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THE LEOPARDS OF MARIKANIVE:
POPULATION ESTIMATION OF LEOPARDS IN THE MARIKANIVE STATE FOREST, CHITRADURGA

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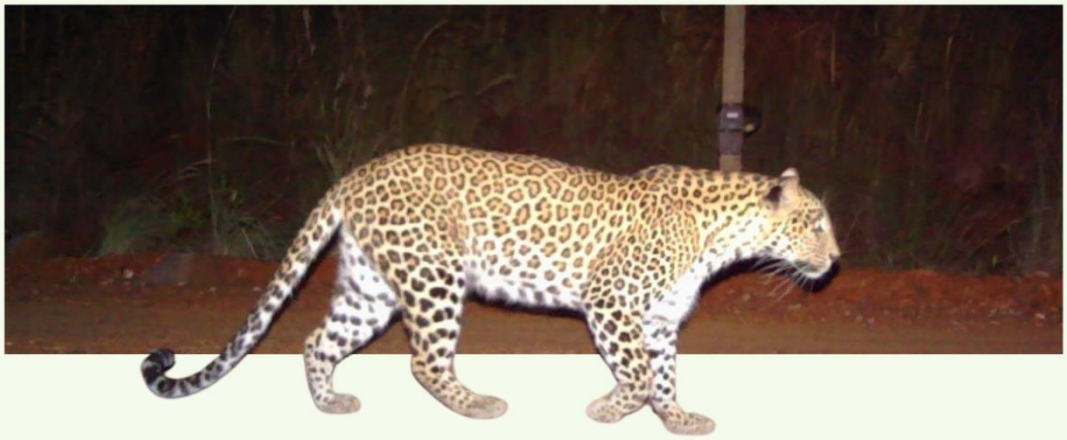

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Introduction

Leopards (*Panthera pardus*) are one of the most widespread large carnivores belonging to the Felidae family. They are distributed over most of Africa, covering entire sub-Saharan Africa and part of North Africa, while in Asia they are spread from the Middle East to the Pacific Ocean (Jacobson *et al.* 2016; Jhala *et al.* 2020). Their range extends to islands such as Sri Lanka and Java, Indonesia (Gubbi 2021). The International Union for Conservation of Nature (IUCN) recognises nine subspecies, of which the one present in India is *Panthera pardus fusca.* Leopard occupies a variety of habitats from rainforests in the tropics to deserts and temperate areas (Jhala *et al.* 2020; Stein *et al.* 2020). They tend to be an elusive and solitary species.

Globally and nationally, leopards might be considered flagship species in need of protection, but locally they are one of the most persecuted (Athreya *et al.* 2011). They are highly conflict-prone species due to their ability to adapt to different habitats, and prey on a wide range of species. They are also well adapted to human-dominated landscapes and even occur near large metropolitan cities such as Mumbai (Bhatia *et al.* 2013) and Bengaluru (Gubbi *et al.* 2017).

Jacobson *et al.* (2016) estimated a range loss of 83-87% in Asia. Their population is on a declining trend and the leopard was initially classified as "Near Threatened" (Jacobson *et al.* 2016) but now the status has been changed to "Vulnerable" under the IUCN Red List of Threatened Species (Stein *et al.* 2020). In India, leopards receive the highest level of protection as a Schedule I species under the Wildlife Protection Act 1972.

The prevailing threats to leopards in India include poaching of prey, vehicular collisions, depletion of natural habitat due to loss and fragmentation, human-leopard conflict, direct persecution of leopards for their body parts and other unconventional threats, all of which pose a serious threat to its populations (Raza *et al.* 2012; Gubbi *et al.* 2014, 2019a; Jacobson *et al.* 2016; Stein *et al.* 2020). To understand how to manage these threats and their effects on the local leopard population, baseline information regarding leopard distribution and population size is very critical to implement effective management plans.

In India, there are studies estimating leopard population size mostly in protected areas (PAs) and a couple of studies in human-dominated landscapes (Harihar *et al.* 2009; Athreya *et al.* 2013; Borah *et al.* 2014; Gubbi *et al.* 2017, 2018, 2019b, 2020a; Gubbi et al. Unpublished). However, there is a serious lack of baseline population and distribution data for leopards from outside the PAs.

The occurrences of leopards in some PAs, reserved forests and other leopard habitats within Karnataka has received recent attention. Gubbi *et al.* (2017) estimated a mean abundance of ~ 300 (SD ± 15.2) leopards in a ~3,170 km^2 area comprising of PAs and reserved forests in Karnataka.

In continuation to the previous studies (Gubbi *et al.* 2017, 2018, 2019b, 2020a), this report provides the first estimates of abundance and density of leopards for Marikanive State Forest (SF) in Chitradurga Forest Division in central Karnataka.

Study area

Chitradurga Forest Division occupies almost a central part in the eastern plains of Karnataka, and the forest occupies about 15.44% of the gross area of Chitradurga district (Singh 2012). These forests are distributed in fragmented plots which include natural forests as well as plantations. The study area, Marikanive SF, is part of this forest division. Marikanive SF covers an area of 112.46 km^2 which falls under Hiriyur (84.21km^2) and Hosadurga ranges (28.25 km^2) (Basavarajappa *et al.* 2016). The area is renowned for the oldest dam in Karnataka known as Vani Vilasa Sagara or Mari Kanive, which is built across the Vedavati river (Singh 2012; Rangaswamy & Bharadi 2018). Hiriyur is situated in the valley of the Vedavati river and is characterised by undulating plains. The western part of the state forest has higher elevations with wind farms extending along the entire length (See Figure 1). The elevation of Marikanive SF extends between 625 m to 1112 m above msl.

The southern boundary of Marikanive SF is contiguous to Kudrekanave SF (80.44 km^2), and Dasudi Reserved Forest (RF) (12.85 km^2) through deemed forests. It is adjacent to Suvarnamukhi SF (22.54 km^2) and Bukkapatna Chinkara Wildlife Sanctuary (WS) (142.82 km^2) but is quite fragmented due to crop lands. The northern boundary is adjacent to Gowdanahalli SF (9.77 km^2), Bagganadu SF (5.86 km^2) and Lakkihalli SF (76 km^2) which further connects to Jaankal SF (48.4 km^2) (See Map 2). These forest patches were probably contiguous and fragmented over time due to agricultural expansion and infrastructure development.

Uttare is the only human settlement within the study area. Vanivilasapura, Iddalanagenahalli, Yelladakere, Arasinagundi and Kasappanahalli are some of the towns that surround the Marikanive SF.

The climate of Chitradurga district is characterised by hot summers from March to May, followed by monsoons from June to November, and winters from November to February (Singh 2012). The annual rainfall in Hiriyur is 788 mm (KSNDMC 2019). Overall district temperature ranges between 13 to 38°C (NCC 2020).

Location co-ordinates

Latitude: 13°53'7.35"N to 13°42'14.63"N

Longitude: 76°28'40.82"E to 76°34'39.21"E

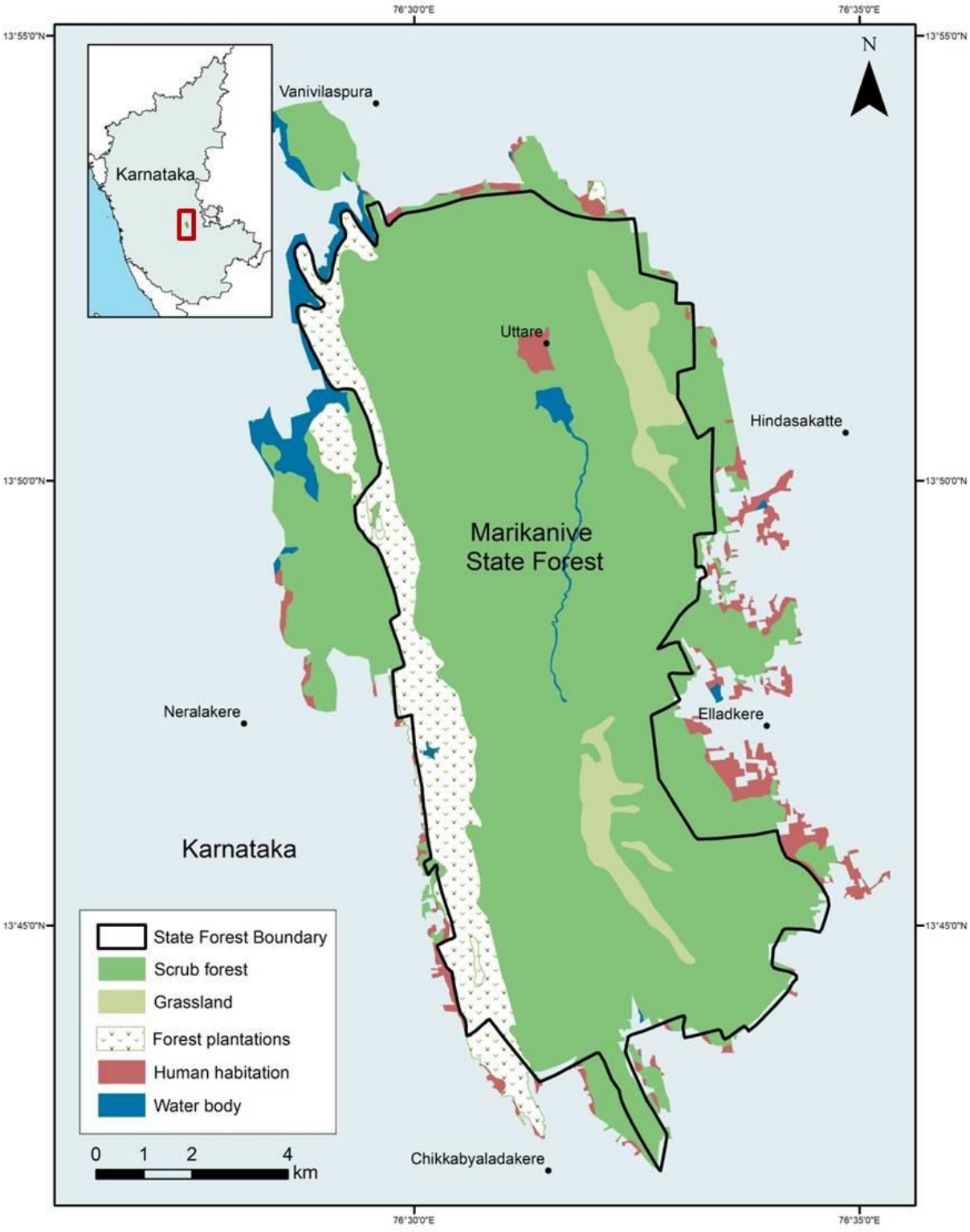
Figure 1. Marikanive State Forest is characterised by a mixture of southern tropical dry deciduous forests and woodland savannah comprising of open grassland patches and scrub forests. Windmills extend along the length of the western side of the forest.

Flora

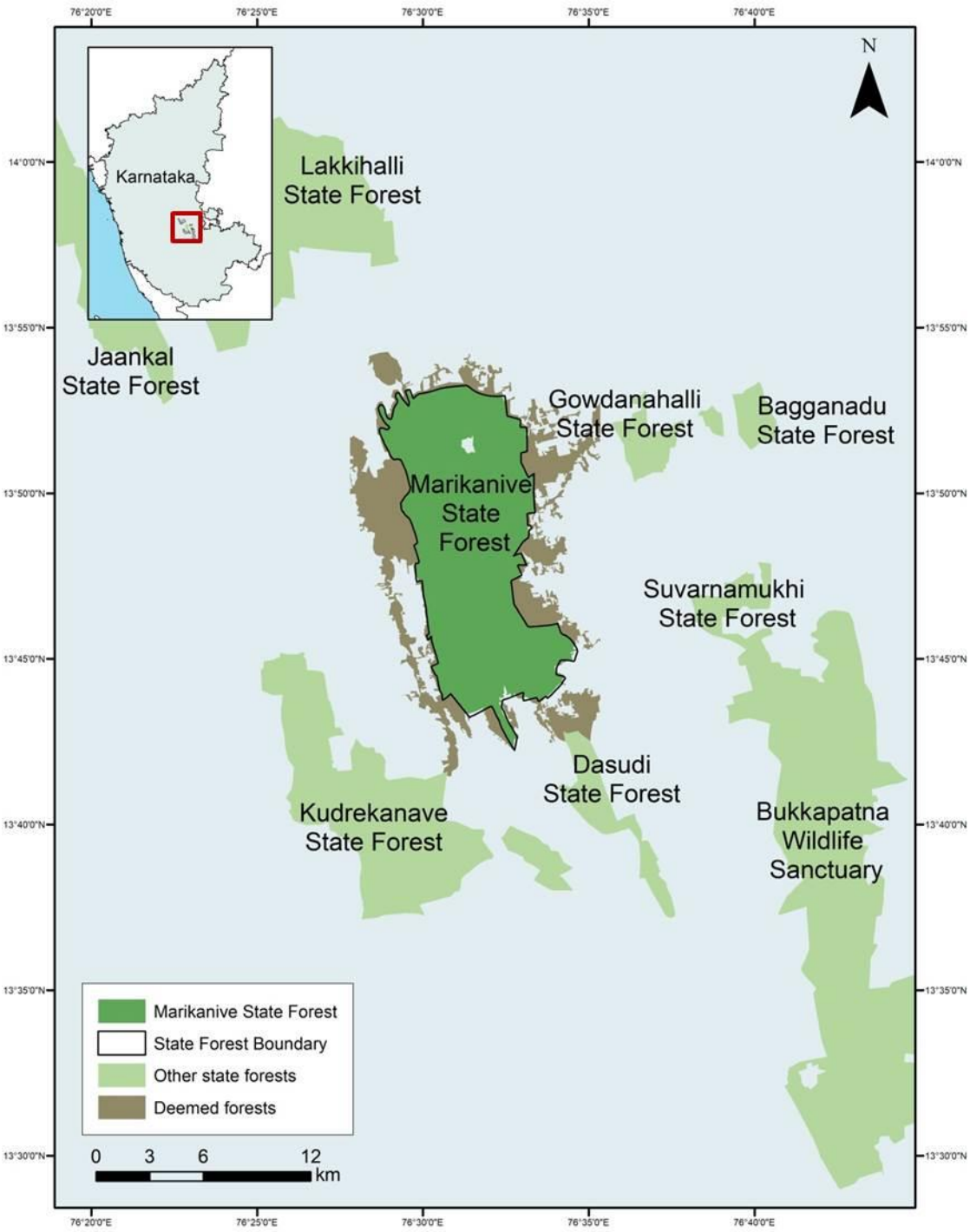
Marikanive SF is characterised by a mixture of southern tropical dry deciduous forests and woodland savannah comprising of open grassland patches and scrub forests on the eastern part of the SF; and forest plantations occupying the higher elevations on the western part (Singh 2012) (See Figure.1). In moist and favourable areas of the forest, the lower canopy is well defined and tends to be evergreen (Singh 2012).

Some tree species that are commonly found here include *Acacia catechu, Acacia horrida, Anogeissus latifolia, Buchanania latifolia, Cassia fistula, Chloroxylon swietenia, Dalbergia lanceolaria, Diospyros melanoxylon, Dolichandrone atrovirens, Givotia rottleriformis, Grewia villosa, Hardwickia binata, Holoptelea integrifolia, Maytenus emarginata, Phoenix humilis, Phyllanthus emblica, Soymida febrifuga, Syzygium cumini, Tectona grandis, Terminilia bellarica, Terminilia tomentosa and Ziziphus mauritiana* (Singh 2012). *Tectona grandis* is found only at higher elevations. *Hardwickia binata* tends to form pure groups covering the slope grounds of Vedavati valley, which is a part of Marikanive SF (Singh 2012).

Dendrocalamus strictus, Pongamia pinnata and *Madhuca latifolia* don't seem to occur here naturally but have been planted as part of afforestation programmes. Besides, *Lantana camara, Eupatorium odoratum* and *Hyptis suaveolens* are the exotic, invasive species found in here. *Eupatorium odoratum* and *Hyptis suaveolens* have been found to grow on new roads constructed for the wind farms within Marikanive SF.



Map 1. Study area comprising of Marikanive State Forest and its adjoining areas in Chitradurga Forest Division, Karnataka, India. The map shows different vegetation types present in the study area.



Map 2. Marikanive State Forest and surrounding state forests in Chitradurga Forest Division, Karnataka, India.

Fauna

Due to the absence of substantial forest cover, the faunal diversity is low. Some bird species found here include ashy wren warbler (*Prinia socialis*), common weaver bird (*Ploceus philippinus*), common hawk (*Cuculus varius*), common kingfisher (*Alcedo atthis*), grey

babbler (*Turdoides malcolmi*), red vented bulbul (*Pycnonotus cafer*), rose-ringed parakeet (*Psittaculla krameri*), pied wagtail (*Motacilla maderaspatensis*) and golden-backed woodpecker (*Dinopium benghalense*) (Singh 2012). Peacock (*Pavo cristatus*) is common in Marikanive SF (Singh 2012). Some reptilian fauna include cobra (*Naja naja*), common krait (*Bungarus caeruleus*), saw-scaled viper (*Echis carinata),* monitor lizard (*Varanus bengalensis*) and chameleon (*Chameleo calcaratus*) (Singh 2012).

The other mammals that are known to be present in Hiriyur taluk include blackbuck (*Antilope cervicapra*), jackal (*Canis aureus*) , Indian fox (*Vulpes bengalensis*), jungle cat (*Felis chaus*), leopard (*Panthera pardus*), hyena (*Hyaena hyaena*), sloth bear (*Melursus ursinus*), wild pig (*Sus scrofa*), Indian porcupine (*Hystrix indica*), black-naped hare (*Lepus nigricollis*), bonnet macaque (*Macaca radiata*) and common mongoose (*Herpestes edwardsii*) (Singh 2012; Khan *et al.* 2020). Bat species found in this area include the lesser short-nosed fruit bat (*Cynopterus brachyotis*) and Indian flying fox (*Pteropus giganteus*) (Khan *et al.* 2020). However, there has been no specific or targeted survey done to record faunal species present in Marikanive SF. Hence this will be the first such study in that direction.

Methodology

Camera trapping

The study area (112.46 km^2) was divided into two blocks for logistical ease. The camera trap locations were marked based on a reconnaissance survey to maximise leopard captures. The locations were identified based on evidence of presence of leopard which includes scats, pugmarks and scrape marks. This approach helps prioritise high capture probability of leopards and possibly other wildlife.

Panthera V4 and V6 motion detection cameras were used to capture photographs of wildlife. They were secured to an appropriate support (trees or poles) using steel cables. The camera traps were placed at a height of ~ 40 cm from the ground which is the optimal height to ensure capturing both flanks of a leopard. Camera traps were placed on either side of a trail/forest road to ensure that both flanks were captured.

Camera traps were deployed at 90 locations between 5th November and 7th December 2020 for 32 days (16 days in each block, counted as 16 unique sampling occasions). The trapping period conferred to the assumption that it was a closed population (no mortality, natality, immigration and emigration during the study period).

The camera traps were operational through the day and night (24 hrs). They were checked every two days to download photographs and to ensure their proper functioning. A previously trained automated classifier built on Python programming language (version 3.6) was used to process the downloaded images, which classified the photos into folders segregated by species. These folders were then manually validated, and the metadata of the captured images were tagged with the name of the species using the software Digikam (Version 5.8.0; Gilles *et al.* 2018). Date, time and location coordinates for each photo-captured species were available due to the unique combination of the camera trap location and camera ID.

The leopard images were matched to identify particular individuals based on the rosette patterns on their respective flanks using Wild-ID (Bolger *et al.* 2011). Unclear images were discarded during this process. The flanks (right or left) with the maximum number of unique individuals corresponding to the selected flank side were used for the analysis.

Density and abundance estimation

The statistical analysis was done using SECR package (version 4.2) available on RStudio (version 1.1.463) which is based on Spatially Explicit Capture-Recapture methodology (Efford 2018). The input files, i.e. detector layout, capture history matrix and mask layer, were prepared according to the SECR operational manuals. The detector layout file was tabulated based on occasions and corresponding locations where a camera trap was either functional or non-functional depicted as '1' or '0' respectively. The mask layer included a shape file which outlined the forested areas for a 2 km buffer area from the outermost camera trap locations representing the habitat potentially used by leopards (Efford 2018). The capture history matrix comprised of data of an individual at a particular location and sampling occasion. The program ran multiple iterations utilising the provided files to estimate capture probabilities and fitted models by maximising the likelihood (Borchers and Efford 2008). Multiple models were run with different detection functions and dependence of detection probability.

The Akaike's Information Criterion (AIC) for likelihood-based models was considered to select the model with the best estimates of density and abundance. The model with the lowest AIC value is considered the best model. In this case, a constant null model was selected which used half normal as detection function.

Relative Abundance Index

Relative Abundance Index (RAI) was calculated for all prey species (both wild and domestic) using the photographic capture rate i.e. the number of independent photo captures for a particular species per 100 trap days. This accounted for the number of events occurring based on a threshold time interval between photographs. For each species, this threshold time interval (or event duration) was predefined based on the time taken by different species (individually or as a group) to cross the camera trap location (Appendix-2). Studies show that RAI can be used as a valid index of density for unmarked species as photographic capture rates correlate with density estimates for large terrestrial mammals (Rovero & Marshall 2009; Palmer *et al.* 2018).

The photographs of all wild and domestic mammal species were categorised into specific folders with species names. Using the timestamp in the metadata of the image, images from opposite cameras were matched automatically to identify individual events for each species using a VBA (Visual Basic for Applications) script in Microsoft Excel (Version 14.4760.1000). Images with multiple individuals of the same species were considered as one event. Cow and buffalo were categorised as large livestock while sheep and goat were merged as small livestock.

The number of independent events was then tabulated and divided by the total number of camera trapping days and further multiplied by 100 to give the RAI for each species per 100 trap days.

Results

Abundance and density estimates for leopards

The camera traps captured 85 leopard images, from which a total of seven adult individual leopards were identified, which was further used for analysis. Of the identified individuals, two were male and four were female. The sex of one individual could not be identified. Two sub-adults were photo-captured as well.

The SECR analysis provided an abundance estimate of approximately eight leopards (SE ±0.57, 7.02-10.46) and a mean density estimate of 3.91 (SE ±1.48 leopards per 100 km^2) (Table 1).

Multiple models were simulated for SECR analysis by changing the detection function and the covariate dependence of detection probability. The model that gave the best results i.e. the one with the lowest AIC value, was the null model (g0~1 σ ~1) which did not consider any additional covariate dependence on the detection probability other than the forest mask layer.

Table 1: Results of the SECR analysis for leopards for habitat mask area of 2 km in Marikanive State Forest, Chitradurga Forest Division.

	Estimate	**SE**	**lcl**	**ucl**
Abundance (*N*)	7.29	0.57	7.02	10.46
Density (D)	3.91	1.48	1.91	8.01
σ	3622.74	583.73	2647.05	4958.07

N - Estimate of total number of individuals in the study area, D – No. of leopards/100 km^2, σ – Spatial scale of detection function (in meters)

Relative Abundance Index (RAI) of leopard prey

The combined RAI per 100 trap days for wild prey was 24.58 and domestic prey was 16.94. The results of the Relative Abundance Index (RAI) of leopards' natural and domestic prey are given in Table 2.

Other fauna

A total of 14 wild mammal species were photo-captured at Marikanive SF during the study period. All the 14 mammal species are listed in Table 3 and photographs are provided in Appendix-1. Of the 14 species camera trapped, five species belonged to Schedule I, six

species to Schedule II, one to Schedule III and two to Schedule IV of the Wildlife Protection Act 1972.

Table 2: Results of the Relative Abundance Index (RAI) calculated for leopards' natural and domestic prey in Marikanive State Forest, Chitradurga Forest Division.

Species	**Schedule under the Wildlife Protection Act 1972**	**Global status under the IUCN Red List**	**RAI/100 trap days (SE)**
Wild prey			
Four-horned antelope (*Tetracerus quadricornis*)	I	Vulnerable	2.78 (0.006)
Wild pig (*Sus scrofa*)	III	Least Concern	6.04 (0.01)
Porcupine (*Hystrix indica*)	IV	Least Concern	5.49 (0.013)
Indian pangolin (*Manis crassicaudata*)	I	Endangered	0.14 (0.001)
Black-naped hare (*Lepus nigricollis*)	IV	Least Concern	10.14 (0.019)
Domestic prey			
Large livestock	NA	NA	5.69 (0.018)
Small livestock	NA	NA	5.97 (0.015)
Domestic dog	NA	NA	6.04 (0.013)

Table 3: The 14 mammal species photo-captured in camera traps in Marikanive State Forest, Chitradurga Forest Division.

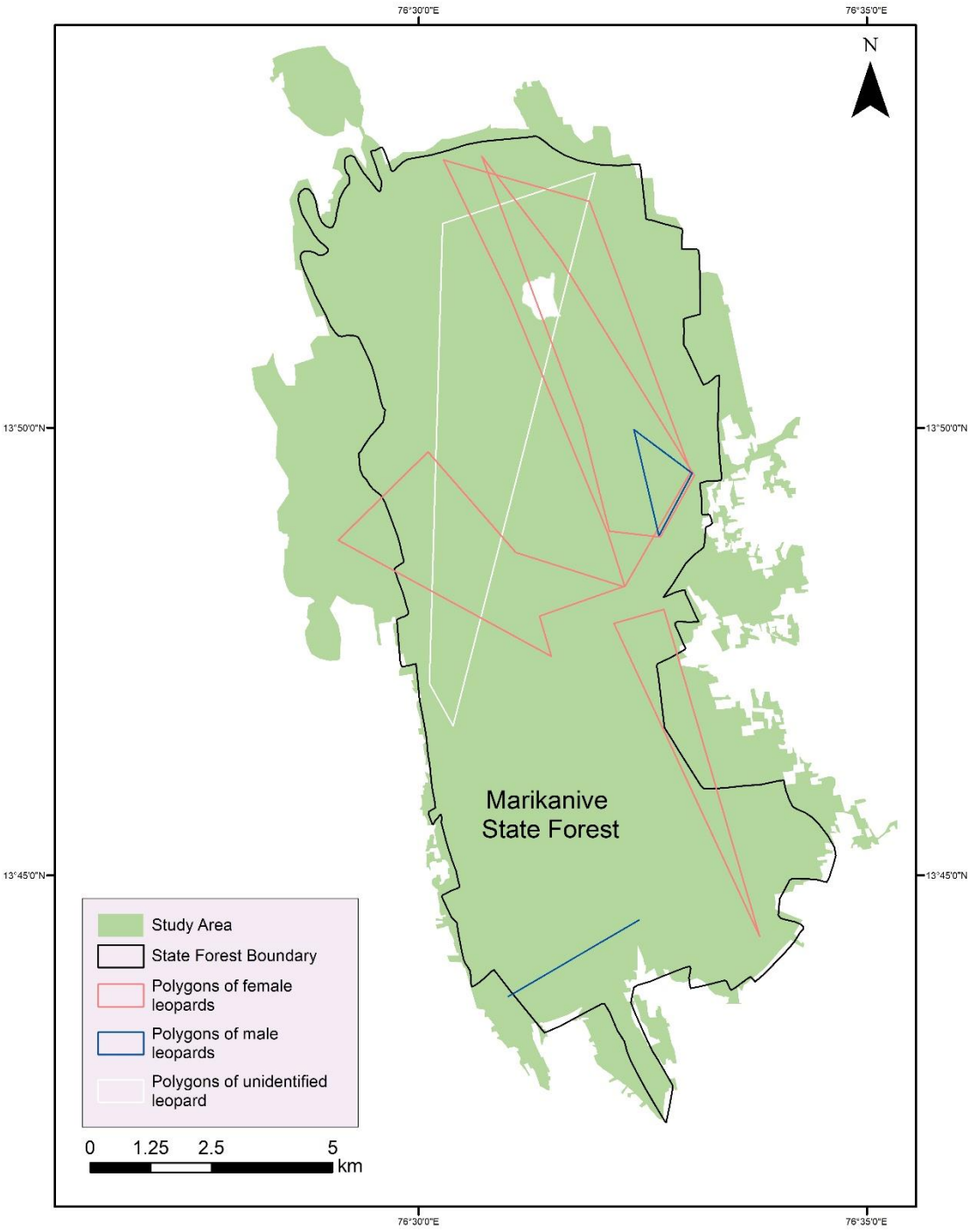
Species	**Schedule status under the Wildlife Protection Act 1972**	**Global status under the IUCN Red List**
Leopard (*Panthera pardus fusca*)	I	Vulnerable
Rusty-spotted cat (*Prionailurus rubiginosus*)	I	Near Threatened
Jungle cat (*Felis chaus*)	II	Least Concern
Jackal (*Canis aureus*)	II	Least Concern
Sloth bear (*Melursus ursinus*)	I	Vulnerable
Four-horned antelope (*Tetracerus quadricornis*)	I	Vulnerable

Wild pig (*Sus scrofa*)	III	Least Concern
Porcupine (*Hystrix indica*)	IV	Least Concern
Indian pangolin (*Manis crassicaudata*)	I	Endangered
Black-naped hare (*Lepus nigricollis*)	IV	Least Concern
Grey mongoose (*Herpestes edwardsi*)	II	Least Concern
Ruddy mongoose (*Herpestes smithii*)	II	Least Concern
Common palm civet (*Paradoxurus hermaphroditus*)	II	Least Concern
Small Indian civet (*Viverricula indica*)	II	Least Concern

Discussion

This study provides baseline abundance and density estimates for leopards and RAI for their prey in Marikanive SF in Chitradurga Forest Division. A few studies have shown that leopard populations tend to be higher outside PAs (Stein *et al.* 2011; Swanepoel *et al.* 2013) possibly due to the absence of conspecific predators like tigers (*Panthera tigris*) and dholes (*Cuon alpinus*). This does not seem to be the case for Marikanive SF. A density estimate of 3.91 SE ±1.48 per 100 km^2 for an area of 112.46 km^2 is comparable with data from previously surveyed PAs in Karnataka such as Malai Mahadeshwara Wildlife Sanctuary (906.01 km^2) and Cauvery Wildlife Sanctuary (1081 km^2) which have density estimates of approximately 3.88 leopards SE±0.32 per 100 km^2 and 3.63 leopards SE±0.4 per 100 km^2 respectively (Gubbi *et al.* 2017).

However, the abundance of Marikanive SF is lower than areas such as Devarayanadurga RF and similar to areas such as Dasudi RF and Madhugiri RF which are smaller in size (Gubbi *et al.* 2017). Narasimhadevarabetta (179.73 km^2) which comprises of three state forests has a density of 6.02 SE ±1.69 per 100 km^2 which is slightly bigger in area than Marikanive SF (Gubbi *et al.* 2020a). Similarly, Bukkapatna Chinkara WS (142.82 km^2) which has similar open woodland savannah has a higher density estimate of 4.84 SE±0.41 per 100 km^2 (Gubbi *et al.* 2017). The open woodland savannah habitat covering the eastern part of Marikanive SF is where most of the leopard individuals were photo-captured (See Map 3). This difference in density estimates could be attributed to the availability of more large wild prey in Chikkaballapura and Bukkapatna Chinkara WS (Gubbi *et al.* 2017, 2020a, 2020b). Dasudi RF (12.85 km^2), which is adjacent to Marikanive SF (See Map 3), also recorded a very high abundance (7.23 SE±4.25) and density estimate (12.74 SE±7.49) of leopards (Gubbi *et al.* 2017). Hence, this variation could also be attributed to the movement of individuals between these forest patches.



Map 3. Minimum bounding polygons formed by each identified leopard individual. A total of seven adult leopards were identified of which four females, two males and one individual whose gender was unidentified were photo-captured.

Studies have shown that leopards' space use depends on the proportion of natural habitats and availability of large wild prey (Dickman & Marker 2005; Khorozyan *et al.* 2008; Gubbi *et al.* 2020b). Understanding prey population dynamics and potential variables that contribute to their decrease will prove insightful while implementing management practices outside PAs. Natural prey populations face similar threats to that of predator populations i.e. poaching, habitat fragmentation, loss of natural habitat and vehicular collisions (Fahrig 2003;

Datta *et al.* 2008; Gubbi *et al.* 2014). Additionally, they are negatively impacted by increasing domestic prey population.

Leopards have been found to depend on domestic prey in human dominated landscapes where natural prey populations are less in number (Athreya *et al.* 2016). In the case of Marikanive SF, domestic prey is also considerably low. The relative abundance index (RAI) of wild prey species (24.58 ±0.28) and domestic prey (16.94±0.3) is comparatively lower than most state forests surveyed in Karnataka (Gubbi *et al.* 2017; Gubbi *et al.* 2020a).

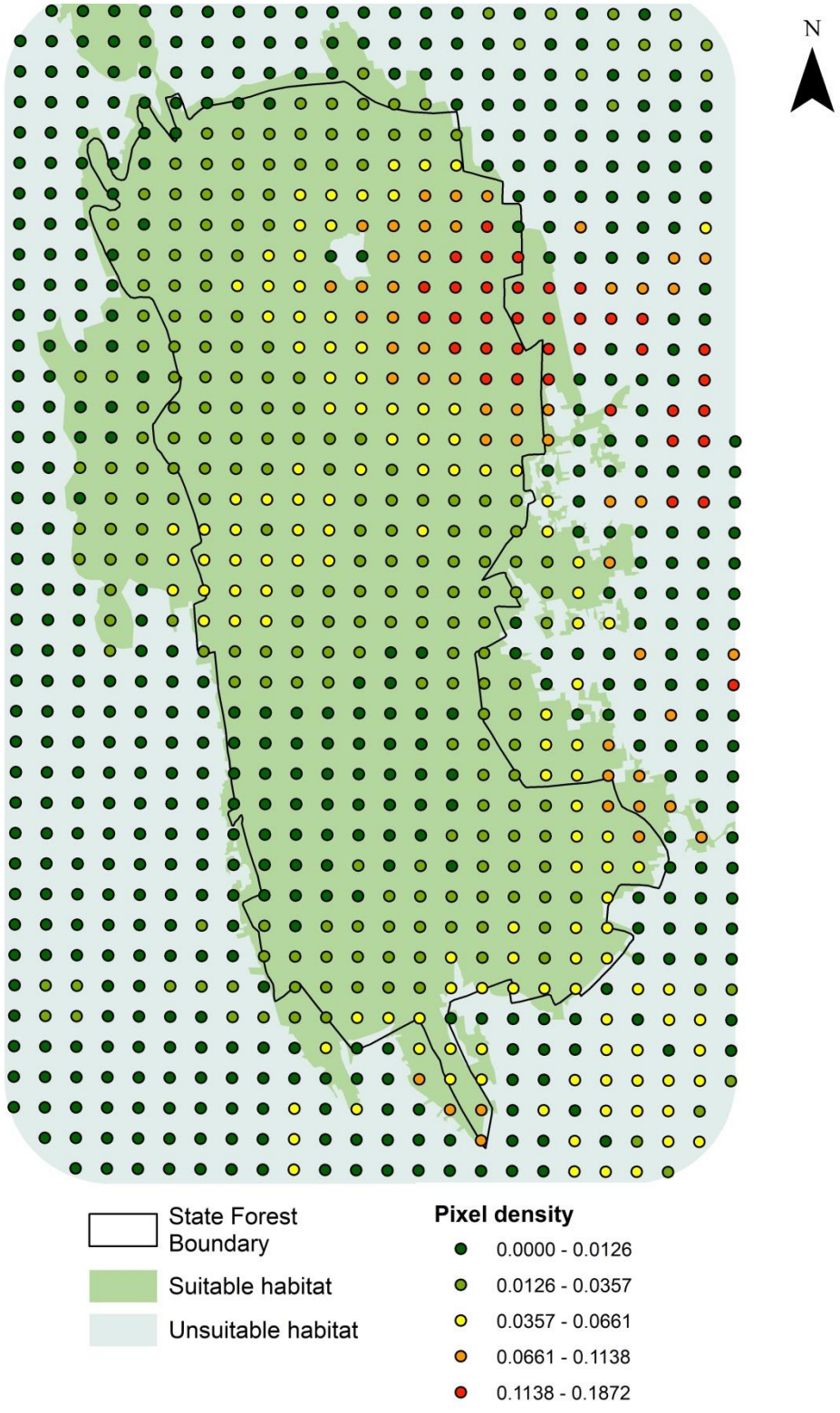
The diversity of wild prey in Marikanive SF is extremely low. Gubbi *et al.* (2017; 2020a) observed a higher diversity of large wild prey in other reserved and state forests (e.g. Madhugiri RF, Narasimhadevarabetta SF) with similar vegetation composition within Karnataka. The wild prey species recorded in Marikanive SF include black-naped hare (*Lepus nigricollis*), wild pig (*Sus scrofa*), Indian porcupine (*Hystrix indica*), Indian pangolin (*Manis crassicaudata*) and four-horned antelope (*Tetracerus quadricornis*).

Loss of habitat due to deforestation and expansion of human settlements is a major threat to the leopard and its prey populations (Jacobson *et al.* 2016). This leads to habitat fragmentation which is detrimental to maintain viable prey populations and in turn predator populations (Fahrig 2003). Afforestation has taken place in multiple patches but unless the forests are restored with natural forest species and enforcement against any prey poaching, it is difficult to revive lost prey populations (Fahrig 2003).

Rapid changes due to economic growth have led to destruction and conversion of natural habitats. Certain habitats such as tropical evergreen forests get more conservation attention as opposed to other lesser known habitats. Leopards are found in a wide variety of habitats and thus Gubbi *et al.* (2020b) argues that leopards can be used as an indicator to prioritise habitats for conservation such as scrub, deciduous forests, rocky outcrops and woodland savannah which are usually neglected. A landscape conservation approach must be considered for state forests such as Marikanive SF as they are smaller forest patches, and are connected to other forest patches through human-modified habitats facilitating the movement of wildlife and possibly maintaining viable leopard populations throughout the area. Kudrekanave SF and Dasudi SF are connected to Marikanive SF through deemed forest (See Map 2). This connectivity should be preserved and expanded to reduce the fragmentation in this landscape and facilitate movement of wildlife. Hence, looking at population estimates of one of these forest patches might not give a clear picture about how the population of leopards is faring.

Additionally, there is possibly a healthy male to female ratio of 2:4 in Marikanive SF (See Map 3). One female was photo-captured with two sub-adults at two different occasions suggesting the presence of breeding females within the state forest (See Figure 2). Breeding females have been considered to play a crucial role in the population stability of large carnivores and more females are expected to be found in healthy populations (Kandel *et al.* 2020; Nowell & Jackson 1996). Distribution of females tends to be a function of resource availability suggesting that the habitat quality of Marikanive SF might be good enough to

support a healthy leopard population (Kandel *et al.* 2020). It is only possible to corroborate this speculation with long term monitoring of leopards in the area.



Map 4. Pixel density map showing the fine scale variation in leopard numbers per km^2 in Marikanive State Forest and its adjoining areas

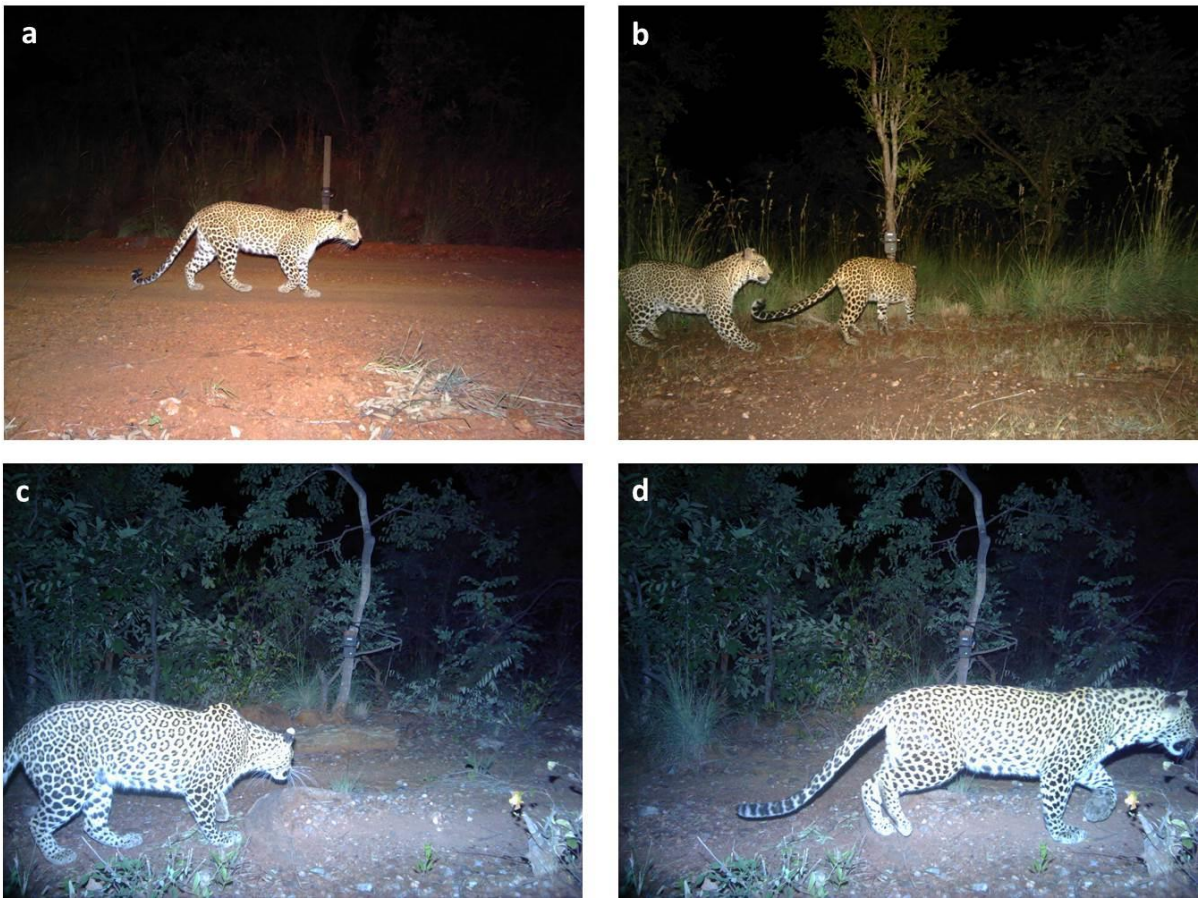


Figure 2. (a) MKL-04 (female) which was captured with two sub-adults **(b)** MKL-04 is captured with Sub-adult-01 on 27-Nov-20 **(c) and (d)** are photos captured one minute after the other where MKL-04 (c) was captured again with Sub-adult-02 (d) on 25-Nov-20

The pixel density map (See Map 4) shows the fine scale variation in leopard density per km^2 and leopards were observed mainly in the northern part of the state forest. Marikanive SF along with the adjacent forest patches are directly subjected to human disturbances including livestock grazing. The wind farms in the area contribute to the disturbance of these natural habitats. The distribution patterns of leopards within this habitat could possibly be due to more human intrusion in one specific area of the state forest. Such high human disturbances can often lead to human-wildlife conflict situations. Appropriate measures must be taken to reduce these conflicts by increasing awareness amongst the local communities and sensitising them towards wildlife.

Overall, the threats faced by leopards outside PAs are numerous. A combination of these threats and movement between forest patches might govern the differences in population density estimates and local distribution of leopards in forest patches like Marikanive SF. This study establishes a population density estimate to start monitoring the population on a long-term basis. Additionally, we were able to establish presence and relative abundances of other

large mammals that inhabit this area. Baseline data is of utmost importance to monitor these populations over longer periods to identify area-specific threats and to implement appropriate mitigation measures.

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Appendix – 1

Photographs of mammal species captured in Marikanive State Forest in Chitradurga forest division during camera trapping session in November-December 2020.

Leopard
(*Panthera pardus fusca*)

Jungle cat
(*Felis chaus*)

Rusty-spotted cat
(*Prionailurus rubiginosus*)

Jackal
(*Canis aureus*)

Sloth bear
(*Melursus ursinus*)

Porcupine
(*Hystrix indica*)

Four-horned antelope
(*Tetracerus quadricornis*)

Wild pig
(*Sus scrofa*)

Indian pangolin
(*Manis crassicaudata*)

Black-naped hare
(*Lepus nigricollis*)

Small Indian civet
(*Viverricula indica*)

Common palm civet
(*Paradoxurus hermaphroditus*)

Grey mongoose
(*Herpestes edwardsii*)

Ruddy mongoose
(*Herpestes smithii*)

Appendix – 2

Event duration used for calculating Relative Abundance Index (RAI) of leopards' natural and domestic prey

Species	**Event duration (seconds)**
Wild prey	
Four-horned antelope (*Tetracerus quadricornis*)	60
Wild pig (*Sus scrofa*)	60
Porcupine (*Hystrix indica*)	60
Indian pangolin (Manis crassicaudata)	60
Black-naped hare (*Lepus nigricollis*)	60
Domestic prey	
Large livestock	300
Small livestock	180
Domestic dog	60

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