





# EXPLORING NEW LANDSCAPES FOR LARGE MAMMAL CONSERVATION CHINCHOLI WILDLIFE SANCTUARY



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#### 01 INTRODUCTION

The leopard (*Panthera pardus*) is one of the top predators found over a wide geographic range and also adapted to various habitats including human-dominated landscapes. They are elusive and solitary species with a diet that constitutes a wide range of prey species. The combination of habitat adaptability and catholic diet also makes it a highly conflict-prone species.

The leopard is listed under the 'Vulnerable' category in the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (Stein *et al.* 2024). Under the Wildlife Protection Act 1972 in India, they are listed as a Schedule 1 species which provides them with the highest level of protection.

Leopards are exposed to several threats such as habitat loss and fragmentation, retaliatory killing, vehicular collisions, poaching, depletion of prey and other unconventional threats (Gubbi *et al.* 2014; Jacobson *et al.* 2016; Gubbi *et al.* 2017; Gubbi *et al.* 2020). Apart from understanding the threats it is important to know their distribution and population information to implement effective management and conservation strategies.

In India, most studies about leopard density and abundance estimates are from Protected Areas (PAs) and very few studies have focused in leopard habitats outside PAs and in human-inhabited areas (Harihar *et al.* 2009; Athreya *et al.* 2013; Borah *et al.* 2014; Gubbi *et al.* 2017). However, there is a serious lack of population information about the species both within PAs and their habitats outside PAs due to the limited number of studies and the leopards' wide geographic distribution.

In Karnataka, the population of leopards has been documented in PAs and human-dominated habitats. Gubbi *et al.* (2017) estimated a mean abundance of ~ 300 (SD ± 15.2) leopards in a ~3,170 km<sup>2</sup> area comprising PAs and multiple-use forests in Karnataka. However, there continues to be a lack of information from northern Karnataka now called the Kalyana-Karnataka Region. This region is known for its dry arid grasslands. However some parts of the region also host dry deciduous, scrub forests that are ideal leopard habitats but yet to be surveyed to understand leopard distribution and population. Establishing such baseline data could not only help in better understanding of their distribution in the Kalyana-Karnataka region but also help in future management of the population if there are any conflict situations.

Hence, in continuation of the previous studies and as an exploratory attempt to document leopard population in the Kalyana-Karnataka Region this study attempted to estimate the abundance and density of leopards in Chincholi Wildlife Sanctuary (CWS). This also provides an opportunity to document the faunal species of CWS as systematic studies have been limited.



#### 02 STUDY AREA

CWS covers an area of 134.88 km<sup>2</sup> and is located in the Kalaburagi district of Karnataka in South India. It was gazetted as a protected area in November 2011. Three reserved forests (Devagiri-Changler - 25.07 km<sup>2</sup>, Salebeeranahalli - 12.2 km<sup>2</sup>, Basipur - 3.23 km<sup>2</sup>) that fall under the administration of Humanabad range of Bidar Forest Division are contiguous with CWS on its north-western edge. Hence they were included as part of the study area bringing the total study area to 175.38 km<sup>2</sup>.

The protected area is charecterised by dry and arid conditions. The mean annual rainfall at Kalaburagi district is 800 mm. The district's elevation, measured from the mean sea level, is approximately 693 m on average. The temperatures in Kalaburagi district vary from 22° C in winters to 43° C during summers (Devappa *et al.* 2009). The wildlife sanctuary is bordered mostly by dryland agriculture with pigeon pea (*Cajanus cajan*), cotton (*Gossypium herbaceum*), sugarcane (*Saccharum officinarum*) and maize (*Zea mays*) being the predominant crops cultivated. Alongside the Chandrampalli dam, four smaller dams (Chikkalingadhalli dam, Linganagar kere, Venkatapura kere, Salebiranhalli dam) dot the wildlife sanctuary's borders acting as an important watershed for these dams.

Dry deciduous and scrub forests dominate the habitat with laterite plateaus on the hills tops. The predominant vegetation in the study area includes Annona squamosa, Anogeissus latifolia, Butea monosperma, Chloroxylon swietenia, Diospyros melanoxylon, Grewia villosa, Holarrhena pubescens, Terminalia bellirica, and Ziziphus mauritiana. The exotic and invasive Lantana camara is found in some patches of the study area. Plantations of exotic species such as Acacia auriculiformis, Eucalyptus grandis, Gliricidia sepium, and Senna siamea were carried out in the past.

#### LOCATION COORDINATES

Latitude

17° 23' 48.8436" N 17° 38' 16.5912" N Longitude

77° 18' 14.9112" E 77° 37' 47.2836" E



#### Camera trapping

Camera trapping is a widely used methodology to estimate population and abundance of large carnivores with natural body markings. It's also used to understand species diversity of an area. Hence, the same methodology was used for understanding the leopard population and also to document other large mammals at CWS.

Roads, trails, and other important geographical features were marked using Google Earth Pro (Google LLC. 2023) and converted as GIS files. This data was used to identify areas for carrying out initial recce of the study site. Further field reconnaissance surveys were carried out to identify the exact locations to deploy the camera traps to ensure high capture probability of large carnivores. Locations with indirect evidence of carnivore presence, such as scats, pugmarks, and scrape marks, were prioritised for placing camera traps.

Then Panthera V4, V6, and Spartan lumen SR3-CX motion detection cameras were fastened to tree trunks or stumps at optimal heights of ~40 cm from the ground, using high strength python cables. The traps were placed on either side of the identified trails and roads to ensure that both, the right and left, flanks of the large carnivores were effectively photo-captured.

The study area was divided into two (2) blocks for logistical ease and due to resource restrictions. Camera traps were deployed within each block for a continuous period of 16 days. The camera traps operated continuously throughout the day and were periodically checked every 2-3 days to perform maintenance tasks like downloading images, replacing batteries or SD cards, and ensuring their proper functioning. An automated image classifier, developed on the Python platform (version 3.6), was employed to categorise the downloaded images into folders based on species (Rampi *et al.*, unpublished). These categorised images underwent manual validation, and the identified species were integrated into the image metadata using Digikam software (Version 5.8.0, Gilles *et al.*, 2018).

Each captured image was marked with a unique combination of camera trap location and camera ID, allowing for the extraction of date, time, and location coordinates for reference.

The camera trap survey was conducted during October and November 2023.

#### Results

A total of 104 locations were identified for installation of camera traps at CWS and the three Reserved Forests of Bidar Forest Division (Map 1). The survey details are provided in Table 1.

Table 1. Survey period and camera trapping efforts in Chincholi Wildlife Sanctuary and the adjoining reservedforests of Bidar Forest Division				
YEAR	SURVEY PERIOD	NUMBER OF CAMERA TRAP LOCATIONS	OCCASIONS PER BLOCK	CAMERA TRAPPING EFFORT
2023	October-November	104	16	1,650



Map 1. Camera traps were deployed at 104 locations in Chincholi Wildlife Sanctuary and the three Reserved Forests of Bidar Forest Division that are contiguous to the wildlife sanctuary.

Camera trapping effort was determined by multiplying the number of surveyed locations by the number of functional occasions, when the camera trap was operational.

#### 04. MAMMALIAN DIVERSITY

During the study period, in addition to the leopard, camera traps captured a total of 24 different wild mammal species (Table 2, Appendix - 1). This included three species of canids (dhole, jackal and Bengal fox), three species of felids (leopard, jungle cat and rusty spotted cat), and five species of ungulates (nilgai, chital, four-horned antelope, wild pig and blackbuck).

Table 2. Mammalian species photo-captured in camera traps in Chincholi Wildlife Sanctuary and three			
reserved forests of Bidar Forest Division			
SR.NO.	SPECIES	SCHEDULE STATUS UNDER THE WILDLIFE PROTECTION ACT <b>1972</b>	GLOBAL STATUS UNDER THE IUCN RED LIST
01	Leopard (Panthera pardus)	I - Part A	Vulnerable

02	Dhole (Cuon alpinus)	I - Part A	Endangered
03	Jackal (Canis aureus indicus)	I - Part A	Least Concern
04	Indian fox (Vulpes bengalensis)	I - Part A	Least Concern
05	Common Palm Civet (Paradoxurus hermaphroditus)	I - Part A	Least Concern
06	Small Indian civet (Viverricula indica)	I - Part A	Least Concern
07	Jungle cat (Felis chaus)	I - Part A	Least Concern
08	Rusty spotted cat (Prionailurus rubiginosus)	I - Part A	Near Threatened
09	Grey mongoose (Herpestes edwardsii)	I - Part A	Least Concern
10	Ruddy mongoose (Herpestes smithii)	I - Part A	Least Concern
11	Nilgai (Boselaphus tragocamelus)	II - Part A	Least Concern
12	Chital (Axis axis)	II - Part A	Least Concern
13	Four-horned antelope (Tetracerus quadricornis)	I - Part A	Vulnerable
14	Blackbuck (Antilope cervicapra)	I - Part A	Least Concern
15	Wild pig (Sus scrofa)	II - Part A	Least Concern
16	Indian porcupine (Hystrix indica)	I - Part A	Least Concern
17	Indian pangolin (Manis crassicaudata)	I - Part A	Endangered
18	Indian hare (Manis crassicaudata)	II - Part A	Least Concern
19	Rhesus macaque (Macaca mulatta)	Unlisted	Least Concern
20	Northern Malabar langur (Semnopithecus hypoleucos achates)	I - Part A	Near Threatened
21	Indian gerbil (Tatera indica)	Unlisted	Least Concern
22	Three-striped palm squirrel (Funambulus palmarum)	Unlisted	Least Concern
23	False Vampire bat (Megaderma/Lyroderma sp.)	Unlisted	-
24	Leaf-nosed bat (Hipposideros sp.)	Unlisted	-



Since there was only one event of leopard capture, the scope for estimating leopard density or abundance using traditional capture-recapture methodology is not possible. However, we used photographic capture rates to estimate Relative Abundance Index (RAI, Table 3) and to map the distribution of some of the wild mammalian species and domestic prey found in the study area. RAI is widely used as a proxy index of abundance, but RAI does not account for imperfect detection. The threshold time interval to count independent events for RAI is mentioned in Appendix - 2 for leopard and its wild and domestic prey.

Table 3. Mammalian species photo-captured in camera traps in Chincholi Wildlife Sanctuary and threereserved forests of Bidar Forest Division			
SPECIES	RELATIVE ABUNDANCE INDEX(RAI) PER 100 TRAP DAYS	STANDARD ERROR	
Leopard (Panthera pardus)	0.06	0.0006	
Wild prey			
Nilgai (Boselaphus tragocamelus)	0.61	0.0025	
Chital (Axis axis)	8.06	0.0156	
Four-horned antelope (Tetracerus quadricornis)	7.45	0.0132	
Blackbuck (Antilope cervicapra)	0.06	0.0006	
Wild pig (Sus scrofa)	18.61	0.0219	
Indian porcupine (Hystrix indica)	11.45	0.0166	
Indian pangolin (Manis crassicaudata)	0.12	0.0008	
Indian hare (Manis crassicaudata)	16.30	0.0223	
Rhesus macaque (Macaca mulatta)	31.70	0.0465	
Northern Malabar langur (Semnopithecus hypoleucos achates)	17.58	0.0282	
Domestic prey			
Domestic dog	63.94	0.1088	
Large livestock	78.55	0.0924	
Small livestock	52.42	0.0746	

## 05 NOTABLE OBSERVATIONS

Our camera trapping work resulted in the first-ever documentation of dholes for the Kalyana Karnataka region. Initially, a dhole was captured in Devagiri-Changler Reserved Forest which is part of Humnabad Range of Bidar Division. Subsequently dholes were also recorded in some parts of CWS (Map 2).



Map 2. Locations of camera traps where dholes were photo-captured during the study.



### 06 DISCUSSION

This is possibly the first systematic studies on large mammals at CWS and its adjoining areas. The documentation of dholes during this study is of significant importance. It has recorded the range extension for this species into the Kalyana-Karnataka area. Specific conservation measures need to be taken up for dhole protection in these areas.

Of the nine subspecies of leopards, two have been listed as Critically Endangered, three as Endangered, and two as Vulnerable (IUCN 2023). The primary threats leading to the decimation of leopards have been identified as loss and fragmentation of habitat, natural prey population declines attributed to the bushmeat trade, poaching for body parts, and human-leopard conflict which leads to retaliatory measures for livestock depredation. In India, leopards are geographically widely distributed and even found in high densities in agricultural landscapes (Athreya *et al.* 2013) which demonstrates their flexibility in adjusting to habitats and domestic prey. However, documentation of a single leopard in CWS which is a large natural habitat with adequate natural prey is of concern. Historical records such as gazetteers show the presence of leopards in this area (Sathyan 1966). It is unsure what has led to the decimation of leopard populations in CWS and its adjoining areas. However, direct extermination of leopards for their body parts can be one of the possible reasons which needs to be ascertained.

The tiger (*Panthera tigris*) and the sloth bear (*Melursus ursinus*) that were documented here as per the Mysore State Gazetteer for the Gulbarga district (Sathyan 1966) have gone locally extinct. Neither of these two species were documented during our study period. Sloth bears are generalist species that are found in a wide variety and size of habitats, their absence from CWS is also an important point that needs further research.

The presence of rhesus macaques which have reestablished their range in Karnataka after several decades need to be examined with further studies. Previous studies (Kumara *et al.* 2010) have not documented the presence of rhesus macaque from this area. Hence, the range extension of rhesus macaque into CWS and adjoining area needs to be examined closely. Currently their RAI is twice compared to that of Northern Malabar langur and no bonnet macaques were recorded during this study. Hence, the impact of range of expansion of rhesus macaque on the other primate species is to be studied.

Similarly, nilgai, the largest antelope in India, is also expanding its distribution into northern Karnataka as seen from results of this study. Both nilgai and rhesus macaques can cause significant conflict with humans hence need careful examination from a long-term conservation and conflict mitigation perspective. Pro-active conflict mitigation measures have to be taken up for these two species before they become problematic to communities. Based on the study results and field observations we recommend the following

### **07 RECOMMENDATIONS**

- 1. CWS needs focused anti-poaching efforts hence establishing more anti-poaching camps (APCs) with adequate staff should be prioritised in the coming years.
- 2. Network roads for patrolling need to be developed for effective management of the wildlife sanctuary.
- Documentation of the dhole in Reserved Forests in the adjoining Bidar division calls for more attention towards these areas from a dhole conservation perspective. Hence it is recommended that the following areas (Table 4) be added and notified as part of the Chincholi Wildlife Sanctuary.

Table 4. List of areas be added and notified as part of the Chincholi Wildlife Sanctuary			
SL.NO.	NAME OF THE RESERVED FOREST	AREA(KM <sup>2</sup> )	
01	Devagiri-Changler	25.07	
02	Salebeeranahalli	12.2	
03	Basipur	3.23	
	Total	40.5	

- 4. A large number of feral dogs have been documented in the camera traps including feral dogs hunting wildlife (Figure 1). Hence a comprehensive management strategy should be adapted to control and remove feral dogs from the CWS limits.
- Several natural plateaus that host grasslands have been planted with Gliricidia sepium (Figure 2 and 3). Hence efforts to eradicate these from CWS should be taken up. Such grasslands are extremely important for species such as the four-horned antelope which is one of the key species of CWS.
- Some parts of the wildlife sanctuary have lost natural cover due to expansion of agriculture leading to internal fragmentation. Hence such corridors need to be identified and conserved. One such corridor that requires urgent attention is the Antwaram-Mambapur corridor. (Map 4)



Map 3. Proposed area to be added and notified as part of the Chincholi Wildlife Sanctuary



Figure 1. A feral dog carrying a chital fawn in Chincholi Wildlife Sanctuary.



Figure 2. Gliricidia plantation in Chincholi Wildlife Sanctuary.



Figure 3. Gliricidia plantation in Chincholi Wildlife Sanctuary.





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#### Appendix 01

Photographs of mammal species captured in Chincholi Wildlife Sanctuary and three adjoining Reserved forests of Bidar Forest Division during camera trapping in 2023.

Leopard Panthera paradus fusca Jackal Canis aureus indicus Dhole

Dhole Cuon alpinus



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Indian fox Vulpes bengalensis

**Common palm civet** Paradoxurus hermaphroditus

> Small Indian civet Viverricula indica

> > **Jungle cat** Felis chaus

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Rusty-spotted cat Prionailurus rubiginosus

> Grey mongoose Herpestes edwardsii

> > Ruddy mongoose Herpestes smithii

Nilgai Boselaphus tragocamelus



**Chital** Axis axis

#### Four-horned antelope Tetracerus quadricornis

Blackbuck Antilope cervicapra

> **Wild pig** Sus scrofa



Indian porcupine Hystrix indica

Indian pangolin Manis crassicaudata

Indian hare Lepus nigricollis



**Indian gerbil** Tatera indica

**Three-striped palm squirrel** Funambulus palmarum

> **Leaf-nosed bat** *Hipposideros sp.*

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### Appendix 02

Event duration used for calculating Relative Abundance Index (RAI) of leopard and its wild and domestic prey.

SPECIES	EVENT DURATION (SECONDS)		
Leopard (Panthera pardus)	60		
Wild prey			
Nilgai (Boselaphus tragocamelus)	60		
Chital (Axis axis)	120		
Four-horned antelope (Tetracerus quadricornis)	60		
Blackbuck (Antilope cervicapra)	60		
Wild pig (Sus scrofa)	60		
Indian porcupine (Hystrix indica)	60		
Indian pangolin (Manis crassicaudata)	60		
Indian hare (Manis crassicaudata)	60		
Rhesus macaque (Macaca mulatta)	360		
Northern Malabar langur (Semnopithecus hypoleucos achates)	180		
Domestic prey			
Domestic dog	60		
Large livestock	300		
Small livestock	180		

## CITATION

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