., Laake, J L., Borchers, D.L and Thomas, L. (2001): Introduction to Distance Sampling: Estimating Abundance of Biological Population. Oxford University Press, Oxford, UK.

Buckland, S.T., Anderson, D., Burnham, K., Laake, J.L., Borchers, D., & Thomas, L. (2004). Advanced distance sampling.

Efford, M. G. (2015). secr: Spatially explicit capture-recapture models. R package version 2.10.0. http://CRAN.R-project.org/package=secr

Efford, M. G., & Fewster, R. M. (2013). Estimating population size by spatially explicit capture—recapture. Oikos, 122(6), 918-928.

Habib, B., Nigam, P., Mukul, T., Chatterjee, N., Madhura, D., Dashahre, A., Garad, G. P., Sinha, V., Kalaskar, A. S. and Narwane, G. P. (2014). Status of Tigers, Co-Predator and Prey in Tadoba Andhari Tiger Reserve (TATR) — Phase IV Monitoring Report and Report on Collaring of Leopards. Pp 26.

Habib, B., Nigam, P., Chatterjee, N., Madhura, D., Dashahre, A., Ghaskadbi, P., Garad, G. P., Sinha, V., Kalaskar, A. S. and Narwane, G. P. (2015): Status of Tigers, Co-Predator and Prey in Tadoba Andhari Tiger Reserve (TATR) — Pp 62.

Habib, B., Nigam P., Chatterjee, N., Madhura, D., Dashahre, A., Garad, G. P., Sinha, V., Mankar, K. and Narwane, G. P. (2017): Status of Tigers, Co-Predator and Prey in Tadoba Andhari Tiger Reserve (TATR) 2016 — Pp 27.

Habib, B., Nigam P., Chatterjee, N., Madhura, D., Ghaskadbi, G., Gomes, L., Trivedi, M., Sinha, V., Mankar, K. and Narwane, G. P. (2018): Status of Tigers, Co-Predator and Prey in Tadoba Andhari Tiger Reserve (TATR) 2017 — TR No. 2018/15 Pp 44.

Habib, B., Nigam P., Pallavi, G., Gomes, L., Praveen, N. R., Sinha, V., Ladkat, N. S., Guruprasad, G..and Bhagwat, S. (2019): Status of Tigers, Co-Predator and Prey in Tadoba Andhari Tiger Reserve (TATR) 2018 — Pp 41.

Habib, B., Nigam P., Pallavi, G., Gomes, L., Praveen, N. R., Sinha, V., Ladkat, N. S., Guruprasad, G. and Bhagwat, S. (2020): Status of Tigers, Co-Predator and Prey in Tadoba Andhari Tiger Reserve (TATR) 2019. Wildlife Institute of India & Maharashtra Forest Department. TR. No. 2020/05 — Pp 47.

Habib, B., Nigam, P., Krishnan, A., Praveen, N. R., Ramgaonkar, J., Ladkat, N. S., Guruprasad, G., Kale, N., Bhagwat, S. S. (2020): Status of Tigers, Co-Predator and Prey in Tadoba Andhari Tiger Reserve, Maharashtra, India (TATR) 2020 — Pp 51. Maharashtra Forest Department and Wildlife Institute of India.

Habib, B., Nigam, P., Ramgaokar, J., Guruprasad, G., Kale, N., Bhagwat, S. S., Krishnan, A., Hushangabadkar, P., Sheikh, S. (2022): Status of Tigers, Co-Predator and Prey in Tadoba Andhari Tiger Reserve (TATR) 2021 — Pp 54, Maharashtra Forest Department and Wildlife Institute of India TR. No. 2022/01.

Habib, B., Nigam, P., Banerjee, J., Ramgaokar, J., Annabathula, S., Jayramegowda, R., Patil, J., Krishnan, A., Koley, S., Ravindran, A., Kanishka, Bhowmick, I., Basu, N., Dabholkar, Y, Qadri, S. H. and Saxena, A. (2023): Status of Tigers, Co-Predator and Prey in Vidarbha Landscape, Maharashtra, India 2022 — Pp 382. TR. NO. 2023/01. Wildlife Institute of India and Maharashtra Forest Department.

Habib, B., Nigam, P., Ramgaokar, J., Kale, N., Pathak. K., Reddy, A., Krishnan, A., Thapliyal, A., Hushangabadkar, P., Sheikh, S. (2023): Status of Tigers, Co-Predator and Prey in Tadoba Andhari Tiger Reserve, Maharashtra, India. — Pp 56. Wildlife Institute of India and Maharashtra Forest Department.

James D. Nichols & William L. Kendall (1995): The use of multistate capture-recapture models to address questions in evolutionary ecology, Journal of Applied Statistics, 22:5-6, 835-846.

Jethva, B. J. (2002). Feeding ecology and habitat needs of wolves (Canis lupus pallipes) in the Bhal area of Gujarat. PhD. Dissertation. Forest Research Institute Deemed University, Dehradun, India. 95pp.

Jhala, Y. V. (1993) Predation on blackbuck by wolves in Velavadar National Park. Conser. Biol. 7(4): 874-881.

Johnson, M., Wofford, K and Pearson, H. (1983). Micro histological techniques for food habit analysis. USDA Forest Services Southern Forest Experiment Station Research Paper SO-199.

Karanth, K. U. (1995): Estimating tiger Panther tigris populations from camera trap data using capture-recapture models. Biological Conservation, 71:333 — 338. Leopold, B. D. and P. R. Krausman (1986). Diet of three predators in Big Bend national Park, Texas. Journal of Wildlife Management 50: 290-295.

Linkie, M., & Ridout, M. (2009). Estimating Overlao of Daily activity patterns for camera trap data. Journal of Agricultural, Biological and Environmental Statistics, 322-337.

Mackenzie, D. I., Nichols, J. D., Lachman, G. B., Droege, S., Royle, J. A., & Langtimm, C. A. (2002). Estimating Site Occupancy Rates When Detection Probabilities Are Less Than One. Ecology, 83(8), 2248-2255. doi:10.1890/0012-9658(2002)083

MacKenzie, D. I., Nichols, J. D., Royle, J. A. Pollock, K. H., Bailey, L. L., and Hines, J. E. (2006). Occupancy estimation and modeling: inferring patterns and dynamics of species occurrence. Elsevier, Amsterdam.

McDougal 1977- McDougal, C. (1977). The face of the tiger. London: Rivington Books.

McNaughton, S. J. (1979). Grazing as an optimization process: grass-ungulate relationships in the Serengeti. The American Naturalist, 113(5), 691-703.

Mukherjee, S., Goyal, S.P., & Chellam R. (1994a) Standardization of scat analysis techniques for leopard (Pathera pardus) in Gir National Park, western India. Mamma. 139-143.

Mukherjee, S., Goyal, S.P., & Chellam R. (1994b) Refined techniques for analysis of Asiatic lion (Panthera leo persica) scats. Acta Theriologica. 39(4): 425-430.

Nichols, J.D (1992). Capture —recapture models: using mark animals to study population dynamics. BioScience 42: 94 — 102.

Otis, D.L., Burnham, K.P., White, G.C. and Anderson, D.R. (1978): Statistical inference from capture data on closed animal population, Wildlife Monograph, 62: 1 — 135.

Rexstad, E., & Burnham, K. P. (1991). User's guide for interactive program CAPTURE. Color. Cooperative Fish and Wildlife Research Unit.

Schaller, G. B. (1967). The deer and the tiger.: a study of wildlife in India.

Schemed, A., & Schmidt, R. (2006). Nonparametric estimation of the coefficient of overlapping - theory and empirical application, Computational Statistics and Data Analysis, 1583-1596.

Spaulding, R.L., Krausman P. R. & Ballard, W. B. (1997) Calculation of prey biomass consumed by wolves in Northwest Alaska. Journal of Wildlife Research 2(2): 121-132.

Taylor, C. C. (2008). Automatic bandwidth selection for circular density estimation. Computational Statistics and Data Analysis, 52, 3493—3500.

Walters, C. J. (1986). Adaptive management of renewable resources. Macmillan Publishers Ltd.

Weitzman, M. S. (1970). Measures of overlap of income distributions of white and Negro families in the United States (Vol. 22). US Bureau of the Census.

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