



AN ASSESSMENT OF WILDLIFE, THREATS, AND BOTTLENECKS IN THE CORRIDOR BETWEEN THE SAHYADRI AND KALI TIGER RESERVES

TECHNICAL REPORT 2024



Wildlife Conservation Trust, India
In collaboration with
the Sahyadri Tiger Reserve, and the Forest
Circle (Territorial), Kolhapur,
Maharashtra Forest Department

Cover Photo: Girish Punjabi, WCT

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FOREWORD



The Wildlife Conservation Trust's (WCT) mission is to catalyse conservation of wild species and spaces using a holistic approach, with on-ground science-based actions and policy interventions. WCT strongly believes in collaborating with state Forest Departments to carry out systematic field studies that can strengthen existing management practices. Such research, conducted in partnership with the Sahyadri Tiger Reserve and the Territorial Divisions of Kolhapur Circle, has over the years, assisted senior forest officers and frontline forest staff alike to better understand the ecology of an indicator species such as the tiger, and employ this understanding in assessing the effectiveness of their management interventions. Protecting and monitoring the tiger corridor between the Sahyadri and Kali Tiger Reserves is pivotal in improving the status of tigers and other large mammals in this vast, multiple-use landscape.

Additionally, WCT's capacity building workshops in the field of Law Enforcement, Forensics, Trauma Management, and Wildlife Monitoring are continually enhancing the capabilities of the frontline forest staff. I am very proud of this organic relationship between the Maharashtra Forest Department and WCT and glad that the two agencies have been able to co-create an important baseline for long-term monitoring and conservation of northern Sahyadris, a key biodiversity hotspot in India.

Dr. Anish Andheria
President & CEO
Wildlife Conservation Trust

FOREWORD



The Corridor from Sahyadri Tiger Reserve to Kali Tiger Reserve is the only corridor which can allow for the movement of wildlife, including tigers, across the landscape, and also plays a key role in repopulating tigers in the Sahyadri Tiger Reserve. Therefore, it is vital to preserve this corridor landscape and sincere efforts are needed to ensure this. This report exemplifies how the collaboration between NGOs and the Forest Department can result in an elaborate database which can guide corridor planning and on-ground management. The Tiger Conservation Plan of the Sahyadri Tiger Reserve will receive many practical inputs as a result of this study.

It is noteworthy to mention that Shri. Uttam Sawant, Deputy Director, Sahyadri Tiger Reserve has played a crucial role in conceptualising the study, training staff and completing this work. Shri. G. Guruprasad, Dy. Conservator of Forests, Kolhapur (T) and Shri. S. Navakishor Reddy, Dy. Conservator of Forests, Sawantwadi (T), ensured that all the necessary assistance was provided to the Wildlife Conservation Trust (WCT) team in the field. All the Range Officers and forest staff of both territorial divisions have played a key role in this project. Shri. Girish Punjabi, Wildlife Biologist with WCT, along with his team made sincere efforts to implement this collaborative project successfully. I congratulate all of them and the authors of this report, which has been written based on the noteworthy efforts of WCT, in collaboration with the Sahyadri Tiger Reserve and the Territorial Divisions of Kolhapur and Sawantwadi.

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Chief Conservator of Forests (T), Kolhapur &
CF & Field Director, Sahyadri Tiger Reserve (Addl. Charge)

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WCT acknowledges the long-term support provided by Vinati Organics Limited (VOL) in funding this programme in the Sahyadri-Kali TR Landscape. We thank the BNP Paribas Foundation for funding a field vehicle. Contributions in the field by project assistant Amit Sutar, and volunteers Ravi Bandekar, Vadiraju Deshpande, Ajinkya Berde, Tanya Rao Gabriel, Sanjay Natekar, Makrand Naik, and Mahesh Mhangure are acknowledged. Lastly, the various teams at the WCT Head Office in Mumbai for ensuring the smooth functioning of the project.

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EXECUTIVE SUMMARY

This report presents findings from a collaborative study between the WCT, Sahyadri Tiger Reserve, and the Territorial Forest Circle at Kolhapur. The study was conducted in the Conservation Reserves (CRs) that were declared in Maharashtra between the Sahyadri Tiger Reserve and Bhimgad-Kali Tiger Reserve landscape of Karnataka. The objectives were to assess: (a) the minimum population of large carnivores, (b) status of wild prey, (c) breeding areas for large carnivores, (d) biotic pressures and threats, and (e) bottlenecks and gaps along major highways passing through the CRs. The overarching goal of the study was to use the findings to revise the Tiger Conservation Plan of the Sahyadri TR.

The study found eight adult tigers, two tiger cubs, 46 leopards, and nine dhole packs in the corridor between the Sahyadri and Kali Tiger Reserves. The study also assessed the first-ever density estimates for the tiger and leopard in these CR areas and relative abundance indices for wild prey species. Gaur and sambar deer were found to be the dominant prey species available for large carnivores in the CR areas. The Human Disturbance index was found to be highest for the Gaganbawda area, followed by the Chandgad-Ajara-Kadgaon CR complex. A number of bottlenecks, crossing points, and gaps were identified for wild mammals along major State and National Highways passing through the CRs and adjoining forests. Any future expansion of these highways needs to factor in these bottlenecks, crossing points and gaps to design appropriate mitigation measures. This study has set a baseline which is vital to assess the impact of management actions or landscape changes on large carnivore populations in the future.

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LIST OF ABBREVIATIONS

AIC	Akaike's Information Criterion
CCF	Chief Conservator of Forests
CR	Conservation Reserve
MoU	Memorandum of Understanding
KTR	Kali Tiger Reserve
RAI	Relative abundance index
STR	Sahyadri Tiger Reserve
TCP	Tiger Conservation Plan
TR	Tiger Reserve
UNESCO	United Nations Educational, Scientific and Cultural Organization
WCT	Wildlife Conservation Trust
WLS	Wildlife Sanctuary

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INTRODUCTION

The Western Ghats is a global biodiversity hotspot as it supports a large number of endemic species, but is highly threatened due to anthropogenic activities (Myers et al. 2000). It was inscribed as a UNESCO World Natural Heritage Site in 2012 (UNESCO World Heritage Convention 2012). This eco-region is a prominent mountainous landscape in India that harbours hundreds of globally endangered species and is the origin of numerous rivers provisioning water to millions of people in peninsular India. The northern Western Ghats landscape, locally known as Sahyadri in Maharashtra, is highly threatened with a large human population dependent on land resources for agriculture, human development, and biotic materials. The corridor region, stretching from the Sahyadri Tiger Reserve in the north to the Kali Tiger Reserve in the south, as explained further on, is the focus in this study. This region is also referred to as the Sahyadri-Konkan Corridor by some authors in other available literature, and expands into three states and measures about 10,800 sq. km. (Bawa et al. 2007; Pant and Punjabi 2023).

The Sahyadri Tiger Reserve (STR) is the sole tiger reserve in the northern Western Ghats region of Maharashtra. It comprises the Koyna Wildlife Sanctuary and Chandoli National Park along a buffer area, which were notified in the year 2010. STR is linearly connected to a source population of tigers, the Kali Tiger Reserve (KTR) in Karnataka and the Bhimgad-Mhadei-Tillari forest complex at the tri-junction of Karnataka, Goa, & Maharashtra, which are approximately 140 kilometers to the south of STR. This connectivity is provided by a series of newly declared Conservation Reserves (CRs), Reserve Forest patches, and the Radhanagari Wildlife Sanctuary in Maharashtra.

WCT, in collaboration with the STR administration, conducted a large-scale occupancy survey to assess large carnivore distribution in the Sahyadri to Kali Tiger Reserve Corridor landscape in the year 2019-20. The results revealed that the tiger occupies 61% of the viable forested landscape, whereas the leopard occupies 96%; the dhole was found to occur in 81%, whereas the sloth bear used 65% of the landscape (WCT report 2020). Following this study, it was mutually decided to collect more detailed information regarding the minimum population of tigers and leopards, as well as systematic information on threats and bottlenecks from the CR areas in the landscape. This information would be useful in order to revise the Tiger Conservation Plan (TCP) of the STR. With this background in mind, the management of STR and the Territorial Circle of the Maharashtra Forest Department (CCF Territorial at Kolhapur), and the WCT signed a MoU with the following objectives:

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OBJECTIVES

1. Assess the minimum population (& habitat-use) of the tiger, leopard, dhole, and sloth bear in the notified and approved CRs, and neighbouring forest patches.
2. Assess an index of abundance of major prey species in CRs using camera-trap data.
3. Understand bottlenecks in movement of large carnivores, especially crossing points along linear infrastructure using a road ecology framework in and around CRs.
4. Understand breeding areas for large carnivores (evidence of cubs/pups) using camera-trap data.
5. Assess biotic pressures and anthropological disturbance in CRs using camera-trap data.
6. Train frontline forest staff in scientific monitoring protocols such as camera trapping, data management.
7. Incorporate the above scientific information to demarcate and prepare an indicative plan for the corridor in the Tiger Conservation Plan (TCP) of Sahyadri TR (2023-24 to 2032-33), as well as the Management Plans of respective Conservation Reserves.

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STUDY AREA

The study area comprised nearly 830 sq. km. of forest land in the Kolhapur and Sindhudurg districts of Maharashtra, governed by the Kolhapur Territorial Circle. A number of CRs were declared in the years 2020 and 2021 in this region to safeguard this corridor between STR and KTR. These include the Tillari CR (29.53 sq. km.), Chandgad CR (225.24 sq. km.), Amboli-Dodamarg CR (56.92 sq. km.), Vishalgad CR (92.96 sq. km.), and Panhalgad CR (72.90 sq. km.). Two CR areas, Gaganbawda (105.48 sq. km.), and Ajara-Bhudargad (246.64 sq. km.) were approved by the Maharashtra State Board of Wildlife in their 16th Meeting (dated 04/12/2020) but have not been notified as yet. More details on the landscape are available in Pant and Punjabi (2023).

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METHODS

Assessing the minimum population & habitat use of large carnivores

Five notified CRs and two approved CR areas were surveyed using camera-traps (Models: BhartiCam; Browning Strike Force Pro XD) in the Sahyadri-Konkan Corridor (Figure 1). A map of these CRs was overlaid with a square grid-cell array, where each grid measured four square kilometers. We attempted to cover as many grids as possible during the camera-trap survey, however as camera theft was a major concern, we avoided areas closer to villages within a distance of one to three kilometers. Based on the experience of field staff and knowledge of existing trails in the landscape, cameras were

deployed at a total of 102 locations in the entire study region. Since vehicular access to forest areas was limited, a total walk effort of 328 km. was invested during camera deployment. Each camera location usually had a pair of cameras placed on opposite sides of a trail. In some cases where the risk of theft was high, only one camera was placed. Cameras were tied at about 45 cm. above the ground to the tree trunks. Cameras were active for a period of 20 days in most locations, after which they were removed. They were checked intermittently for battery levels and safety by forest staff, and the data was saved on a laptop from the memory cards after each area was surveyed.

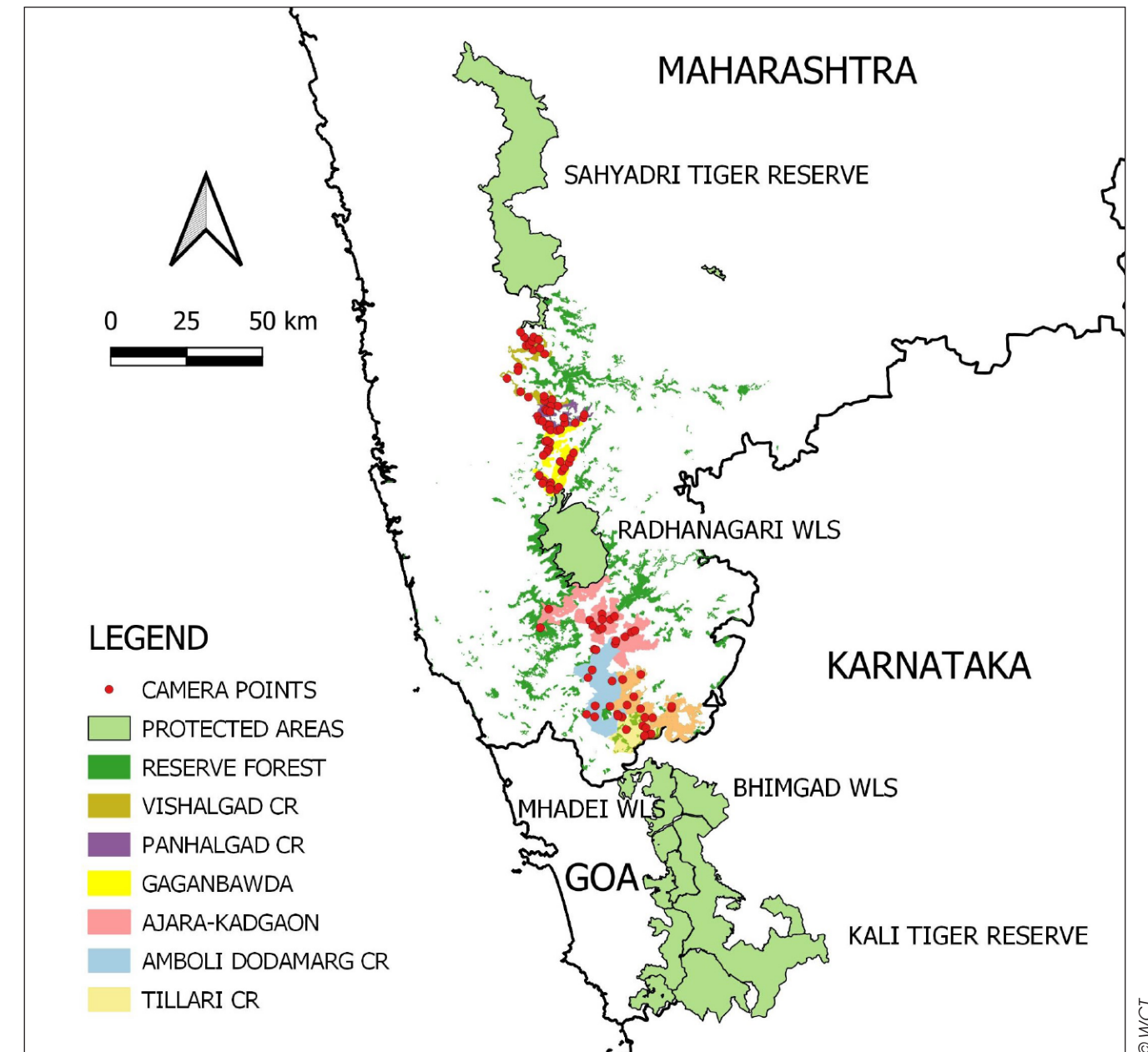


Figure 1: Locations of camera-trap points during the survey of CRs in the corridor between the Sahyadri and Kali Tiger Reserves in 2022-23

The raw data from camera-traps was fed into spreadsheets with detection information such as camera location identity, species identity, date, time, geographical location, and area details. Only independent captures were considered during the analysis (i.e. time duration between captures ≥ 30 min.). Photographs of tigers and leopards were identified and numbered to understand the minimum population and tagged with other details such as camera location, date, and time of capture. This information was later used to prepare capture details of the individuals for density analysis. For minimum number of dhole packs and sloth bears, the number of individuals were counted in the photographs

of these species and assumed to be the same individuals if photographed in a radius of five kilometres on any other cameras. This was done as it is difficult to identify these species to the level of individuals or individual packs due to a lack of distinct natural markings.

For analysis of spatial densities of leopard and tiger, we used the R package secr (Efford et al. 2023). To adhere to sampling assumptions of demographic and geographic closure, the data was divided into groups of different CRs which were surveyed in a planned manner within 60 days of each other. Two files each were prepared for each group - a capture file that comprised details of all captures of identified leopards or tigers from the area, and a detector file which comprised details of camera locations and deployment details. A habitat mask was prepared in QGIS for each CR group by including only habitat areas and removing non-habitat areas for a buffer distance of 10 km. around a polygon connecting the outermost camera locations. Three models to estimate density were run for each species (Half-Normal, Hazard Rate, and Negative Exponential) and these were compared using Akaike's Information Criterion scores corrected for small sample sizes (AICc). A buffer distance of 8 to 10 times the biased sigma value was used during model fitting for estimation of animal density (Efford et al. 2023). Model fits were evaluated visually using plots and the best model was chosen using AICc values and overall visual fit.

To assess the habitat use of the four large carnivores, we used the day-wise detection histories of the carnivore species to model their predicted occupancy (probability of occurrence or use) at the fine-scale of the camera stations. Ecological and anthropogenic covariates were used to understand the effect of preferred prey species occurrence, competing large carnivore species presence, and human disturbance index on the habitat use of the carnivores. Survey effort (number of days each camera station was operational) was used as a covariate to assess its effect on detection probability. Since the sampling unit was the view-shed area of a camera station, the predicted occupancy probability values were interpreted as the 'probability of habitat use' rather than occupancy (MacKenzie 2006). All models were run in software PRESENCE (Hines 2006).

Covariates were either site-specific or sampling specific, i.e., one value per sampling site in the former or a presence/absence value per sampling occasion of a site in the latter case. Site-specific covariates were normalised using z-scores. For the analysis, we used the correlated detection model as detections of the carnivores at the same site or neighbouring sites were not independent of each other (Hines et al. 2010). Although the model is designed to be employed with spatially replicated sampling, we employed it to our data with temporal replication due to correlated detections in our data. The model accounts for the lack of independent detections within and between camera stations which biases predicted estimates of habitat-use.

Using a null model for occupancy (no covariates), we first modelled the detection probability component for each species. Based on which of the two models for detection probability (with effort or the null model) was ranked higher in terms of Akaike's Information Criteria (AIC) weights, we decided whether to use the covariate or not to model detection probability further on. Once the structure for detection probability was fixed, competing models from the candidate model set were run for the occupancy component and ranked based on AIC scores and model weights. Models that faced convergence issues were deleted from the model set. For species where the top ranked model was the null model (i.e., other models with covariates explained little to no variation in the data), we presented only the overall predicted probability of habitat use for the species.

Index of abundance of major prey species

For each prey species (gaur, sambar, muntjac/barking deer, wild pig, Indian chevrotain, Indian crested porcupine, Indian hare, common peafowl) of the carnivores, we calculated a relative abundance

index (RAI) in each CR complex and overall for the study region. To calculate the RAI of each prey species, the total number of independent captures in the CR was multiplied by 1000 and divided by the total number of trap nights in each CR/CR-complex. Although RAIs have a number of issues in terms of their interpretation, we present them to get a general understanding of prey species in different CR areas.

Bottlenecks and gaps

A survey of bottlenecks and gaps along major highways cutting across the corridor was conducted at different times from December 2022 to July 2023. First, we examined the highway sections on freely available high resolution satellite images of the region using Google Earth. Where a highway cuts through government-notified forest, which would otherwise be continuous, we consider it to be a bottleneck. Where the distance between forest patches on either side of the road was less than one kilometre, we consider it to be a gap (a one kilometre threshold was considered, assuming that large carnivores would still be able to cross this distance despite non-conducive land-uses for movement). The bottlenecks and gaps were verified on the ground by driving along the roads and conducting foot surveys of locations with prominent crossing points, such as animal trails or dry watercourses seen on either side of the road.

Breeding areas

The breeding locations for the four large carnivores were identified using camera-trap data. The presence of a lactating female of a species or clear photos of young individuals were a confirmation of a breeding area for a species. Although a survey in a short span may not reveal all the important breeding areas for threatened large carnivores, this information can be regularly updated with future surveys of the landscape.

Biotic pressures and anthropological disturbance

For biotic pressures and anthropological disturbance, we examined the relative abundance index of five species, which included domestic cattle, domestic buffalo, domestic dog, domestic goat, and humans in each CR-complex. We summed up the total number of independent detections of these five species and calculated a human disturbance index (same as the RAI but included the sum of detections of all five species) for each CR complex. The indices were compared for the different CRs in the landscape.

8 RESULTS AND KEY FINDINGS

A total of 2,770 independent captures of 36 different species were obtained (Figure 2). The most photographed species was humans (641 independent captures), followed by gaur (277 captures), and Indian crested porcupine (229 captures). The least photographed species included four-horned antelope and golden jackal (2 captures each), domestic cat (1 capture), and the arboreal Malabar giant squirrel (1 capture). In terms of large carnivores, leopards were most captured (106 captures), followed by sloth bear (29 captures), tiger (24 captures), and the least captured large carnivore was the dhole (17 captures). Detections of large carnivores and major wild herbivore prey species are shown in Figures 3 and 4. Other interesting smaller carnivores included the Asian small-clawed otter, rusty-spotted cat, leopard cat, stripe-necked mongoose, and the endemic brown palm civet.

Minimum population and density

The camera-trap survey found the presence of eight adult tigers, two tiger cubs, and 46 leopards, and nine dhole packs in the CRs (Table 1; Appendix A1, A2). The survey resulted in the first-ever calculation of scientifically robust density estimates of the leopard and tiger in the CRs of the Sahyadri to Kali Tiger Reserve Corridor (Table 2; Appendices A3 to A7).

Habitat use

The naive habitat-use and predicted habitat-use probability values for each species in the overall landscape (all CRs taken together) are shown in Table 3. Model sets ranked using AIC scores are shown in Appendix A8. Except for the tiger, the null model was ranked as the top model for all the other three carnivore species (Appendix A8).

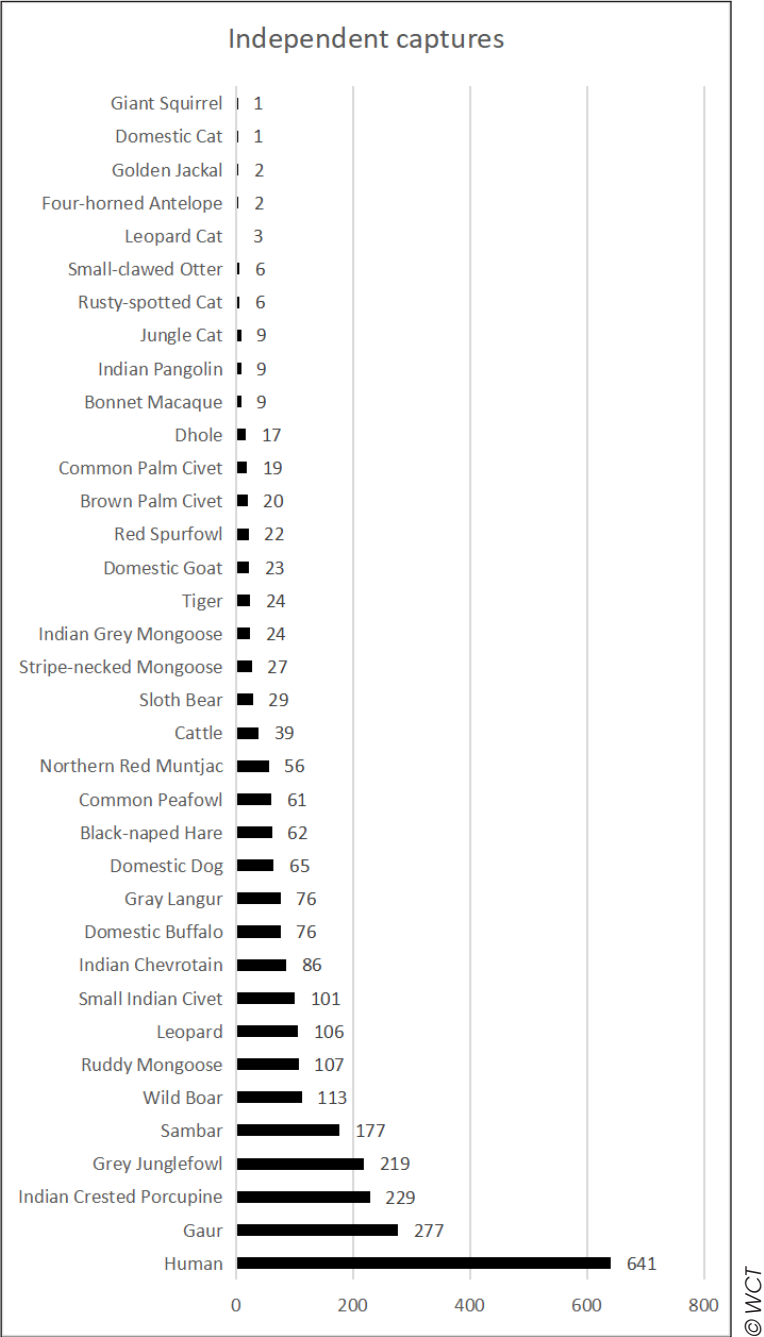


Figure 2: Number of independent captures of various species in the camera-trap survey of CRs within the corridor between the Sahyadri and Kali Tiger Reserves.

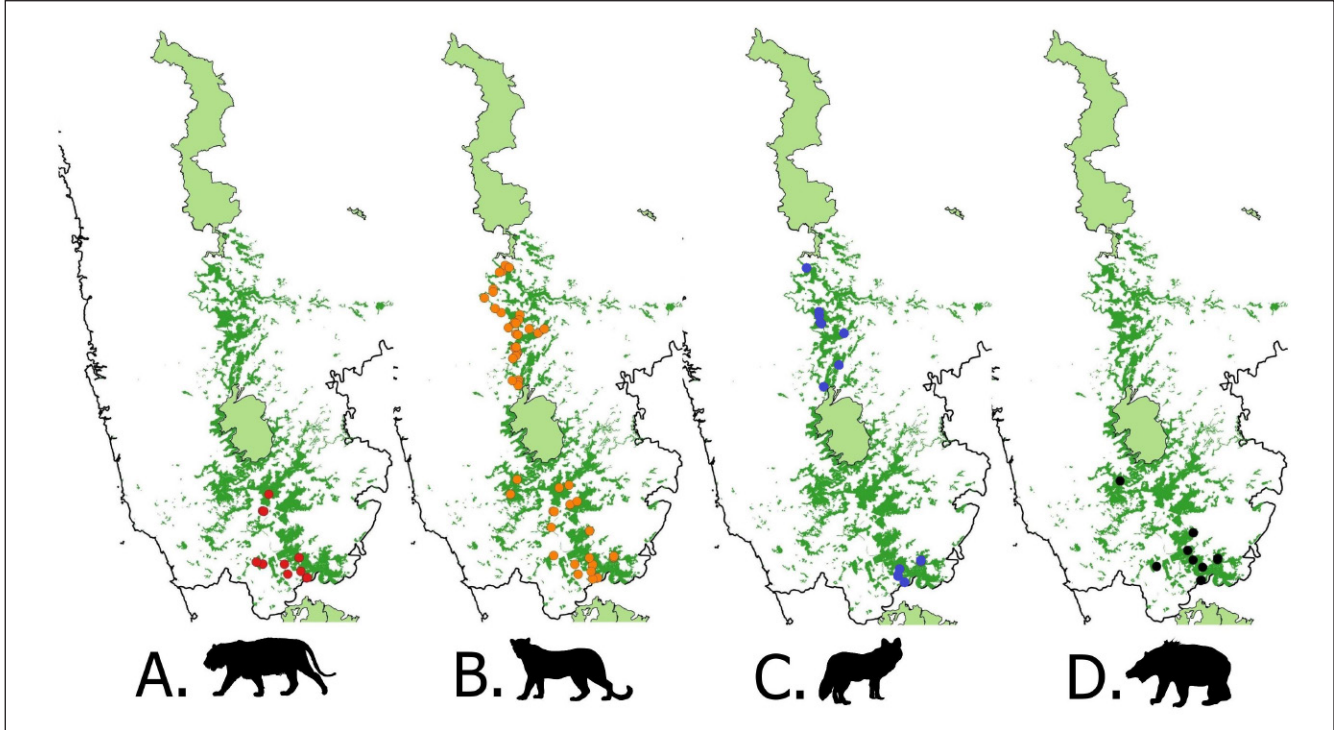


Figure 3: Photo-captures of the Tiger (A), Leopard (B), Dhole (C), & Sloth bear (D) during the camera-trap survey of CRs in the corridor between the Sahyadri and Kali Tiger Reserves (2022-23). Silhouettes used under Creative Commons (CC) license from phylopic.org. Copyright belongs to individual contributors.

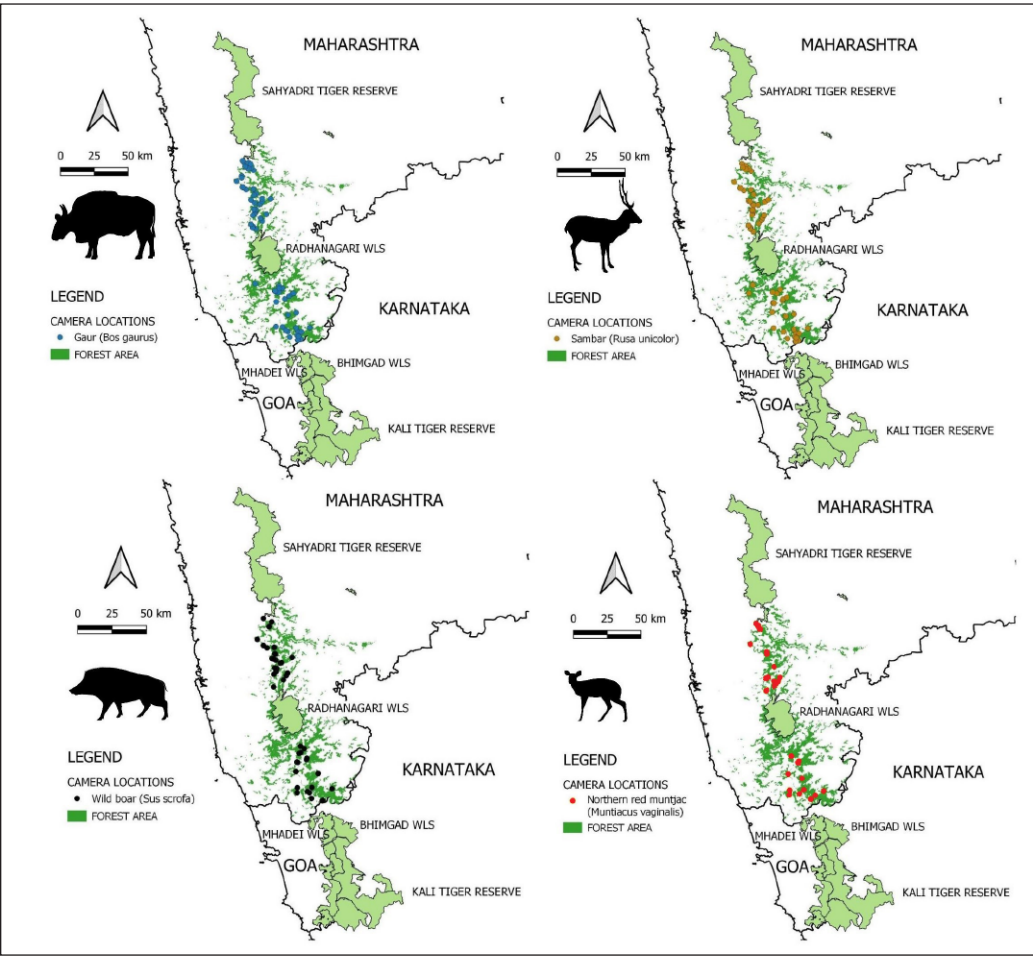


Figure 4: Photo-captures of the gaur, sambar, northern red muntjac, and wild pig (clockwise from top left) during the camera-trap survey of CRs in the corridor between the Sahyadri and Kali Tiger Reserves (2022-23). Silhouettes used under Creative Commons (CC) license from phylopic.org. Copyright belongs to individual contributors.

Table 1: Minimum population identified of the four large carnivores in different CR-complexes in the corridor between the Sahyadri and Kali Tiger Reserves.

CR complex	Leopard	Tiger	Sloth bear [†]	Dhole (packs) [‡]
Vishalgad-Panhalgad-Gaganbawda	24	NA	NA	6
Tillari-Amboli-Dodamarg	11	8 (+2 cubs)	3	2
Chandgad-Ajara-Kadgaon	11	3*	7	1
Total	46	8 (+2 cubs)	~10	~9 packs

*three tigers were common across the two CR complexes
‡ approximate minimum number based on individuals photographed on cameras within 5 km of each other
‡ minimum number of packs; packs are the basic unit of dholes and number of individuals is higher
NA = Not available/ captured

Table 2: Estimated densities of the leopard and tiger in the corridor between the Sahyadri and Kali Tiger Reserves.

CR complex	Leopard Density (Individuals/ 100 sq.km.)	Tiger Density (Individuals/ 100 sq.km.)
Vishalgad-Panhalgad-Gaganbawda	4.70 ± 1.06	NA
Tillari-Amboli-Dodamarg	10.96 ± 6.10	1.26 ± 0.6
Chandgad-Ajara-Kadgaon	1.26 ± 0.6	NE

NA = Not available as no individuals were captured; NE = Not estimable due to low number of captures/ recaptures during the survey

Table 3: Naive (uncorrected) and predicted habitat-use probabilities based on the null model for each large carnivore in the CR areas (all CRs taken together) of the corridor between the Sahyadri and Kali Tiger Reserves.

Species	Naive habitat-use	Predicted habitat-use (± SE)	LCI - UCI
Tiger	0.12	0.30 (± 0.09)	0.16 - 0.49
Dhole	0.14	0.33 (± 0.16)	0.11 - 0.68
Leopard	0.52	0.69 (± 0.08)	0.51 - 0.83
Sloth bear	0.11	0.27 (± 0.11)	0.11 - 0.51

SE = Standard Error; LCI = Lower Confidence Interval; UCI = Upper Confidence Interval

Index of abundance for major prey species

Relative Abundance indices (RAIs) were calculated for the major prey species for large carnivores and included 11 wild species, of which nine were mammals and two birds. Additionally, four domestic species of animals were also captured, these are presented under results for biotic pressures.

Table 4: Relative Abundance Indices (RAIs) for major prey species in the CR-complexes of the corridor between the Sahyadri and Kali Tiger Reserves. Higher values indicate higher relative abundance (i.e., number of independent captures per 1000 trapping nights).

CRs	Vishalgad	Panhalgad	Gaganbawda	Tillari-Amboli-Dodamarg	Chandgad-Ajara-Kadgaon
Prey species					
Gaur	137.57	23.81	77.33	48.60	99.26
Sambar	37.04	26.98	81.33	72.16	32.59
Northern red muntjac	15.87	1.59	18.67	22.09	20.74
Wild pig	17.20	19.05	20.00	76.58	31.11
Indian Chevrotain	5.29	1.59	25.33	75.11	16.30
Black-naped hare	11.90	3.17	37.33	16.20	17.78
Common peafowl	7.94	0.00	14.67	8.84	56.30
Gray langur	11.90	22.22	20.00	10.31	45.93

CRs	Vishalgad	Panhalgad	Gaganbawda	Tillari-Amboli-Dodamarg	Chandgad-Ajara-Kadgaon
Bonnet macaque	0.00	1.59	4.00	0.00	7.41
Indian crested porcupine	44.97	49.21	45.33	92.78	99.26
Grey junglefowl	51.59	41.27	112.00	41.24	62.22

Bottlenecks and gaps

Major bottlenecks and gaps were identified along the State and National Highways cutting across the corridor. The GPS locations of bottlenecks, crossing points, and gaps are listed road-wise going from North to South in the Sahyadri-Konkan Corridor in Appendix A9.

Breeding areas for large carnivores

Photographic captures of cubs, sub-adults and lactating females for large carnivore species recorded during the survey is presented in Table 5 & Figure 5.

Table 5: Locations with captures of young ones and/or lactating females in the CR-complexes of the corridor between the Sahyadri and Kali Tiger Reserves.

Species	Latitude	Longitude	CR complex	Evidence
Tiger	15.813422	74.010417	Tillari-Amboli-Dodamarg	Two cubs
Leopard	16.82028	73.733992	Vishalgad CR	One cub/ sub-adult
	15.840154	74.246896	Chadgad CR	Two cubs
Dhole	16.767955	73.849143	Vishalgad CR	Lactating female
	16.724322	73.858728	Panhagad CR	Lactating female
	15.845138	74.247713	Chandgad CR	Two pups
Sloth bear	15.873766	74.130953	Chandgad CR	One cub
	15.845138	74.247713	Chandgad CR	One cub



Figure 5: Evidence of breeding captured for carnivore species (clockwise from top left), two tiger cubs, a sub-adult leopard, lactating female dhole, and bear cub on the back of a mother in the corridor between the Sahyadri and Kali Tiger Reserves in 2022-23.

Biotic and anthropological pressures

Relative abundance indices of different species of domestic animals and humans in CR-complexes revealed that human presence was the highest among all other species in forests. However, this result may have been an artifact of humans using trails more often than other domestic animal species. Humans were found engaging in multiple activities, including using the trails for commuting, visiting religious sites, grazing livestock, collecting firewood, fishing, and even hunting with guns. Two cases were registered by the Forest Department during the camera-trap survey based on photographic evidence from camera-traps (Appendix A10). In terms of an overall Human Disturbance Index, Gaganbawda CR appeared to have the highest human disturbance, followed by Chandgad-Ajara-Kadgaon CR-complex. The RAIs and Human Disturbance Index for the CR-complexes are presented in Table 6 & Figure 6.

Table 6: Relative abundance indices (RAIs) of various domestic animals and humans, along with a human disturbance index calculated for various CR complexes in the corridor between the Sahyadri and Kali Tiger Reserves. Higher values indicate higher relative abundance and human disturbance (last row).

	Vishalgad	Panhalgad	Gaganbawda	Tillari-Amboli-Dodamarg	Chandgad-Ajara-Kadgaon
Species					
Cattle	5.29	4.76	25.33	0.00	19.26
Domestic Buffalo	5.29	0.00	54.67	0.00	45.93
Domestic Dog	1.32	6.35	26.67	26.51	32.59
Domestic Goat	7.94	0.00	16.00	0.00	7.41
Human	167.99	160.32	254.67	111.93	216.30
Human Disturbance Index	187.83	171.43	377.33	138.44	321.48

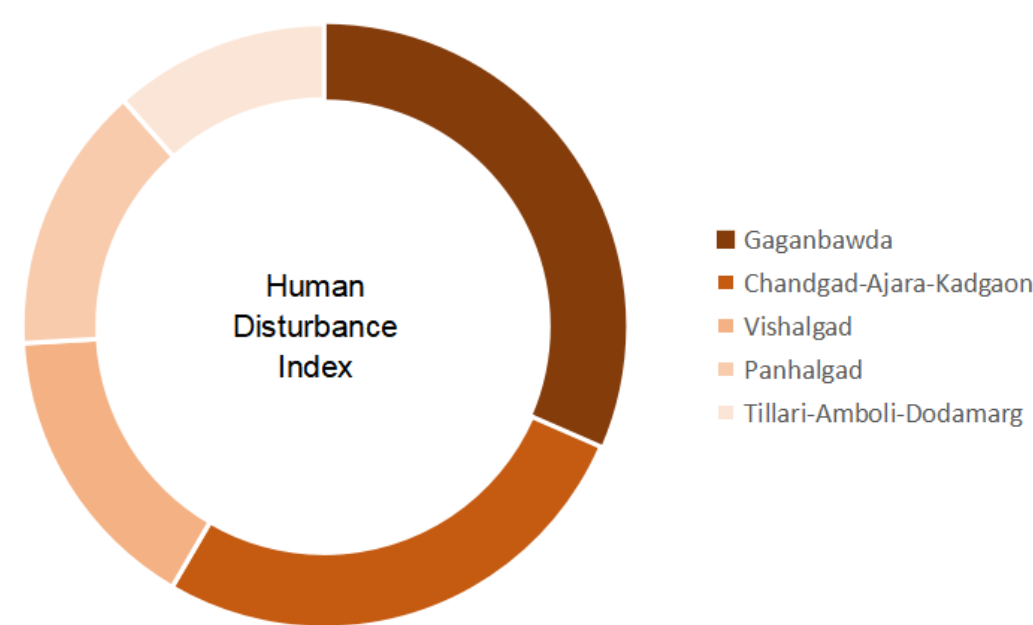


Figure 6: Human Disturbance Index as a pie wheel chart for different CR-complexes in the corridor between the Sahyadri and Kali Tiger Reserves. Darker colours with larger areas denote higher human disturbance.

9

DISCUSSION

This study is the first systematic assessment of the minimum population and density of the tiger and leopard in the recently declared CRs of the Sahyadri to Kali Tiger Reserve Corridor. We have also attempted to understand the habitat-use of all four carnivores in the corridor region, as well as identify their breeding areas from camera-trap data. The bottlenecks, gaps and crossing points presented in this report also have implications for future expansion of the major highways passing through these CRs. Relative abundance indices of prey species and human disturbance indices provide a broad understanding of the status of prey species in the CRs and the impacts of humans and their livestock on these species. These findings are discussed here with respect to management measures that should be undertaken to improve or maintain the status of large mammalian wildlife in these CRs. This is also crucial for tiger management as without a functional corridor, natural dispersal of tigers to STR is unlikely.

In terms of tiger density, we could only calculate a robust density estimate in one CR-complex, the Tillari-Amboli-Dodamarg. This CR complex (Tillari CR and Amboli-Dodamarg CR) together comprises 86.45 sq. km. of protected forest (although private forest area is considerably higher), however eight tigers and two cubs were found using the habitat in these CRs. Although three of these individuals also use the neighbouring Chandgad-Ajara-Kadgaon CR-complex, it appears that the habitat in the former is preferred. The reasons for this appear to be a lower Human Disturbance Index in Tillari-Amboli-Dodamarg as compared to other CR-complexes (shown in Table 6). The habitat-use analysis for the tiger also shows a similar pattern as the model with Human Disturbance Index was ranked as the top model for the species. The covariate shows a negative effect on tiger habitat use. This indicates that reducing human disturbance should be a key aim of CR management strategies so that the status of tigers can be improved in the region.

Leopard density was also found to be the highest in the Tillari-Amboli-Dodamarg CR-complex as compared to the other areas (Table 2). This was nearly two to three times higher than that estimated for other CR-complexes. In the case of the sloth bear, no individuals were photographed in the Vishalgad-Panhalgad-Gaganbawda CR-complex. This finding matches the results of our landscape-level occupancy study as well (WCT report 2020), where no sloth bear signs were detected in these regions (except in southernmost Gaganbawda abutting Radhanagari WLS). Overall, sloth bears also appear to be threatened and more efforts should be made to conserve remnant populations in the corridor areas. Reintroduction of sloth bears can also be considered in larger and less disturbed habitat patches of the Vishalgad-Panhalgad-Gaganbawda CR-complex after looking at past data on human-sloth bear interactions. Lastly, for the dhole, we conservatively identified a minimum number of nine packs in the CR-complexes. Conservative because there may be a small probability of the same pack being misidentified as a different one. However, given the linear nature of the landscape and the rapid nature of our survey, chances of misidentification are minuscule at best. Pack size appeared to range from two to ten individuals based on camera-trap captures. A higher number of unique packs were identified in the Vishalgad-Panhalgad-Gaganbawda complex and only one pack was identified in the Chandgad-Ajara-Kadgaon complex. Interestingly, all four large carnivores were found to be breeding in at least one CR-complex, indicating the importance of the corridor landscape for the persistence of all four species in the Sahyadri-Konkan Corridor.

The bottlenecks, crossing points, and gaps identified along major highways passing through the CRs are crucial and should be strongly considered before forest clearances are accorded to any road expansions in the future. The absence of data can lead to incorrect placement of mitigation measures, or worse,

no mitigation measures at all. At the same time, the size and type of mitigation structures need to be carefully determined to suit the species composition occurring in the landscape. We have collected this information through observational ground surveys and examining the presence of animal trails or potential crossing points. Some local knowledge of the frontline forest staff has also been considered to identify the bottlenecks and gaps. However, there is scope to do in-depth studies using camera-traps on each of the bottlenecks, crossing points, and gaps identified in our report. Functional connectivity can also be modelled using multiple sources of data (telemetry, camera-trap detection, animal signs) to clearly understand the role of bottlenecks in animal movement.

10 CONCLUSION

This study presents a systematic baseline for large carnivore status in the different CRs of the Sahyadri-Konkan Corridor. The study recommends improving protection measures in the new CRs so as to see a perceptible difference in the status of tigers in the landscape. The other three large carnivore species will also benefit from regular patrolling and enforcement activities in the region. Including the CRs as part of the revised TCP of STR is recommended as this would allow the inflow of funds for protection activities within the CRs. Systematic patrolling in CRs is crucial for deterring poaching and hunting activities as that is one of the most prominent threats to wild prey and carnivore populations in the region. During this study, action was taken in two separate cases when poachers were photographed on camera-traps (Appendix A10). Camera-traps are therefore a useful addition to the protection toolkit for wildlife managers as they generate hard evidence which can help with law enforcement.

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12

APPENDICES

A1. Identified tigers in the CR complexes of the corridor between the Sahyadri and Kali Tiger Reserves

LEFT FLANK

SKT_02 (FEMALE)



© WCT/STR/MFD

SKT_04 (FEMALE)



© WCT/STR/MFD

SKT_05 (FEMALE)



© WCT/STR/MFD

SKT_10 (MALE)



© WCT/STR/MFD

RIGHT FLANK

SKT_02



© WCT/STR/MFD

SKT_04



© WCT/STR/MFD

SKT_05



© WCT/STR/MFD

SKT_10



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LEFT FLANK

SKT_11 (MALE)



© WCT/STR/MFD

SKT_12 (MALE)



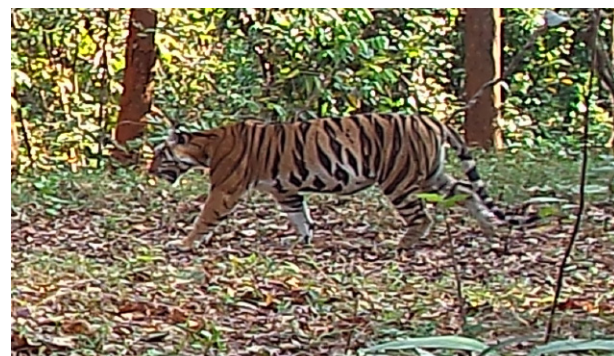
© WCT/STR/MFD

SKT_13 (FEMALE)



© WCT/STR/MFD

SKT_17 (FEMALE)



© WCT/STR/MFD

RIGHT FLANK

SKT_11



© WCT/STR/MFD

SKT_12



© WCT/STR/MFD

SKT_13



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CUBS OF SKT 13 (FATHERED BY SKT 12)



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A2. Photographs of locally threatened wildlife species in the CR-complexes of the corridor between the Sahyadri and Kali Tiger Reserves

LEOPARD



© WCT/STR/MFD

GAUR



© WCT/STR/MFD

DHOLE



© WCT/STR/MFD

SLOTH BEAR



© WCT/STR/MFD

INDIAN PANGOLIN



© WCT/STR/MFD

LEOPARD CAT



© WCT/STR/MFD

SMALL-CLAWED OTTER



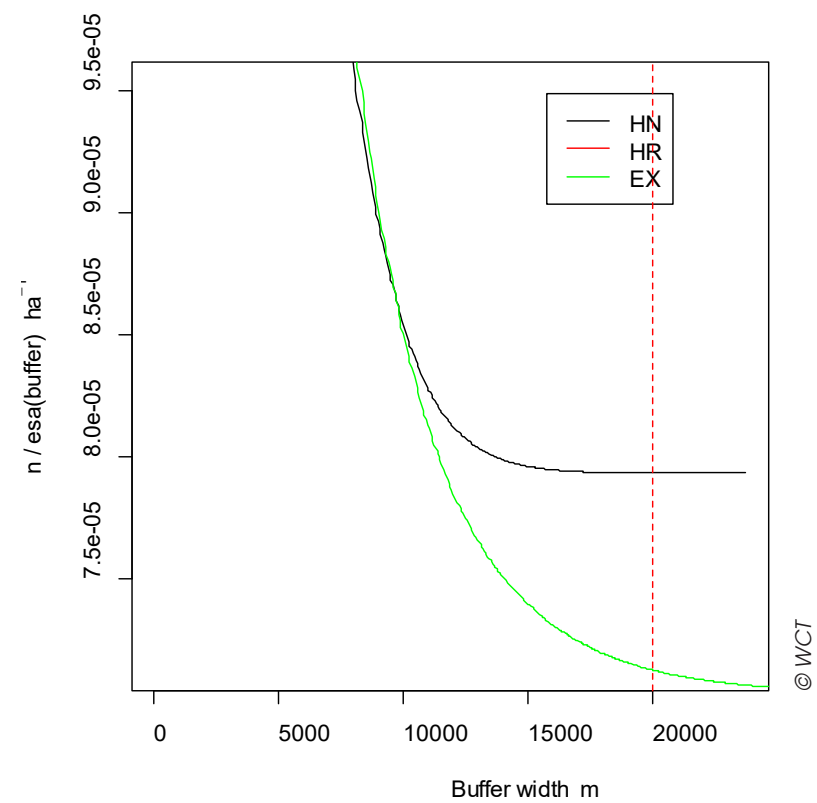
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RUSTY-SPOTTED CAT

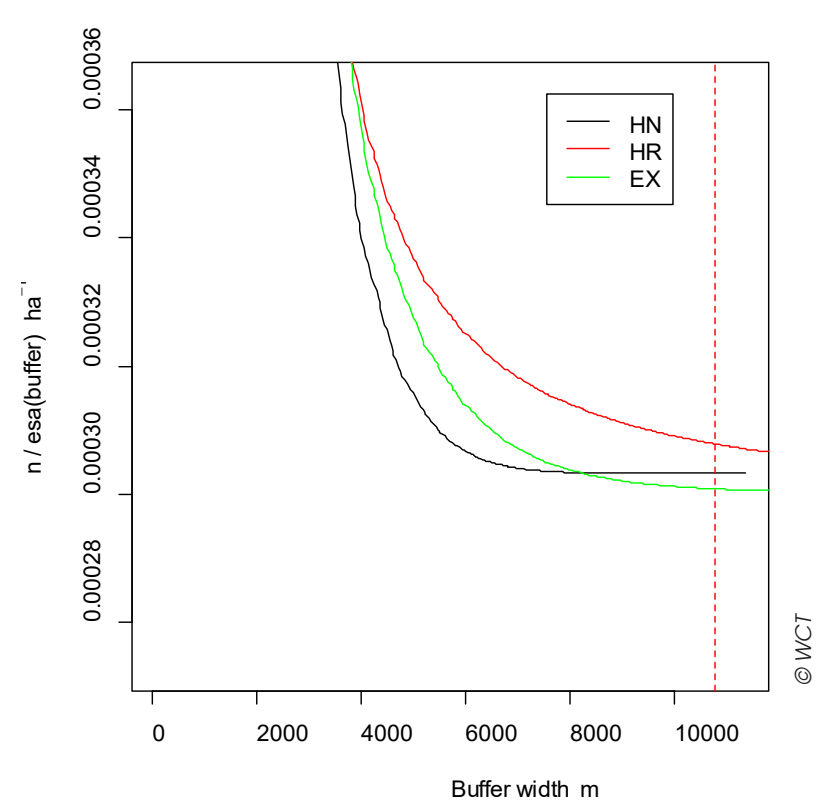


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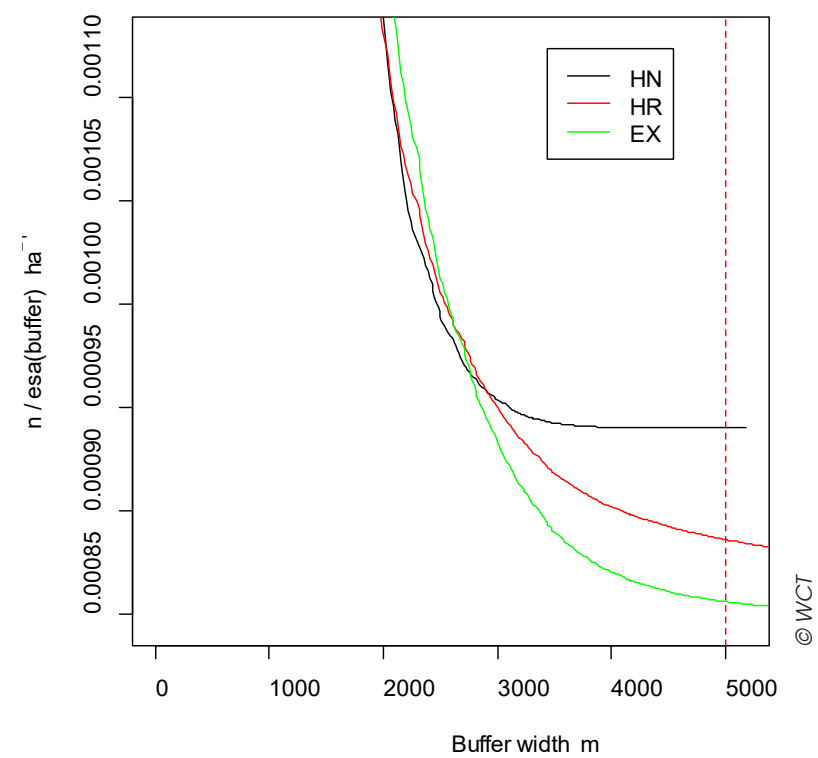
A3. Graphs of model fit used to estimate tiger density in the Tillari-Amboli-Dodamarg CR-complex. The model curve that plateaus before it reaches the buffer width (red dotted line) is considered a good fit.



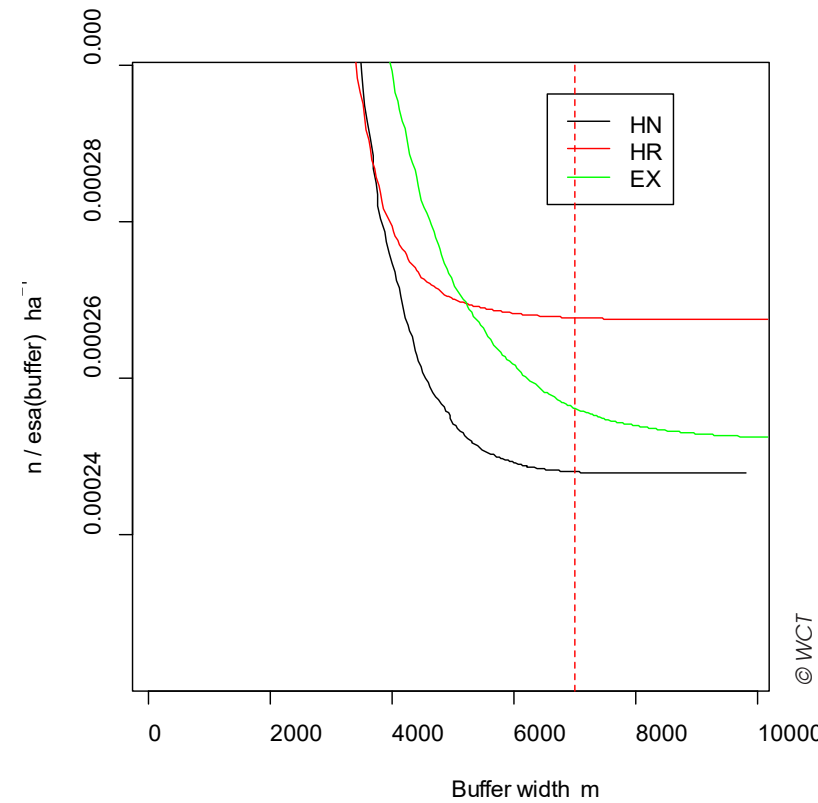
A4. Graphs of model fit used to estimate leopard density in the Vishalgad-Panhalgad-Gaganbawda CR-complex. The model curve that plateaus before it reaches the buffer width (red dotted line) is considered a good fit.



A5. Graphs of model fit used to estimate leopard density in the Tillari-Amboli-Dodamarg CR-complex. The model curve that plateaus before it reaches the buffer width (red dotted line) is considered a good fit.



A6. Graphs of model fit used to estimate leopard density in the Chandgad-Ajara-Kadgaon CR-complex. The model curve that plateaus before it reaches the buffer width (red dotted line) is considered a good fit.



A7. Tables showing comparison of models used for tiger and leopard density estimation in different CR-complexes. Models in bold indicate those used for density estimates.

Tiger							
CR complex	model	detectfn	npar	logLik	AICc	dAICc	AICcwt
Tillari-Amboli-Dodamarg	D~1 g0~1 sigma~1	HN	3	-42.57	97.14	0	0.71
	D~1 g0~1 sigma~1	EX	3	-43.56	99.12	1.98	0.26
	D~1g0~1 sigma~1 z~1	HR	4	-41.09	103.52	6.39	0.03
Leopard							
Vishalgad-Panhalgad- Gaganbawda	model	detectfn	npar	logLik	AICc	dAICc	AICcwt
	D~1 g0~1 sigma~1	EX	3	-131.90	271.01	0	0.39
	D~1 g0~1 sigma~1	HN	3	-132.15	271.49	0.49	0.31
	D~1g0~1 sigma~1 z~1	HR	4	-130.69	271.49	0.49	0.30
Tillari-Amboli-Dodamarg	model	detectfn	npar	logLik	AICc	dAICc	AICcwt
	D~1 g0~1 sigma~1	HN	3	-30.75	70.94	0	0.52
	D~1 g0~1 sigma~1	EX	3	-30.93	71.29	0.36	0.44
	D~1g0~1 sigma~1 z~1	HR	4	-30.69	76.04	5.10	0.04
Chandgad-Ajara- Kadgaon	model	detectfn	npar	logLik	AICc	dAICc	AICcwt
	D~1 g0~1 sigma~1	HN	3	-34.78	78.99	0	0.62
	D~1 g0~1 sigma~1	EX	3	-35.39	80.23	1.23	0.34
	D~1g0~1 sigma~1 z~1	HR	4	-34.82	84.30	5.302	0.04

Detectfn = detection function, npar = number of parameters, logLik = Log Likelihood, AICc = Akaike's Information Criterion corrected for small sample sizes, dAICc = delta AICc, AICcwt = Akaike model weight, HN = Half Normal, EX = Negative Exponential, HR = Hazard Rate, D = Density, g0 = detection parameter, sigma = spatial scale parameter, z = shape parameter

A8. Model rankings using AIC scores for each large carnivore species to assess habitat-use in the CRs of the corridor between the Sahyadri and Kali Tiger Reserves (2022-23).

TIGER						
Model	AIC	deltaAIC	AIC wgt	Mod Lik	no. Par.	-2*LogLik
psi(HDI),p(EFFORT)	203.92	0	0.5502	1	7	189.92
psi(PREPNEY+HDI),p(EFFORT)	205.28	1.36	0.2787	0.5066	8	189.28
psi(PREPNEY+HDI+DHL), p(EFFORT)	207.28	3.36	0.1025	0.1864	9	189.28
psi(.), p(EFFORT)	209.44	5.52	0.0348	0.0633	6	197.44
psi(PREF_PREY),p(EFFORT)	210.46	6.54	0.0209	0.038	7	196.46
psi(DHL),p(EFFORT)	211.44	7.52	0.0128	0.0233	7	197.44
Psi(.),p()	223.64	19.72	0	0.0001	5	213.64

AIC =Akaike's information criterion, deltaAIC=difference in AIC scores, AIC wgt= AIC weight, Mod Lik = model likelihood, no.Par.= number of parameters, -2*LogLik = - 2 log likelihood, psi=habitat use/ occupancy, p = detection probability

DHOLE						
Model	AIC	deltaAIC	AIC wgt	Mod Lik	no.Par.	-2*LogLik
psi(.),p()	200.74	0	0.2608	1	5	190.74
psi(.),p(EFFORT	201.33	0.59	0.1942	0.7445	6	189.33
psi(HDI),p(.)	201.4	0.66	0.1875	0.7189	6	189.4
psi(PREFPREY),p(.)	202.5	1.76	0.1082	0.4148	6	190.5
psi(TGR_P),p(.)	202.74	2	0.096	0.3679	6	190.74
psi(PREFPREY+HDI),p(.)	203	2.26	0.0843	0.323	7	189
psi(HDI+TGR_P), p(.)	203.4	2.66	0.069	0.2645	7	189.4

AIC =Akaike's information criterion, deltaAIC=difference in AIC scores, AIC wgt= AIC weight, Mod Lik = model likelihood, no.Par.= number of parameters, -2*LogLik = - 2 log likelihood, psi=habitat use/ occupancy, p = detection probability

LEOPARD						
Model	AIC	deltaAIC	AIC wgt	Mod Lik	no.Par.	-2*LogLik
psi(.),p(.)	765.26	0	0.2054	1	5	755.26
psi(GOAT+DOG),p(.)	765.77	0.51	0.1592	0.7749	7	751.77
psi(.),p(EFFORT)	766.06	0.8	0.1377	0.6703	6	754.06
psi(PREF_PREY),p(.)	766.63	1.37	0.1036	0.5041	6	754.63
psi(HDI),p(.)	766.97	1.71	0.0874	0.4253	6	754.97
psi(DHL_P),p(.)	767.26	2	0.0756	0.3679	6	755.26
psi(TGR_P),p(.)	767.26	2	0.0756	0.3679	6	755.26
psi(PQP+MJK+PIG),p(.)	767.39	2.13	0.0708	0.3447	8	751.39
psi(PREF_PREY+HDI),p(.)	768.24	2.98	0.0463	0.2254	7	754.24
psi(LGR+SBR),p(.)	768.61	3.35	0.0385	0.1873	7	754.61

AIC =Akaike's information criterion, deltaAIC=difference in AIC scores, AIC wgt= AIC weight, Mod Lik = model likelihood, no.Par.= number of parameters, -2*LogLik = - 2 log likelihood, psi=habitat use/ occupancy, p = detection probability

SLOTH BEAR						
Model	AIC	deltaAIC	AIC wgt	Mod Lik	no.Par.	-2*LogLik
psi(.),p(EFFORT)	228.57	0	0.3171	1	6	216.57
psi(HUMAN+DOG), p(EFFORT)	229.76	1.19	0.1749	0.5516	8	213.76
psi(HUMAN),p(EFFORT)	229.84	1.27	0.168	0.5299	7	215.84
psi(GOAT),p(EFFORT)	229.88	1.31	0.1647	0.5194	7	215.88
psi(HDI),p(EFFORT)	229.9	1.33	0.1631	0.5143	7	215.9
psi(.),p(.)	235.07	6.5	0.0123	0.0388	5	225.07

AIC =Akaike's information criterion, deltaAIC= difference in AIC scores, AIC wgt= AIC weight, Mod Lik = model likelihood, no.Par.= number of parameters, -2*LogLik = - 2 log likelihood, psi=habitat use/ occupancy, p = detection probability

A9. The GPS locations of major bottlenecks, crossing points, and gaps identified along major highways crossing through the CRs of the corridor between the Sahyadri and Kali Tiger Reserves.

HIGHWAY	BOTTLENECK	GAP	REMARKS
NH 166 - Kolhapur to Ratnagiri (via Amba Ghat)	SKC BN1 (Amba to Dakhin)	GAP 1 (Chandoli to Talawade)	Crossing points in the bottleneck are important for leopard, tiger, dhole, gaur, sambar.
	START POINT: N 16.977003°, E 73.787267°	START POINT: N 16.960554°, E 73.841790°	A Gap of 1-2 km. exists along the highway
	CROSSING POINT (CP) 1: N 16.978495°, E 73.784596°	END POINT: N 16.966689°, E 73.807010°	between the buffer area of Sahyadri TR on the north and the Vishalgad CR on the south of the NH166.
	CP 2: N 16.978568°, E 73.783302°		Limitations to crossing include the prevalence of resorts, farm houses, houses and agriculture (mainly sugarcane and rice).
	CP 3: N 16.978358°, E 73.781828°		
	CP 4: N 17.003352°, E 73.760875°		
	CP 5: N 17.004959°, E 73.755245°		
	END POINT N 17.003349°, E 73.740766°		

HIGHWAY	BOTTLENECK	GAP	REMARKS
NH 166 - Kolhapur to Ratnagiri (via Amba Ghat)	SKC BN 2 (Anuskura to Pangri)		This bottleneck does not have many crossing points. Therefore, it is crucial to retain connectivity where crossing points exist.
	START POINT: N 16.778512°, E 73.802398°		
	CP 6: N 16.765967°, E 73.797868°		
	CP 7: N 16.752325°, E 73.794746°		
	END POINT: N 16.734900°, E 73.770050°		
MH SH 115 - Kolhapur to Gaganbawda to Vaibhavwadi (via Karul Ghat)	SKC BN3 (Palsambe):	GAP 2	SKC BN 3 is a bottleneck along the SH 115 but south of the road there exists a small gap of 1 km due to presence of agricultural land and houses.
	START POINT: N 16.583355°, E73.883360°	START POINT: N 16.610241°, E 73.896336°	
	END POINT: N 16.582316°, E 73.882000°	END POINT: N 16.607042°, E 73.893852°	
	SKC BN 4 (Gaganbawda)		
	START POINT: N 16.553101°, E 73.844868°		SKC BN 4 is a very crucial bottleneck point for the leopard, sambar, and possibly even the tiger and dhole.
	END POINT: N 16.549306°, E 73.839185°		
SH 114 - Gaganbawda to Rajapur (via Bhuibavda Ghat)	N.A.	N.A.	Very steep Ghat road, therefore no crossing points identified. Once descended into Konkan, fragmented private forest flanks both sides of road in Bhuyadewadi and Karul.

HIGHWAY	BOTTLENECK	GAP	REMARKS
SH 180 - Redi-Belgavi Road	SKC BN5 (Chandgad CR connecting Ajara Range) START POINT: N 15.968109°, E 74.086258° CP 8: N 15.969813°, E 74.084772° CP 9: N 15.971231°, E 74.084437° CP 10: N 15.972365°, E 74.082487° CP 11: N 15.975304°, E 74.077119° CP 12: N 15.979259°, E 74.075263° CP 13: N 15.980231°, E 74.073497° CP 14: N 15.981820°, E 74.071710° CP 15: N 15.987400°, E 74.066768° CP 16: N 15.989880°, E 74.063684° CP 17: N 15.995920°, E 74.065461° CP18: N 16.005602°, E 74.058506° CP 19: N 16.003245°, E 74.051906°		SKC BN 5 is a crucial crossing point for tiger, gaur, leopard, dhole, sambar, and many other species. There are a number of crossing points in this bottleneck and this is crucial to maintain for wildlife movement. Camera trap photographs of a male tiger have been captured from different points on either side of this road.

SH 180 - Redi-Belgavi Road	CP 20: N 16.001835°, E 74.050859° END POINT N 16.003123°, E 74.044811°		SKC BN 5 is a crucial crossing point for tiger, gaur, leopard, dhole, sambar, and many other species. There are a number of crossing points in this bottleneck and this is crucial to maintain for wildlife movement. Camera trap photographs of a male tiger have been captured from different points on either side of this road.
NH 548H - Sankeshwar to Banda (via Amboli Ghat)	SKC BN 6 (Ajara Forest Range) START POINT N 16.046747°, E 74.067985° END POINT N 16.032327°, E 74.061699° SKC BN 7 (Amboli Ghat) START POINT: N 15.960315°, E 73.994706° CP 21: N 15.931347°, E 73.963916° CP 22: N 15.931847°, E 73.962811° END POINT N 15.932693°, E 73.921068°		SKC BN 6 is an important crossing point identified for the tiger, gaur, dhole, sambar deer. On the western side of this road, there is a break in forest connectivity between the areas of Ghatkarwadi and Kitawade due to agricultural land. Tiger pugmarks have been recorded in both the forest areas. SKC BN 7 is an important bottleneck for wildlife to cross the Amboli Ghat. This includes the leopard, gaur, sambar among other species. Locals have observed the tiger using the two crossing points identified.

HIGHWAY	BOTTLENECK	GAP	REMARKS
SH 130 - Patne phata to Dodamarg (via Tillari Ghat)	SKC BN 8 (Tillari Ghat) START POINT: N 15.805535°, E 74.193035° CP 23: N 15.804690°, E 74.192638° CP 24: N 15.801848°, E 74.190274° CP 25: N 15.796394°, E 74.176307° CP 26: N 15.802324°, E 74.171784° CP 27: N 15.803566°, E 74.169095° CP 28: N 15.807504°, E 74.156560° END POINT: N 15.807428°, E 74.153538° SKC BN 9 (Tillari CR) START POINT N 15.803522° E 74.137750° END POINT N 15.804003° E 74.121753°		The bottlenecks (BN 8 & 9) are crucial for movement of the tiger, dhole, leopard, sloth bear, gaur, sambar among other wildlife.

NA = Not available or identifiable during the survey

A 10. Photographic captures of hunters and press coverage of action taken by the Forest Department based on evidence from camera-traps



घोळसावडे जंगलात फिरताना अटक

लोकमत न्यूज नेटवर्क

मलकापूर : परळेपैकी मुठकलवाडी येथील माजी ग्रामपंचायत सदस्य बाळू लाड हा वनविभागाच्या जंगलात बेकायदेशीरपणे प्रवेश करून बंदूक घेऊन शिकार करण्याच्या उद्देशाने फिरताना आढळल्याने, वनविभागाच्या पथकाने त्याला ताब्यात घेतले. तपासी अधिकाऱ्यांनी त्याला अटक करून मलकापूर - शाहूवाडी न्यायालयासमोर उभे केले असता, त्याला कोर्टाने एक दिवसाची वन कोठडी सुनावली. वनविभागाच्या पथकात वनअधिकारी अमित भोसले, वनपाल रशीद गारदी, संजय कांबळे, वनरक्षक आबासाहेब परीट, साधू कांबळे, स्वाती मेथे, दिग्विजय पाटील यांचा समावेश होतो.

Kolhapur Main
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गगनबावडा : गगनबावडा वनक्षेत्रामध्ये शिकारीसाठी गेलेल्या चार जणांना गगनबावडा वनविभागाने सोमवारी सकाळी ताब्यात घेतले. त्यांना न्यायालयात हजर केले असता तीन दिवसांची वनकोठडी सुनावली. तानाजी विष्णू पाटील (वय ४२), विनायक दत्तात्रय लाड (वय ३५, दोघेही रा. नखेली), सर्जेराव शिवाजी पाटील (वय २७), दीलू जानू कांबळे (वय ७३, दोघेही रा. लखमापूर) अशी त्यांची नावे आहेत.

१३ जानेवारी रोजी नखेली परिसरात चौघे जण शिकारीसाठी गेले होते. गगनबावडा वनक्षेत्रात लावलेल्या ट्रॅप कॅमेऱ्यात ते दिसून आले होते. त्यांच्याकडे चौकशी केली असता त्यांनी गावच्या जंगल हद्दीत विना परवाना शिकारीच्या निमित्ताने प्रवेश केल्याचे कबूल केले. वन्यजीव संरक्षण अधिनियम २९७२ अन्वये त्यांना सोमवारी अटक केली. कोल्हापूर उपवनसंरक्षक जी. गुरुप्रसाद यांच्या मार्गदर्शनाखाली सहायक वनसंरक्षक प्रतिक्षा काळे, वनक्षेत्राल अविनाश तायनाक, वनपाल बी. एल. कोट्टी, राजेंद्र उलपे, वनरक्षक मनिषा न्हायकर, नितीन शिंदे, आंकार भोसले, रीमा मुल्ला, प्रकाश खांडे, सरपंच व पोलीस पाटील यांच्या वतीने ही कारवाई करण्यात आली. वनविभागाच्या या थेट कारवाईने अनेकांचे घाबे दणाणले आहेत. वनपशुपक्षी पाळणे, हाताळणे, विक्री करणे त्यांची शिकार करणे हा वन्यजीव संरक्षण अधिनियमनुसार अशी माहिती मिळताच संपर्क साधावा असे आदेश कोल्हापूर जिल्हा वनविभागाने केले.



MEMORANDUM OF UNDERSTANDING BETWEEN THE MAHARASHTRA FOREST DEPARTMENT AND THE WILDLIFE CONSERVATION TRUST, MUMBAI

This Memorandum of Understanding (MoU) is made on the 13th day of Dec, 2022 between

THE Maharashtra Forest Department through the Chief Conservator of Forests (Territorial), Kolhapur having office in _____ **Chief Conservator of Forest (Territorial)** _____ and

The Conservator of Forests and Field Director, Sahyadri Tiger Reserve having office in _____ **Conservator of Forests & Field Director** _____ (hereinafter together referred to as MFD), which expression, unless repugnant to the context and meaning thereof, shall deem to include its heirs, executors, administrators and assigns of the FIRST PART,

AND

THE WILDLIFE CONSERVATION TRUST, Mumbai, a trust registered under the Bombay Public Trusts Act, 1950, through its President, having office at 11th Floor, Mafatal Centre, Nariman Point, Mumbai 400 021 (hereinafter referred to as WCT), which expression, unless repugnant to the context and meaning thereof, shall deem to include its heirs, executors, administrators and assigns of the SECOND PART.

WHEREAS the MFD desires to encourage generation of scientific knowledge related to tigers and its habitats including its co-predators, prey base and key associated wildlife corridor areas for improved management and conservation of wildlife as well as related capacity building of stakeholders in Territorial and Wildlife Divisions of Kolhapur Forest Circle

AND WHEREAS WCT desires to assist the MFD for generating scientific knowledge and carry out related capacity building of the stakeholders for the purpose improved management and conservation of wildlife in the Kolhapur Forest Circle using its own resources including but not limited to their team of trained wildlife biologists and experts.

MFD and WCT held a meeting on 06/12/2022 to discuss the proposed plan of action and outcomes foreseen through this collaboration. Based on the outcomes expected at this meeting, this MoU is being signed with additional activities designed to help improve co-ordination between both parties to achieve the larger goal of effective science-based management and conservation of wildlife.

THEREFORE, both parties will collectively engage themselves as contained herein:

Objectives of the Project

- 1.1 Assess the minimum population (& habitat-use) of the tiger, leopard, dhole, and sloth bear in the notified and approved Conservation Reserves (CRs), including neighbouring forest areas as per NTCA Phase IV protocols.
- 1.2 Assess an index of abundance of major prey species in CRs
- 1.3 Understand bottlenecks in movement of large carnivores, especially crossing points along linear infrastructure using a road ecology framework in and around CRs
- 1.4 Understand breeding areas for large carnivores (evidence of cubs/pups)
- 1.5 Assess biotic pressures and anthropological disturbance in the forest areas of CRs
- 1.6 Train frontline forest staff in scientific monitoring protocols such as camera trapping, data management
- 1.7 Incorporate the above scientific information to demarcate and prepare an indicative plan for the corridor in the Tiger Conservation Plan (TCP) of Sahyadri TR (2023-24 to 2032-33), as well as the Management Plans of respective Conservation Reserves.

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2. Duration of the MoU

2.1 This memorandum of understanding shall remain effective for a period of two years from the date of signing (2022-2024).

2.2 After review of projects taken up consequent to this MoU, both parties may extend its operation for another term with prior approval of the Chief Conservator of Forests (Territorial), Kolhapur and Conservator of Forests and Field Director, STR.

2.3 The Chief Conservator of Forests (Territorial) Kolhapur or Conservator of Forests and Field Director, STR may terminate this MoU prior to the end date with understanding of the WCT.

Geographical location & Area of Study: Corridor forest area between STR and nearest source population of tigers (i.e. Tillari CR). This includes Conservation Reserve areas in the Forest Circle of Kolhapur and areas adjoining the Conservation Reserves managed by the Territorial Divisions of Kolhapur Forest Circle.

3. Responsibilities of the MFD

3.1 The MFD through the CCF (Territorial), Kolhapur will arrange for field support and access to the study areas in the forest and in terms of accommodation facilities as per availability at the field sites within the said area.

3.2 The MFD through the CF and Field Director, Sahyadri TR shall provide 300 camera traps, 600 memory cards, consumables such as 5000 AA batteries, and 2 external Hard Disks for this study. These would be used in the field by WCT researchers along with Forest Department staff and handed over to the office of the CF and Field Director, STR upon completion of the study.

3.3 The MFD will nominate the DFO Vigilance as a nodal officer for the Kolhapur Territorial Circle and the Deputy Director, Sahyadri Tiger Reserve as a nodal officer for the Wildlife Wing to coordinate the project activities with WCT representatives.

3.4 The MFD will nominate its officers and staff as well as other stakeholders to participate in the capacity building programs taken up under this MoU. MFD will also arrange participation of concerned forest staff in all aspects of monitoring in the specified area. The responsibility of the safety of the camera-traps during the study, and any proceedings as a consequence of unforeseen circumstances such as theft, breakage etc lie with the MFD.

3.5 Logistical arrangement of training workshops will be the responsibility of the concerned Range Officer and the MFD.

3.6 The MFD shall carry out review of activities envisaged under this MoU at least once a year and facilitate effective coordination for the purpose of this MoU.

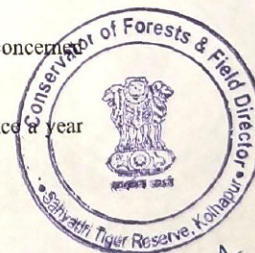
4. Responsibilities of the Wildlife Conservation Trust (WCT)

4.1. WCT will nominate one nodal contact person for the Forest Circle Kolhapur. This nodal contact person will closely liaise with the respective Conservators of Forests and nodal Divisional Forest Officer and Deputy Director, Sahyadri TR for the project activities.

4.2 WCT will also nominate one staff to co-ordinate data sharing and results dissemination in a timely manner to Maharashtra Forest Department.

4.3 WCT will disseminate results in a timely manner to the office of the Chief Conservator of Forests (Territorial) and the Conservator of Forests and the concerned Divisional Forest Officers.

4.4 WCT will liaise closely with concerned Deputy Conservator of Forest/Divisional Forest Officers and Range Forest Officers at the time of field work to update them about the commencement and conclusion of field activities.



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4.5 WCT will carry out capacity building of frontline staff during fieldwork and make all necessary logistic arrangement for the same.

4.6 WCT will provide necessary financial support, trained human resources and required equipment (other than that mentioned in Section 3) including transportation for implementing the projects and associated field work approved under this MoU. The MFD shall not be responsible for meeting project-related expenses including those on travel and field support for the WCT project staff involved in field work.

4.7 WCT will carry out analysis of collected data and share results with the MFD at mutually agreed time intervals not exceeding six months and at the end of the Projects.

4.8 WCT will also maintain copies of the data for backup purposes on their servers for access in future by Maharashtra Forest Department if required.

RESOURCE	REQUIRED FROM CF (W L) & FD, STR	REQUIRED FROM CCF (T)	AVAILABLE WITH WCT
CAMERA-TRAPS	300 UNITS		40 UNITS
BATTERIES	5000 UNITS		800 UNITS
MEMORY CARDS	600 UNITS		40 UNITS
EXTERNAL HARD DISKS	2 UNITS OF 2TB EACH		1 UNIT
FIELD VEHICLE			AVAILABLE
PERMISSION	MoU	MoU	
FIELD IMPLEMENTATION AND LOGISTICS	SUPPORT FOR TRAINING	STAFF SUPPORT, EQUIPMENT SAFETY AND REST HOUSES	FUNDING SECURED FOR STUDY OR FIELD TEAM & VOLUNTEERS



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5. Deliverables and Outputs

5.1. Deliverables and outputs under this MoU shall be as follows:

A. Data and information to be used for Indicative Plan for the corridor of the Sahyadri TR TCP (2023-24 to 2032-33) & Management Plans of respective Conservation Reserves.

B. A report with:

- Photo album of all captured individuals
- Habitat-use assessment of each species (Density estimate where possible)
- Bottlenecks & crossing points identified along major linear infrastructures
- Breeding areas identified with cubs/pups

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V. Assessment of biotic disturbance and resource dependency of local people using camera-trap photos

C. Training of 300 staff of CRs and adjacent forest areas in camera-trap monitoring/ sign surveys/ data management and wildlife monitoring during daily patrolling shall be accomplished in the duration of this MoU

D. Raw data shared with individual Ranges and with the respective DCF/DFO office

5.2. The reports prepared by WCT under this MoU to be submitted to the Chief Conservator of Forests (Territorial) and the Conservator of Forests (Wildlife) with a copy to the concerned Deputy Conservator of Forests and Divisional Forest Officer.

6. Terms and Conditions

6.1. The WCT shall be responsible for all financial expenditure incurred under this MoU or any project under the same. Support of the MFD will be limited to as specified in section 3 of this MoU.

6.2. The WCT shall provide to the MFD all information, data, report, etc., generated out of activities under this MoU or any project there under.

6.3 The WCT or any of his personnel will not start any other research project within this project.

6.4 The WCT will share live data of camera trap with local RFO day-to-day if required by the local officer for immediate mitigation of man-animal conflict.

6.5 The camera trap photos should have date and time stamping on it.

6.6 Raw data collected by WCT during the project should be submitted to the MFD, monthly and at the end of the study.

6.7 All reports under the project shall carry the logo of both the MFD and WCT. Persons authorised by the Chief Conservator of Forests (Territorial) and Conservator of Forests (Wildlife) to participate in the research projects may be included as co-authors as per accepted norms with their respective affiliations for the purpose of publications and other outputs as consequent of this MoU or its project.

6.8 The WCT undertakes to carry out the assignment in accordance with the highest standard of professional and ethical competence and integrity, having due regard to nature and purpose of the assignment. The WCT shall also ensure that its project staff perform their services and conduct themselves accordingly. The WCT and its employees or any person engaged in any activity under this MoU or any project there under shall observe and be responsible for ensuring compliance of provisions of the Wild Life (Protection) Act, 1972, Indian Forest Act, 1927, the Biological Diversity Act, 2002 and any laws applicable and in force in the study area.

6.9 The WCT unconditionally and irrevocably agrees that neither WCT nor any person engaged by it shall have any claim against the MFD in respect of any wages, salary, damages or any other purpose on account, compensation and any statutory benefits due/payable on any account of being engaged by the WCT for the purpose. The WCT shall indemnify, defend and hold the MFD not liable against any and all proceedings, actions and third-party claims for any cost, compensation in this regards.

7. Institutional Representatives

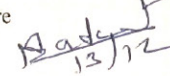
7.1 The Conservator of Forests & Field Director, STR and Chief Conservator of Forests (Territorial), Kolhapur and the President, Wildlife Conservation Trust, Mumbai, will be institutional representatives of respective parties for making amendments, deletions and additions to this MoU with mutual consent.

7.2 Any amendments, deletions or additions to this MoU with or without creation of any liability on the MFD shall not be enforced or considered valid without prior written approval of the Conservator of Forests (Wildlife), Kolhapur and Chief Conservator of Forests (Territorial), Kolhapur.

2. Dispute Resolution

8.1 All the disputes arising out of this MoU shall be resolved by the Chief Wildlife Warden (CWLW), Maharashtra State, whose decisions shall be final and binding on all parties concerned.

The parties have signed this Memorandum of Understanding as a token of acceptance of terms and conditions given above, and have thus put their hands upon it with the signatures as below:

For Maharashtra Forest Department		For Wildlife Conservation Trust
Signature 	Signature 	Signature 
Shri. Ramanujam R.M.	Shri. N.S. Ladkat	Dr. Anish P. Andheria
Chief Conservator of Forests (Territorial), Kolhapur	Conservator of Forests and Field Director, Sahyadri Tiger Reserve	President, WCT
Date 13.12.2022	Date 13.12.2022	Date 13.12.2022
Seal 	Seal 	Seal 
Signature: 	Signature: 	In presence of Signature: 
Name: Uttam S. Sawant	Name: Uttam S. Sawant	Name: GIRISH PUNJABI
Address: Sahyadri TR,	Address: Sahyadri TR,	Address: WCT

A 13. PHOTOGRAPHS OF OTHER TIGERS IDENTIFIED TILL DATE (2014 to 2024) IN THE CORRIDOR BETWEEN THE SAHYADRI AND KALI TIGER RESERVES

LEFT FLANK

SKT 01 (MALE) (2014 to 2019)



© Girish Punjabi/MFD

RIGHT FLANK

SKT 01



© Girish Punjabi/MFD

SKT 06 (MALE) (2018)



© BNHS

SKT 06



© BNHS

SKT 07 (FEMALE) (2018, 2021-MHADEI WLS)



Photo credit: BNHS

© BNHS

SKT 07



© BNHS

SKT 14 (2022 & 2024 RADHANAGARI WLS)



Photo credit: BNHS

© DFO (WL), KOLHAPUR

SKT 14



© DFO (WL), KOLHAPUR

INDIVIDUALS WITH SINGLE FLANKS CAPTURED

LEFT FLANK

SKT 03 (FEMALE) (2014)



© Girish Punjabi/MFD

RIGHT FLANK

SKT 09 (Female) (2017)



Photo credit: WCT/ Maharashtra Forest Department

© Girish Punjabi/MFD

SKT 08 (MALE) (2021)



© WCT/ MFD

SKT 15 (MALE) (2022)



© WCT/ MFD



Wildlife Conservation Trust

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