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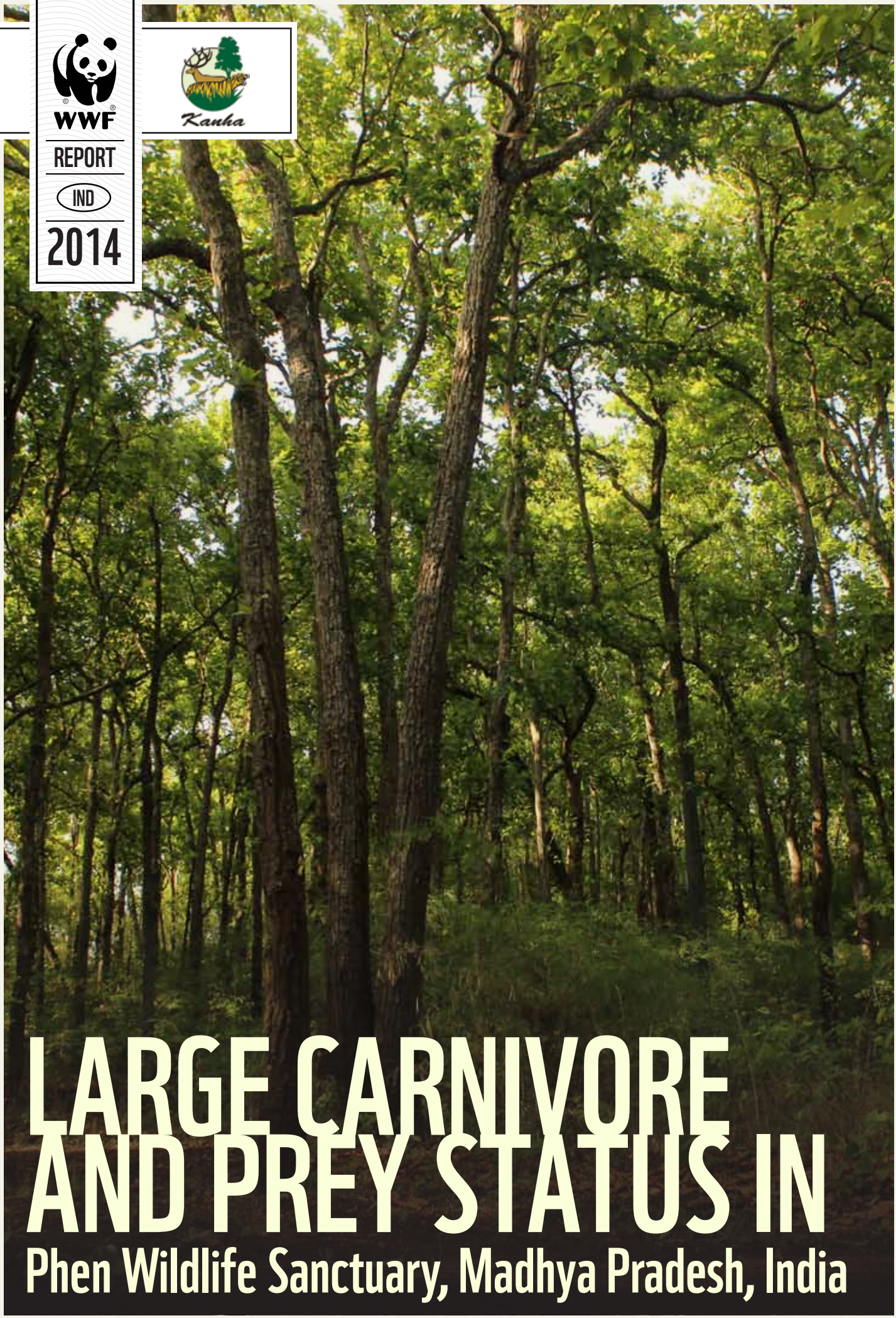
Kanha



LARGE CARNIVORE AND PREY STATUS IN

Phen Wildlife Sanctuary, Madhya Pradesh, India

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Photo credit: Jyotirmoy Jena, WWF-India

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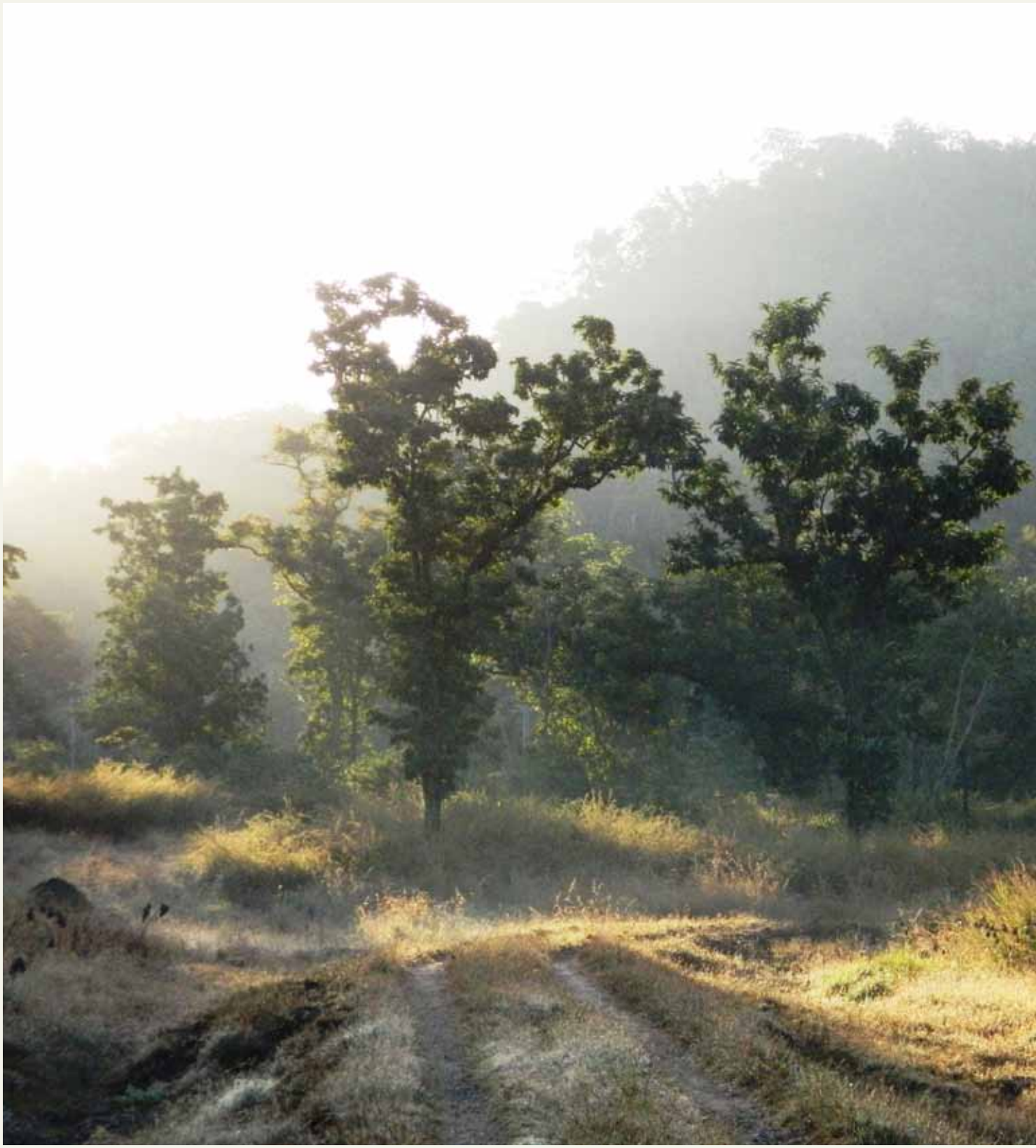


Forest road in Phen sanctuary

Photo credit: Jyotirmoy Jena, WWF-India

1. INTRODUCTION

The population of tiger (*Panthera tigris*) in India has undergone a sharp decline over the past few years. In order to provide them a safe path between two tiger reserves, it's critical that potential habitat be identified, and that needs of tigers be incorporated in development plans of the region. As part of this planning process, it is important to first identify those areas where tigers could potentially survive in the wild, determine where sufficiently large blocks of habitat could retain populations of tigers, identify where connectivity between patches of habitat exists or could be created to link populations, and prioritize such areas on the basis of their importance for tiger recovery.

In recent times conservation efforts have been targeted towards tigers due to their dwindling status. Though tiger is an apex species in the food web of most of the terrestrial ecosystem and conservation of tiger as umbrella species provide safe guard to the overall ecosystem, our understanding on cascading effect of human induced changes to populations of this carnivore species is negligible (Smith *et al.*, 2003). Leopards which occur sympatrically with tigers, also faces threats from habitat loss, intense poaching for body parts and has resulted in decline in their population. Also lack of estimation of population size of these large carnivores makes it difficult for taking appropriate conservation actions.

Due to their ecological traits, large carnivores require larger area for their survival, breeding and dispersal (Miquelle *et al.*, 1999). Therefore, for a tiger population to recover, tigers living outside protected areas also need to be protected. A primary intervention in such sce-

narios would be to minimize conflicts between people and tigers. Corridors or connectivity through forest linkages facilitate the movement and/or dispersal of not only large carnivores but also for other wildlife species. Hence, conservation of large carnivores needs to be based on a meta-population frame work allowing safe and secure dispersal, and genetic exchange between populations on a landscape scale.

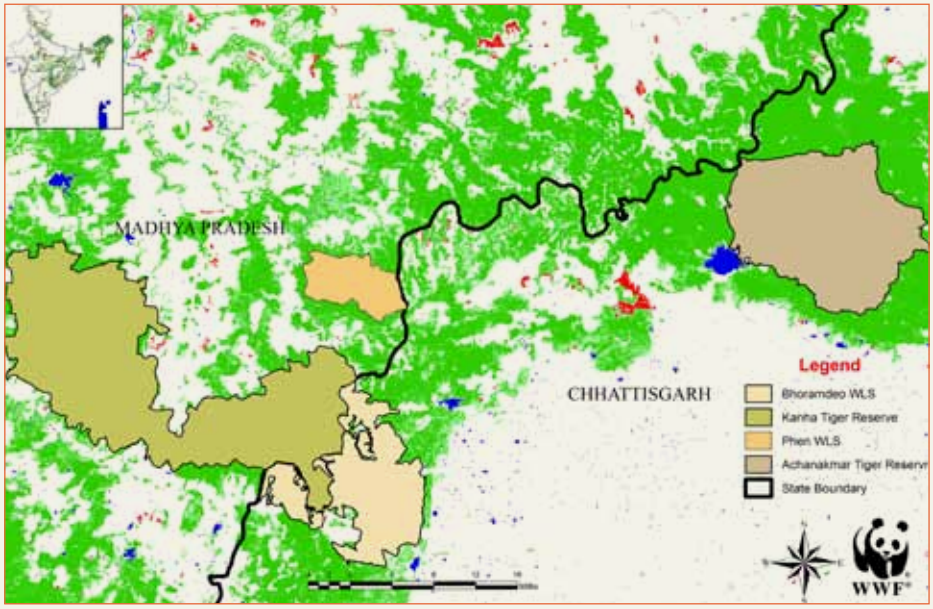
Keeping these factors in mind, a survey was undertaken at Phen Wildlife Sanctuary (PWLS) to determine the large mammal assemblage in the area. Phen WLS forms the satellite micro-core of larger Kanha Tiger Reserve and is an important region in term of connectivity between Kanha and Achanakmar Tiger Reserve (Figure 1). It plays a significant role in Kanha-Achanakmar corridor as a major stepping stone area. Tiger's which disperse or move out from Kanha, either use Bhoramdeo Wildlife Sanctuary or Phen to move further along the Kanha-Achanakmar corridor. Phen has connectivity to Kanha through Motinala buffer forest and further establish a linkage to the forest of Dindori and Mawai. Thus, it is crucial to secure the Kanha-Achanakmar corridor for long term survival of tigers in the landscape. The sanctuary status of Phen provides some degree of protection to wildlife in comparison to the other reserve forests in corridor area and this is apparent from a relatively intact forest structure and frequent animal sightings. The predominant forest is miscellaneous type with *Sal* patches interspersed by small grass lands. The ground cover has revived after complete removal of *Daihan* (settlements with huge livestock rearing and grazing). Tiger and other large carnivore presence have been recorded from time to time in Phen, but systematic understanding of population structure has not been documented so far. For past few years though tiger pugmark has been reported from the sanctuary, but not found regularly every year. However, presence of leopards and prey species was quite frequently recorded by forest department. This report highlights the status of large carnivores and prey in Phen Wildlife Sanctuary, which forms an important habitat as well as a stepping stone for wildlife in Kanha-Achanakmar corridor.

1.1 Kanha-Achanakmar Corridor Complex

The Protected Areas (PA's) in Central India are geographically distributed with some degree of interconnectivity between them through contiguous as well sub-contiguous forest patches. This signifies the potential for tiger meta-population survival through genetic exchange in longer term (Sharma et al. 2013). But the forest forming the connectivity between the PA's are not entirely intact. Rather they follow a multiple land use pattern with varying degrees of anthropogenic pressures and degradation. Connectivity between source population site Kanha and Achanakmar tiger reserve is predominantly a hilly tract, mainly supporting tropical moist deciduous forests. The valleys are dominated by the Sal (*Shorea robusta*) forests, while the lower and higher slopes support the Bamboo (*Dendrocalamus strictus*) with Sal and miscellaneous species respectively (WWF-India, 2011). In addition, many plateaus support extensive grasslands, commonly known as 'dadar'. The wider inter-mountain valleys are mostly occupied by vast stretches of agricultural fields. More importantly, the entire Kanha-Achanakmar corridor area is spread over four different districts in the states of Madhya Pradesh and Chhattisgarh, and encompasses four different PA's (Figure 1). Also the forest of entire corridor is managed by several territorial, production and social forestry divisions. These patches, due to their size and strategic location in the corridor, are crucial

in providing refuge as well as habitat contiguity to different dispersing wild animals. Also these forests are important source of livelihood for tribal dominated communities residing in the entire tract, in the form of timber, non-timber and minor forest produce (NTFP).

Figure 1: Protected areas in Kanha-Achanakmar corridor



Sal mix forest in Phen Wildlife Sanctuary

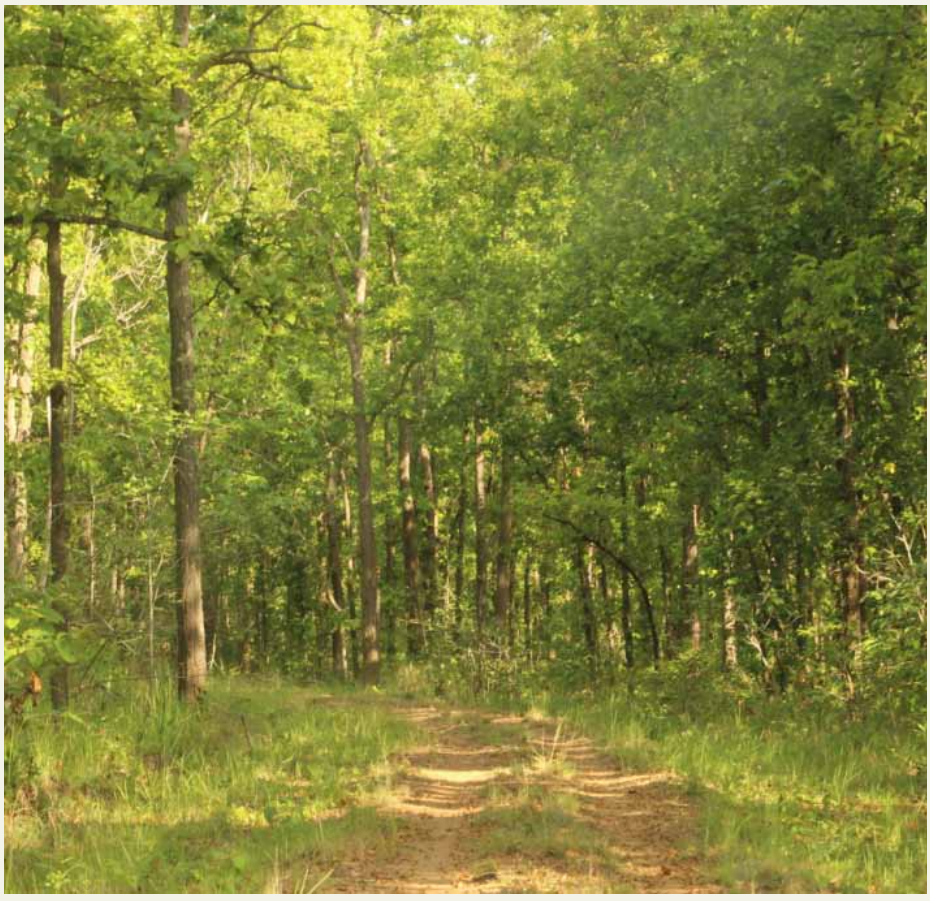


Photo credit: Jyotirmoy Jena, WWF-India

Figure 2: Grass land in Phen wildlife sanctuary

Photo credit: Jyotirmoy Jena, WWF-India

2. STUDY AREA

2.1 Phen Wildlife Sanctuary: A stepping stone for wildlife in Kanha Achanakmar corridor

Phen Wildlife Sanctuary (henceforth as Phen) is better known as satellite micro core of Kanha tiger reserve and is being managed by the Kanha tiger reserve management since 1990. Declared as a Sanctuary by Government of Madhya Pradesh in 1983, Phen comprises of an area of 110.74 square kilometers. Phen is surrounded and connected to Kanha Tiger reserve through Motinala buffer range as well as territorial range. The connectivity extends and forms a connective linkage for the Kanha-Achanakmar corridor through Mawai range in north as well in south and Rajnandgaon of Chattisgarh part. The connectivity with Kanha through the buffer ranges (Motinala and Mawai) in east and north provides continuity for the Kanha-Achanakmar corridor.

Phen currently have only one administrative range. However this range has been divided into three circles and twelve beats. There are eight patrolling camps and four barriers within Phen which helps in preventing any untoward incidents in the sanctuary. Also, three extra temporary camps are present to keep an extra vigilance during monsoons. To reduce the forest fire incidence, a network of 79.50 kilometers fire line has been demarcated and maintained. Also there are several forest roads cross the sanctuary which are 76.10 kilometers in total length (Figure 3).

The sanctuary administratively consists of 12 beats and 13 compartments but do not have any kind of management zones. The sanctuary is surrounded by eighteen villages (within a distance of 5 kilometers from the boundary), and the villagers depends on Phen as well as adjoining territorial forests for livelihood resources in form of fuel wood collection, cattle grazing and NTFP like mahua, char and tendu-patta collections.

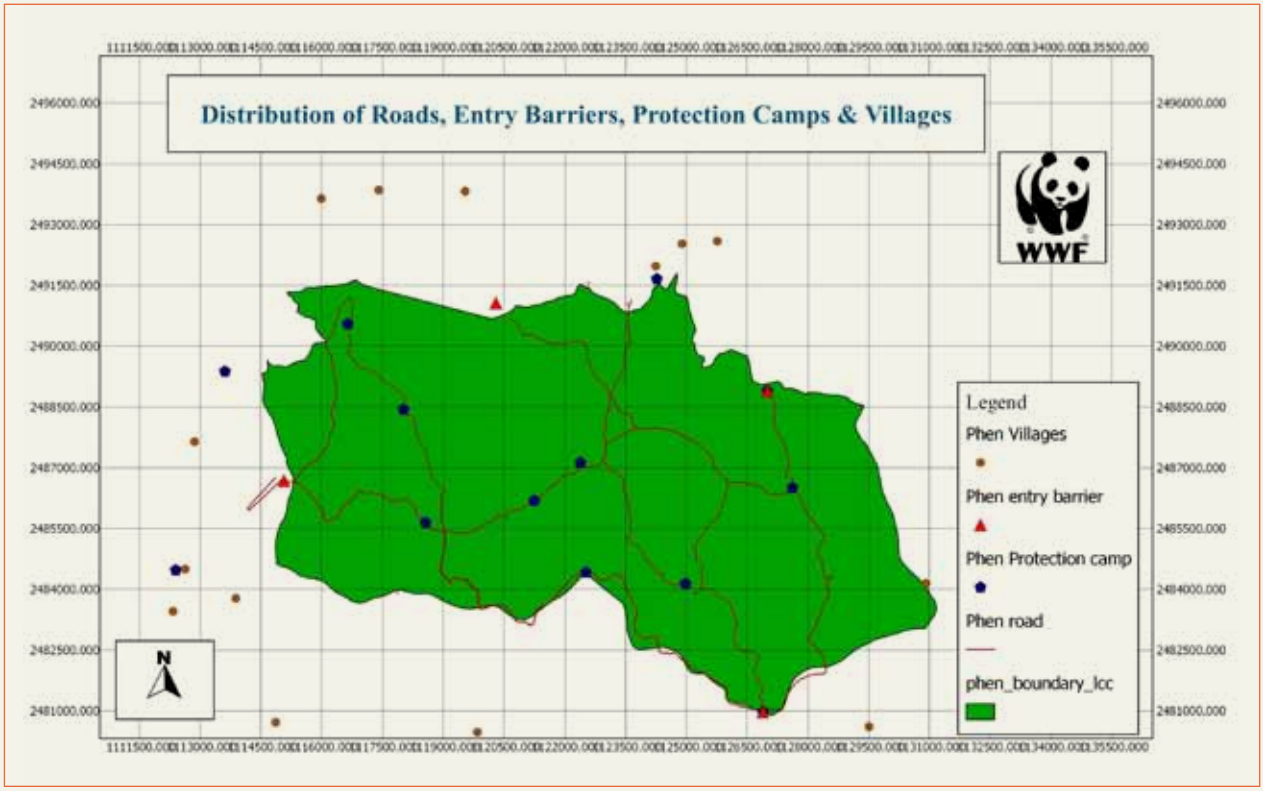


Figure 3: Map of Phen Wildlife Sanctuary showing roads, protection camps and villages in a radius of 5 kilometer

2.2 Location, geography and climate

The sanctuary (22° 16' 8.84" N & 81° 5' 38.8" E) is situated to the northern side of Kanha tiger reserve. The topography of the entire sanctuary is hilly, interspersed with small valleys. However unlike Kanha, the grassland areas are much smaller in size. Phen experiences three distinct seasons like other areas in the landscape, i.e. summer, winter and monsoon. The forest type in Phen is predominantly mix deciduous forest and Sal dominated forest. In the northern as well south east sides of the sanctuary the forest is contiguous with the forest of Mawai range of Madhya Pradesh and Kawardha division of Chhattisgarh.

Considering the importance of Phen Wildlife Sanctuary, particularly on account of its geographical location, it's was found essential to have an understanding of present status of tiger, co-predators, and prey density in the sanctuary in order to have a better management plan towards their protection. It can be regarded as a stepping stone or potential habitat which can provide a safe path between Kanha Tiger Reserve and Achanakmar Tiger Reserve (Ravan *et al.*, 2005).

3. METHODS

The field work was carried out from November 2012 to February 2013. Prior to field exercise, a training workshop was also conducted for the field staff on camera trapping and line transects surveys.

3.1 Field Survey

Camera trapping in mark-recapture framework was used to assess the large carnivore abundance. In order to have best results, suitable camera trap locations were decided on the basis of secondary information gathered from forest department staff on presence of large carnivore in the study area. This information was further supported by the result of reconnaissance survey conducted in all the beats by trained biologists. In each beat 15 km of survey route was followed and hand held Global Positioning System (GPS) were used to record signs such as scats, scraps, claw marks, pugmarks, scent marks, scratch marks etc. that indicate use of sites by large carnivores.

The entire sanctuary area (110.74 sq. km) map was overlaid by 4 (2x2 km) sq km grid. Out of 57 probable locations identified from the reconnaissance survey, 26 locations were selected for setting camera traps. Camera traps were placed in these best 26 locations within the grids to avoid large gaps (Figure 4) and to ensure that no animals had a zero probability of being photo captured. At each camera trap station, two camera units

Figure 4: Setting up camera traps

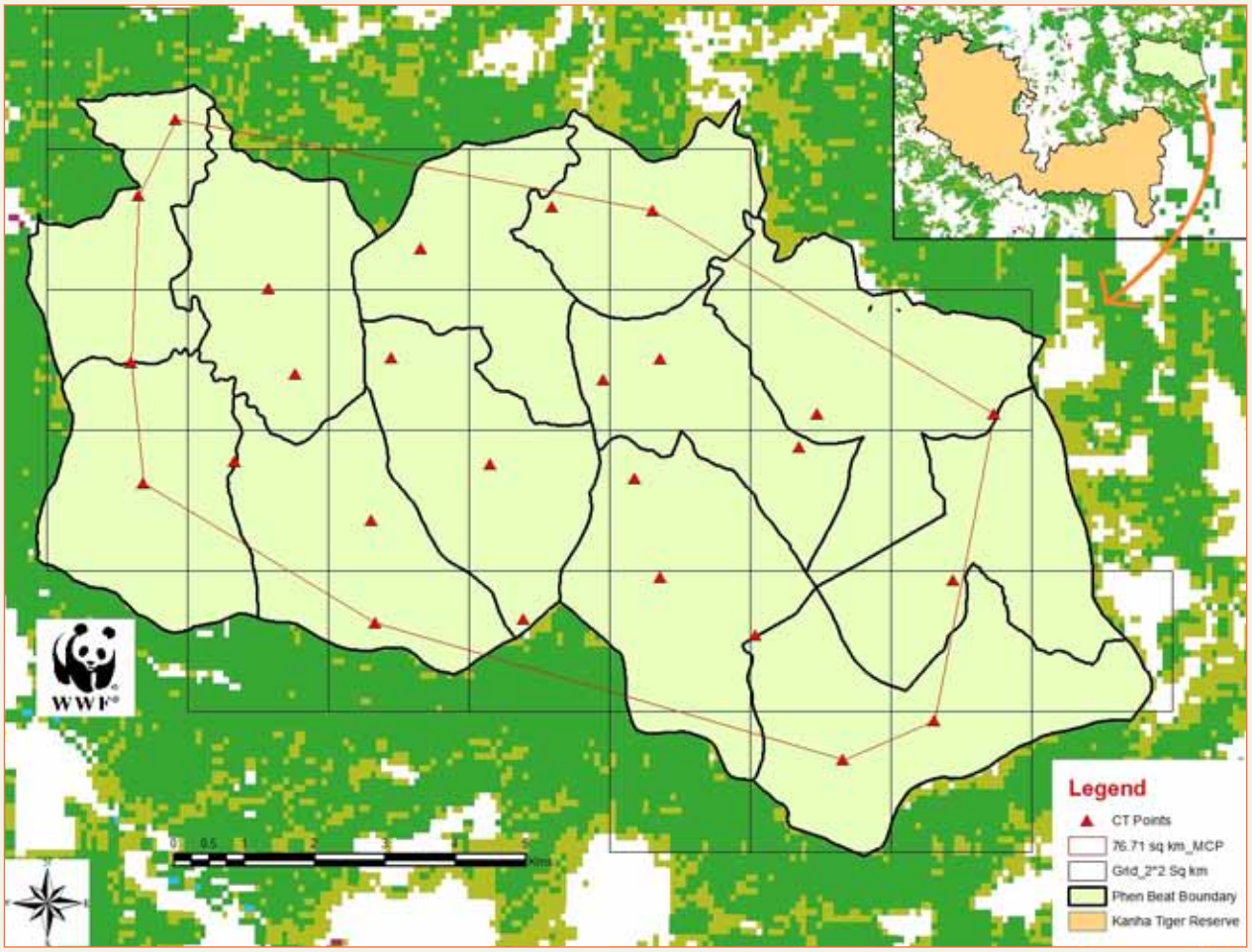
Photo credit: Jyotirmoy Jena, WWF-India

were mounted either on trees or on poles on both sides of the trail or path in such a way that both flanks of the animal get captured. Cuddeback infrared and flash cameras were used for this study and cameras were kept in minimum time delay. The distance between any two camera traps stations varied from 1.75 to 2.15 km. All the cameras were routinely checked for battery status, camera functioning and copying of pictures from memory cards on a gap of three days.

The camera trapping exercise was conducted between 22nd of December 2012 to 4th of February 2013. All the cameras were kept functional for 24 hours a day (also defined as a sampling occasion) and the survey was conducted for a sampling period of 46 days.

The photo captured tiger and leopards were identified by carefully examining the stripe and rosette pattern respectively on flank, limbs and tail. All identified animals were provided a unique identification number (e.g. L1M, L2F for leopards and T1M for tiger).

Figure 5: Camera trap locations in Phen wildlife sanctuary



For estimation of prey density inside the sanctuary, distance sampling method (Buckland et al. 1993, Burham et al. 1980) was used. Line transects were previously marked by forest department in each beat and we used the same transects for this exercise (Figure 7). Each line transect of fixed length (2 kilometers) was walked three times early in the morning. We recorded the number of animals sighted, sighting angle (using a see-through compass) and distance of animal cluster from the observer (using laser range finder).

Figure-6: Chital in Phen wildlife sanctuary

Photo credit: Jyotirmoy Jena, WWF-India

Figure-7: Map of Phen Wildlife Sanctuary showing line transects

3.2 Data Analysis

3.2.1 Abundance estimation

A single male tiger (T1M) and 17 different leopard individuals were photo captured and recaptured from the study. Tigers were excluded from data analysis due to paucity of sufficient data. The capture data for individual leopards were developed in a standard matrix format and used for analysis. The program MARK (Version 6.2) was used to estimate abundance of leopard population using capture histories of the observed individuals. Since the sampling period was only for 45 days, we assumed the population was closed (Karanth and Nichols, 1998). Density of leopard was estimated using spatially explicit capture recapture model (SECR) using the program DENSITY (Thapa *et al.* 2014).

3.2.2 Prey density estimation

Distance sampling by line transect method (Burnham *et al.,* 1980; Buckland *et al.,* 1993) was used to estimate densities of prey species in the study area. This method has been widely applied to estimate densities of prey species in tropical forests (Karanth and Sunquist, 1992, 1995; Biswas and Sankar 2002; Bagchi *et al.* 2003; Majumder *et al.,* 2012). Transects were walked early in the morning in the first three hours after the sunrise when the animals are most active (Schaller, 1967). Program DISTANCE (Version 6.0) was used to analyze the line transect data (Thomas *et al.*, 2010). The fit of possible alternative models to each dataset was done using Akaike's information criterion (AIC) value and goodness of fit tests generated by the program DISTANCE and the best possible model was selected.

4. RESULTS

The total sampling effort of 1196 trap nights (26 camera trap stations, each operating for 46 occasions) resulted in photo capturing 17 individual leopards and one tiger (6 left flanks and 3 right flanks) capture (Table 1). Besides leopards and tiger, the camera trap also recorded other carnivore presence such as wild dogs and jackals. Photographs of sloth bears, rattle, pangolin, gaur, chital, barking deer, sambar and gaur were also captured in the camera traps.

Table 1: Summary of camera trapping in Phen wildlife sanctuary

Session	46 days
Camera Points	26
Trap Nights	1196
Tiger	1
Leopards	17

4.1. Leopard Population

Since more left flank pictures of leopard available, the same were used for preparing the capture history matrix and analysis. However we used both flank, right as well left flank for individual identification where ever available to ensure better individual identification. The total sampling effort yielded 17 unique individual of leopards with 73 no of recaptures (Male 5, Female 11 & Unidentified 1). Out of 17 individual, 15 were recaptured (88.2%). We also captured one leopard with two cubs in one of our camera traps. The capture probability (p-hat) of leopard was 0.10 for right flank. The model selection procedure in MARK rated M_h Jacknife as the most appropriate model. The population was estimated at 19 individuals with a standard error of 2.18 with a confidence interval of 18 -28 (Table 2).

Table 2: Results of leopard abundance using program MARK in Phen Wildlife Sanctuary

FLANK	MODEL	N-hat	S.E.	95% CI	p-hat
Left	Mh Jackknife	19	2.18	18-28	0.1030

N-hat – Population estimate, S.E. - Standard, CI – Confidence Interval

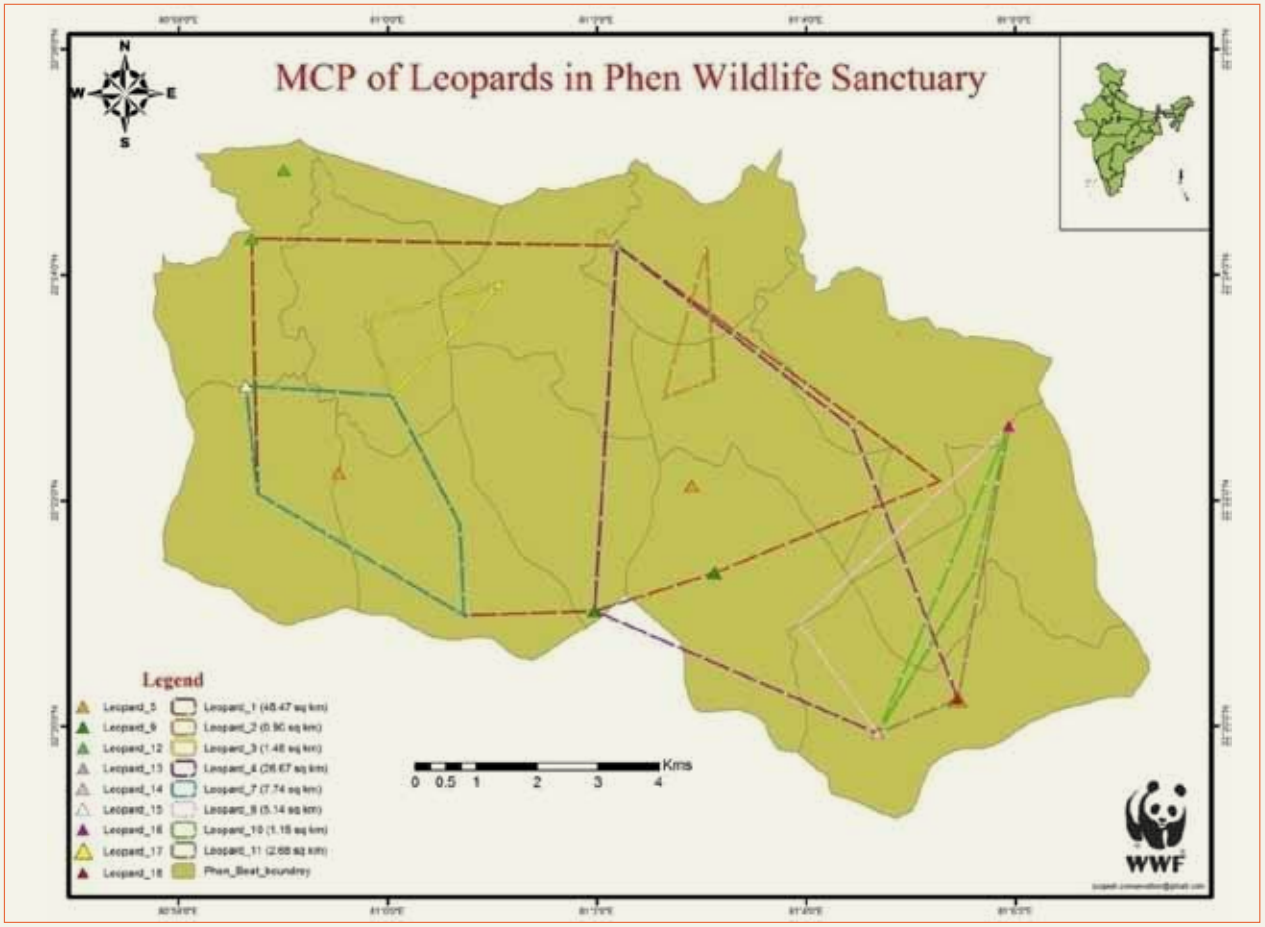


Figure 9: MCP of leopards in Phen wildlife sanctuary

4.1.1 Density estimate of Leopard

The estimated density of leopards in Phen from spatially explicit capture-recapture analysis is 6.86 with a standard error of ±1.69 (Table-3).

Table 3: Estimated density of leopards in Phen wildlife sanctuary using program DENSITY

Variables	Estimation	Standard Error
Camera points	26	-
Effective trapping area (km²)	76.72	-
No. of Trap Nights	1196	-
Unique Individual (Mt+1)	17	-
Population Estimate (N)	19	2.18
D- MLSECR	6.86	1.69

N -The best fit model is Mh Jackknife, D – MLSECR (Maximum likelihood Spatially Explicit Capture Recapture) Based on Half Normal model.

4.2 Density Estimate of Prey Species

Table 4: Showing estimated density of different prey species in Phen wildlife sanctuary

Fifteen line transects of 2 km length were walked two to three times resulting into a total effort of 92 kilometres. The estimated prey species densities are given in Table-4.

Species	ESW	DS±SE	E(S)±SE	D±SE	%CV	95% Confidence Interval	
						Lower	Upper
Barking Deer	41.24	2.50±0.48	1.18±0.60	2.97±0.60	19.50	1.96	4.49
Sambar	41.87	3.11±0.98	1.95±0.24	6.09±2.08	34.14	3.09	12.12
Gaur	70.43	0.69±0.28	3.59±1.25	2.49±1.33	53.44	0.88	7.07
Wild Pig	50.00	2.28±0.51	8.78±1.66	20.05±5.88	29.34	11.21	35.84
Chital	95.00	0.18±0.94	5.33±0.88	0.96±0.53	54.87	0.32	2.86
Chowsingha	32.39	0.53±0.59	1.00	0.59±0.59	111.27	0.75	3.43
Peafowl	38.06	1.42±0.42	2.15±0.47	3.08±1.13	36.93	1.47	6.43

DS - estimate of density of clusters, E(S) - estimate of expected value of cluster size, D - Estimate of number of animals in specified area, ESW - for line transects, effective strip width, % CV- Percent Coef. of Variation

Wild pig was found to be the most abundant (20.05±5.88) prey species in Phen wildlife sanctuary followed by sambar (6.09±2.08), peafowl (3.08±1.13), barking deer (2.97±0.60) and gaur (2.49±1.33). Chital (0.96±0.53) and chowsingha (0.59±0.59) were found to be relatively low in density.

A female Sambar deer in Phen sanctuary

Photo credit: Jyotirmoy Jena, WWF-India

5. DISCUSSION AND CONCLUSION

The current study provides a reliable baseline estimate of leopard as well prey density in the Phen wildlife sanctuary. Phen sanctuary though treated as a satellite core of Kanha tiger reserve, the tiger presence in the sanctuary is not same as Kanha. Sporadic tiger presence has been recorded for past couple of years (personal discussion with staffs). The present study was able to photo capture a tiger from this sanctuary for the first time. The reason for tigers being non-resident in Phen could be attributed to loss of prey and disturbances in recent past due to several number of cattle camps inside the sanctuary. Similar reasons were found in other areas where tiger presence was low due to heavy anthropogenic pressures (Harihar et al., 2009).

Baseline abundance and density estimates for large carnivores are essential for monitoring effectiveness of conservation activities. This study recorded the density of 6.86 (±SE 1.69)/100 sq km leopards in Phen wildlife sanctuary which is high as compared to some other protected areas (Table 5).

Table 5: Leopard density estimates from different habitat types based on spatially explicit capture-recapture (SECR) using maximum likelihood (SECR-ML)

Site	Habitat type	Density estimate (SECR-ML)	Source
Sariska Tiger Reserve	Dry deciduous forest	7.1 (±SE 2.0)	Mondal *et al.*,2012
Satpura Tiger Reserve	Dry and moist deciduous forest	4.04 (±SE 1.37)-7.21(±SE 3.21)	Edgaonkar 2008
Mudumalai Tiger Reserve	Subtropical dry deciduous forest	13.41 (±SE 3.15)	Kalle *et al.*, 2011
Manas National Park	Alluvial floodplain and sub tropical forest	3.40 (±SE 0.82)	Borah *et al.*, 2014
Parsa Wildlife Reserve	Subtropical dry deciduous forest	3.7 (±SE 0.85)	Thapa *et al.*, 2014
Phen Wildlife Sanctuary	**Tropical moist dry deciduous**	**6.86 (±SE 1.69)**	**Present study**

Though it is evident from the study that Phen harbours high density of leopard, prey density was found to be low (Table 6) as compared to Kanha. Though, both the areas are managed by Kanha tiger reserve, we assume that inviolate habitat types as well quality and protection measures is playing a critical role in supporting the prey density.

Table 6: Prey density for Kanha tiger reserve and Phen wildlife sanctuary

Species	Kanha*	Phen
Chital (*Axis axis*)	31.14 ± 4.57	0.96±0.53
Sambar (*Rusa unicolor*)	7.92 ± 1.02	6.09±2.08
Wild Pig (*Sus scrofa*)	5.33 ± 0.95	20.05±5.88
Gaur (*Bos gaurus*)	5.5 ± 1.41	2.49±1.33
Barking deer (*Muntiacus muntjak*)	2.11 ± 0.26	2.97±0.60

* Awasthi et al., 2014

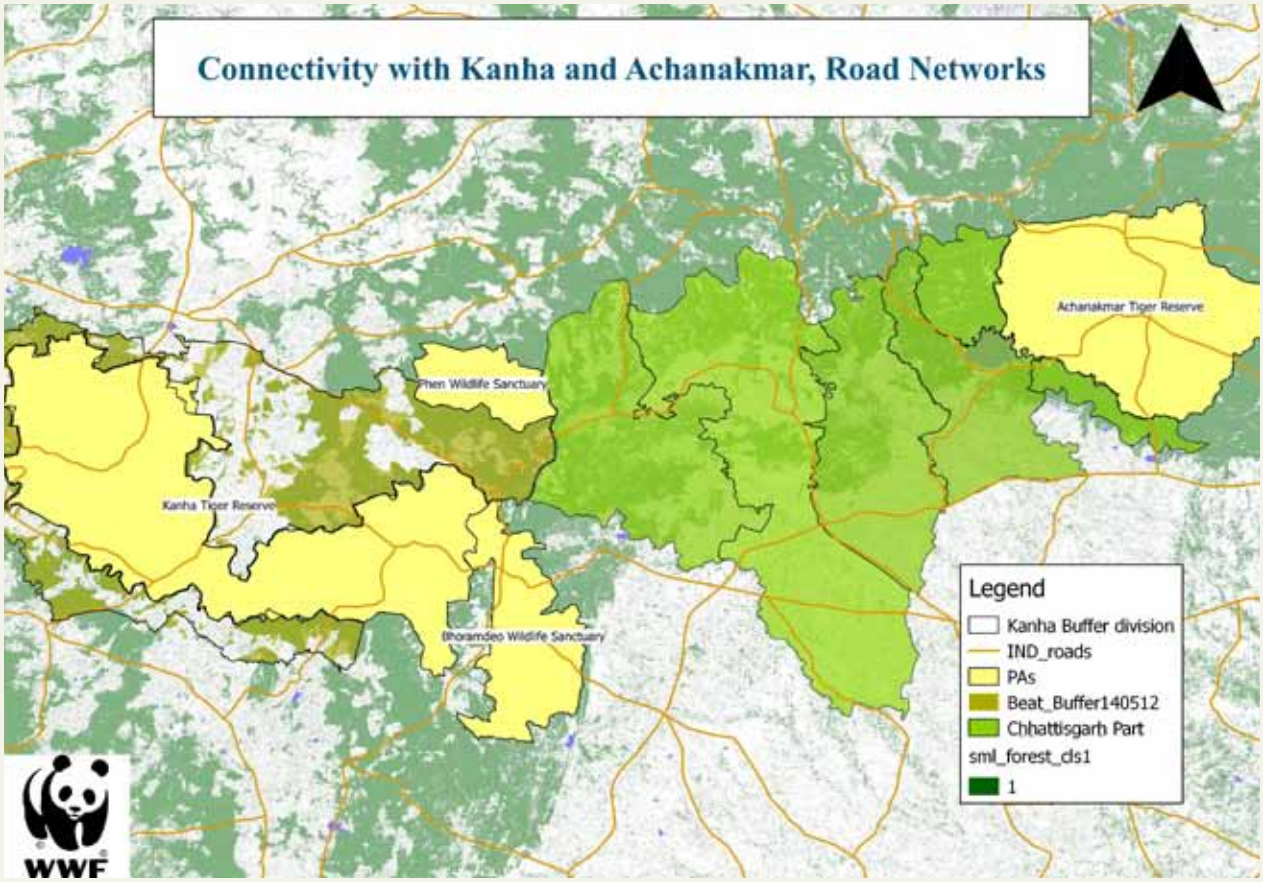
Kanha which is devoid from any kind of human disturbances in the core area has been in the center of conservation focus. Phen sanctuary which is much smaller in size has undergone tremendous pressure from illegal cattle camps. The last human settlement was relocated during the study period i. e. in 2013. This combined with anthropogenic and severe grazing pressure could be a reason for such low prey density. Low density of large and medium sized prey may not be sufficient enough to support tigers for a long period. It would be interesting to see whether the relocation of villages and subsequent changes in habitat quality would be effective in bringing back the prey population, which ultimately would also determine the tiger recovery process in the region.

5.1 Recommendations

As evident Phen sanctuary plays a critical role in the Kanha-Achanakmar area as stepping stone corridor due to comparatively better prey base and protection regime compared to the rest of the corridor areas. As mentioned earlier, Phen sanctuary, Kanha tiger reserve in Madhya Pradesh and Bhoramdeo sanctuary in Chhattisgarh are connected by Motinala range of Madhya Pradesh and Kawardha range of Chhattisgarh. However, to maintain its current important function for the Kanha-Achnakmar corridor following management recommendations are provided.

- The north-west boundary of Phen sanctuary (adjacent to Chhattisgarh state; Taregaon Forest Range) (Figure 9) has to be secured from illegal felling and cattle grazing by establishing permanent barrier and carrying out joint patrolling with Chhattisgarh forest department.
- Prey density especially chital and gaur, as well other prey species, in Phen is very low in comparison to Kanha. Hence development of grasslands for prey is to be considered to support such prey population and which would thereby help in sustaining large carnivores in the sanctuary.
- Phen sanctuary is connected to Kanha tiger reserve (which is a source population) through the Motinala range of territorial as well buffer division. This connectivity is very much essential and needs to be maintained for tiger dispersal and ensuring

Figure 10: Connectivity of Phen wildlife sanctuary to Kanha and Achanakmar tiger reserve



the functionality of the entire corridor. We would recommend Motinala range to be declared as a critical tiger habitat.

- National Highway 12A cuts the Kanha-Phen connectivity through Motinala range. But it is also one of the important road connecting Madhya Pradesh and Chhattisgarh. Looking at the sensitivity of the issue we would recommend that any major developmental activities planned along the stretch of this highway should be done taking into account with proper 'green and smart infrastructure' mitigation measures.
- As evident from the study, Phen currently have high density of leopards. With better management interventions and protection, combined with increase in prey population might result into conflict cases with human in future. Hence continuous monitoring of existing conflict cases, if any, and mechanism to timely payment in such cases is necessary.

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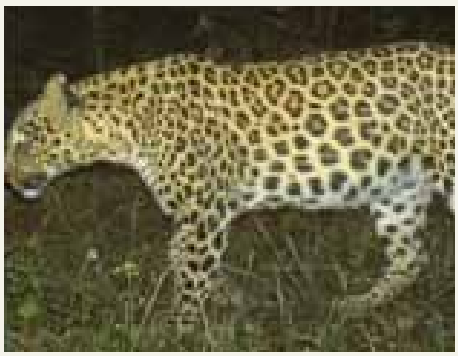
ANNEXURE-1

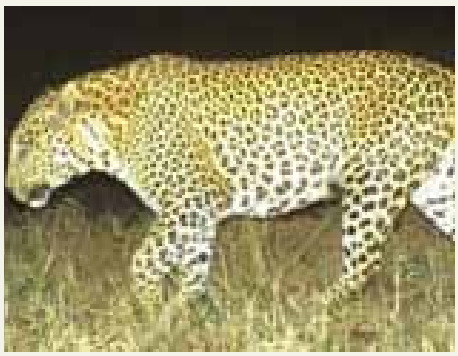
Camera trap pictures of Leopards & Tiger

LP-1



LP-2

LP-3



LP-4

LP-5

LP-6

LP-7

LP-8

LP-9

LP-10

LP-11

LP-12

LP-13

LP-14

LP-15

LP-16

LP-17

TF-1 (Left and right flank)

ANNEXURE-2

Camera trap pictures of other animals









Why we are here
To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

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