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**Abstract:** The present report forms a part of the All India Tiger Monitoring exercise undertaken on the direction of the Ministry of Environment and Forests by the Wildlife Institute of India in association with National Tiger Conservation Authority, MoEF, Government of India, and the State Forest Departments. As a part of this process, preliminary findings on the status, and distribution of tigers, co-predators and prey in the States of Rajasthan, Madhya Pradesh, Maharashtra, Chattisgarh, Andhra Pradesh and Orissa are presented. Tiger population estimates are provided for the States of Rajasthan, Madhya Pradesh, Maharashtra and Chattisgarh. For the remaining States of Andhra Pradesh, Jharkhand, and Orissa tiger population estimation is in progress and estimates will be provided at a later date. The current monitoring system for tigers, co-predators, prey and their habitat transcends beyond generating mere numbers. It is a holistic approach which uses the tiger as an umbrella species to monitor some of the major components of forest systems where the tiger occurs in India. The data and inferences generated by the system would not only serve as a monitoring tool but also as an information base for decision making for land use planning. It provides an opportunity to incorporate conservation objectives supported with a sound database, on equal footing with economic, sociological, and other values in policy and decision making for the benefit of the society. After the Sariska debacle, this system with a few modifications was recommended as a monitoring tool for the entire country by the Tiger Task Force. Central India harbors a reasonably large proportion of the country's tiger population. This is attributed to a good forest cover (406,580 km<sup>2</sup>), reasonable number (179) of good protected areas with a wide coverage and 12 tiger reserves. For estimating the distribution, extent and relative abundances of tigers, other carnivores, and ungulates data were collected in simple formats on carnivore signs and ungulate sightings in forested areas of the region within each forest beat. Data were also recorded on indices of human disturbance and habitat 2 parameters. These constituted the Phase I data and were collected by the State Forest Department between November 2005 to February 2006 after appropriate training (Appendix 1). A total effort of 571,600 man days was expended to sample 35725 beats, with 535,875 km of carnivore sign survey walks and 214,350km of transect walks done within the Central Indian and Eastern Ghat Landscape. Phase II data consisted of independent spatial and aspatial attributes that were remotely sensed, obtained from public domains, or purchased by the Wildlife Institute of India. These data included variables that likely influenced distribution and abundances of wildlife e.g. human density, livestock densities, forest fragmentation statistics, annual precipitation etc. These data were used to model and explain patterns of wildlife / tiger distribution observed by Phase I. Digitized beat maps of Madhya-Pradesh and Andhra-Pradesh were used to spatially link the Phase I data in a Geographic Information System. In the absence of digitized beat maps, hand held Global Positioning System units were used in the remaining states for determining the beat locations. These were mapped and Phase I data of these states attached to these coordinates in a GIS. The Phase I data collected by the forest department was verified in select cluster of beats by a team of researchers. In the same beats absolute densities of tigers and tiger prey was estimated by mark-recapture using camera traps and by distance sampling. This data set is referred to as Phase III and was used to model relationships between indices and absolute abundance, of tigers. This relationship was then used to predict tiger densities from Phase-I and Phase-II data. Tiger Habitat suitability was computed from verified tiger presence areas using Logistic Regression analysis from Phase I and Phase II data. Phase-I tiger distribution was compared with modeled tiger habitat suitability and discrepancies listed for further field investigation. The entire process from conceptualization to implementation (Phase I to Phase III) was transparent and open to scrutiny by independent National and International Peers. A public debate was invited over email by the Tiger Task Force on the methodology which was also critiqued by International peers 3 selected by the IUCN and the MoEF (Appendix 2). Independent National and International observers participated in field data collection and compilation. This process of review greatly refined the methodology and data collection procedure.

# Status of the Tiger and Co-Predators in the Central Indian Landscape

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# **STATUS OF THE TIGERS AND CO-PREDATORS IN THE CENTRAL INDIAN LANDSCAPE**

## **A Preliminary Report**

**National Tiger Conservation Authority  
Ministry of Environment & Forests**

and



**भारतीय वन्यजीव संस्थान  
Wildlife Institute of India**

2007

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## **PREFACE**

For designing, implementing, and evaluating the success of any conservation program for an endangered species, it is imperative to monitor the status, distribution, and trends in the populations of the target species. The monitoring program should be transparent in its approach, and holistic - addressing an array of parameters related to the survival of the species by using the blend of the best available science and technology. In case of the tiger our National animal, the only form of country wide monitoring was based on the pugmark system which depended on identifying individual tigers by experts. The system generated a total count of tigers in the states and in the country, but gave no indication of spatial occupancy, population extent and limits, connectivity between populations, habitat and prey conditions which constitute the crucial elements for the continued survival of the tiger in a landscape. Realizing the shortfalls of the pugmark monitoring system in keeping pace with modern conservation biology needs for a monitoring scheme, the Project Tiger Directorate commenced a project in collaboration with the Wildlife Institute of India and the Forest Department of Madhya Pradesh in 2003 to evolve a monitoring program for “Tigers, Co-predators, Prey and their Habitat” in the Satpura-Maikal Landscape. This pilot project evolved field friendly data collection protocols in consultation with field managers and scientists. The monitoring program uses remote sensing, geographic information system, and global positioning system technology in combination with high resolution spatial data and field data, based on sign surveys, camera trapping, and distance sampling, to effectively monitor tiger and prey populations. After the Sariska crisis, the Tiger Task Force recommended the implementation of this monitoring scheme for all tiger occupied landscapes. The Project Tiger Directorate (currently the National Tiger Conservation Authority) synergized this mammoth task by liaising with the State Forest Departments to generate the required field data in appropriate formats and the Wildlife Institute of India to impart training in field data collection, and for estimating tiger and prey densities for the Nation wide monitoring program.

Dr. Prodipto Ghosh, Secretary (retd.), Ministry of Environment and Forests took personal interest in ensuring the success of the program in the true spirit of an independent scientific endeavor. Shri P. R. Sinha, Director and Dr. V. B. Mathur, Dean, Wildlife Institute of India provided the conditions for fostering the working environment essential for completing this task. We acknowledge their contribution with gratitude. Dr. K Sankar, helped coordinate the logistics and recruitment of researchers at the Wildlife Institute of India. Faculty members of the Wildlife Institute of India are acknowledged for assisting in various field training workshops (Appendix 1). Chief Wildlife Wardens, and participating forest officials are acknowledged for successful implementation of the Phase I field data collection and compilation. Shri K. Nayak, Field Director Kanha Tiger Reserve is acknowledged in particular for galvanizing field managers and conducting training. The enthusiasm and sincerity of the frontline staff in collecting field data which is the backbone of this monitoring program is acknowledged. Estimating absolute densities of tigers and prey with the needed accuracy and precision is by no means an easy task, the research team (Appendix 1) of the Wildlife Institute of India accomplished this within the stipulated timeframe by sincere and untiring efforts. We are grateful to the comments, critiques, and suggestions by the National, International peers (Appendix 2), and others who communicated with us in helping improve this monitoring program.

----- The Authors

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## **Introduction**

The present report forms a part of the All India Tiger Monitoring exercise undertaken on the direction of the Ministry of Environment and Forests by the Wildlife Institute of India in association with National Tiger Conservation Authority, MoEF, Government of India, and the State Forest Departments. As a part of this process, preliminary findings on the status, and distribution of tigers, co-predators and prey in the States of Rajasthan, Madhya Pradesh, Maharashtra, Chattisgarh, Andhra Pradesh and Orissa are presented. Tiger population estimates are provided for the States of Rajasthan, Madhya Pradesh, Maharashtra and Chattisgarh. For the remaining States of Andhra Pradesh, Jharkhand, and Orissa tiger population estimation is in progress and estimates will be provided at a later date.

The current monitoring system for tigers, co-predators, prey and their habitat transcends beyond generating mere numbers. It is a holistic approach which uses the tiger as an umbrella species to monitor some of the major components of forest systems where the tiger occurs in India. The data and inferences generated by the system would not only serve as a monitoring tool but also as an information base for decision making for land use planning. It provides an opportunity to incorporate conservation objectives supported with a sound database, on equal footing with economic, sociological, and other values in policy and decision making for the benefit of the society. After the Sariska debacle, this system with a few modifications was recommended as a monitoring tool for the entire country by the Tiger Task Force.

Central India harbors a reasonably large proportion of the countries tiger population. This is attributed to a good forest cover (406,580 km<sup>2</sup>), reasonable number (179) of good protected areas with a wide coverage and 12 tiger reserves.

For estimating the distribution, extent and relative abundances of tigers, other carnivores, and ungulates data were collected in simple formats on carnivore signs and ungulate sightings in forested areas of the region within each forest beat. Data were also recorded on indices of human disturbance and habitat

parameters. These constituted the Phase I data and were collected by the State Forest Department between November 2005 to February 2006 after appropriate training (Appendix 1). A total effort of 571,600 man days was expended to sample 35725 beats, with 535,875 km of carnivore sign survey walks and 214,350km of transect walks done within the Central Indian and Eastern Ghat Landscape.

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## **Modeling Tiger Occupancy and Densities**

Relationships between verified tiger occupied forested beats, unoccupied beats and Phase-I data, and Phase-II data were developed to understand the underlying factors that make a habitat patch suitable for tigers. Several factors like prey encounter rates, wildlife dung index, canopy cover, anthropogenic disturbance indices life signs of lopping wood cutting, grass cutting, livestock trails, people seen on transects and livestock dung were significantly different between areas occupied by tigers and unoccupied forests. Phase –II information like distance from roads, forest patch size, distance from night lights, and core area size attributes were significantly different between tiger occupied forests and unoccupied patches. This information was then used in a logistic regression framework to validate reported tiger occupancy. Grids with deviations were highlighted for further field verification.

Tiger densities (tigers >1.5 years) obtained from camera traps were used to develop predictive models for tiger density estimation in tiger occupied forests. Principle component analysis was used to extract parsimonious, independent information from Phase-I and II data. Tiger densities (as dependent variable) were modeled using Multiple Linear Regression with the Principle Component stores as the independent variables. The principle components that significantly contributed to explaining variation in tiger densities were primarily those containing information on tiger sign indices, prey indices, anthropogenic disturbances and wilderness values.

## **Rajasthan**

Rajasthan has a forest cover of 21,292 km<sup>2</sup> comprising 6% of the geographic area of the state. There is only a single tiger population in Rajasthan in the Ranthambore Tiger Reserve. The contiguous forest patch harbouring this population is 496 km<sup>2</sup> with a recorded tiger occupancy in 344 km<sup>2</sup>. The population is geographically isolated with “stepping stone” connectivity through Kailadevi Sanctuary to Kuno Wildlife Sanctuary in Madhya Pradesh. This connectivity if revived can serve as a conduit for dispersing tigers to repopulate Kailadevi as well as Kuno. Ranthambore tigers have been reported to disperse through the narrow “ridge top” forest connectivity in the districts of Kota and Bundi towards the South-West. This corridor can potentially connect the forests of Chittorgarh and Mandsaur with the tiger source of Ranthambore.

**Population Size: The total population of tigers in the state of Rajasthan was estimated to be 32 with a standard error range of 30-35 tigers.**

### **Recommendations -**

- (1) Consolidate the area covered by the tiger reserve, so as to increase the tiger occupancy throughout forested habitat in Sawai Mansingh and Kailadevi Sanctuaries. This would permit the tiger population to increase and tend towards becoming a self sustaining viable unit.
- (2) Improve the potential habitat connectivity between Ranthambore, Kuno Wildlife sanctuary and reserve forests of Sheopur district to form a viable Arid zone western most tiger conservation unit in India (Figure 1).

Good potential tiger habitat exists in Sariska Tiger Reserve where tigers became locally extinct in late 2004. The landscape consists of over 700 km<sup>2</sup> of forests. Parts of this forest also have a good prey base. The possibility of natural colonization by tigers of this landscape unit is remote as the closest source population of Ranthambore has no habitat connectivity with Sariska.

The area has potential for reintroduction through restorative measures and continued management of the introduced population by supplementation.

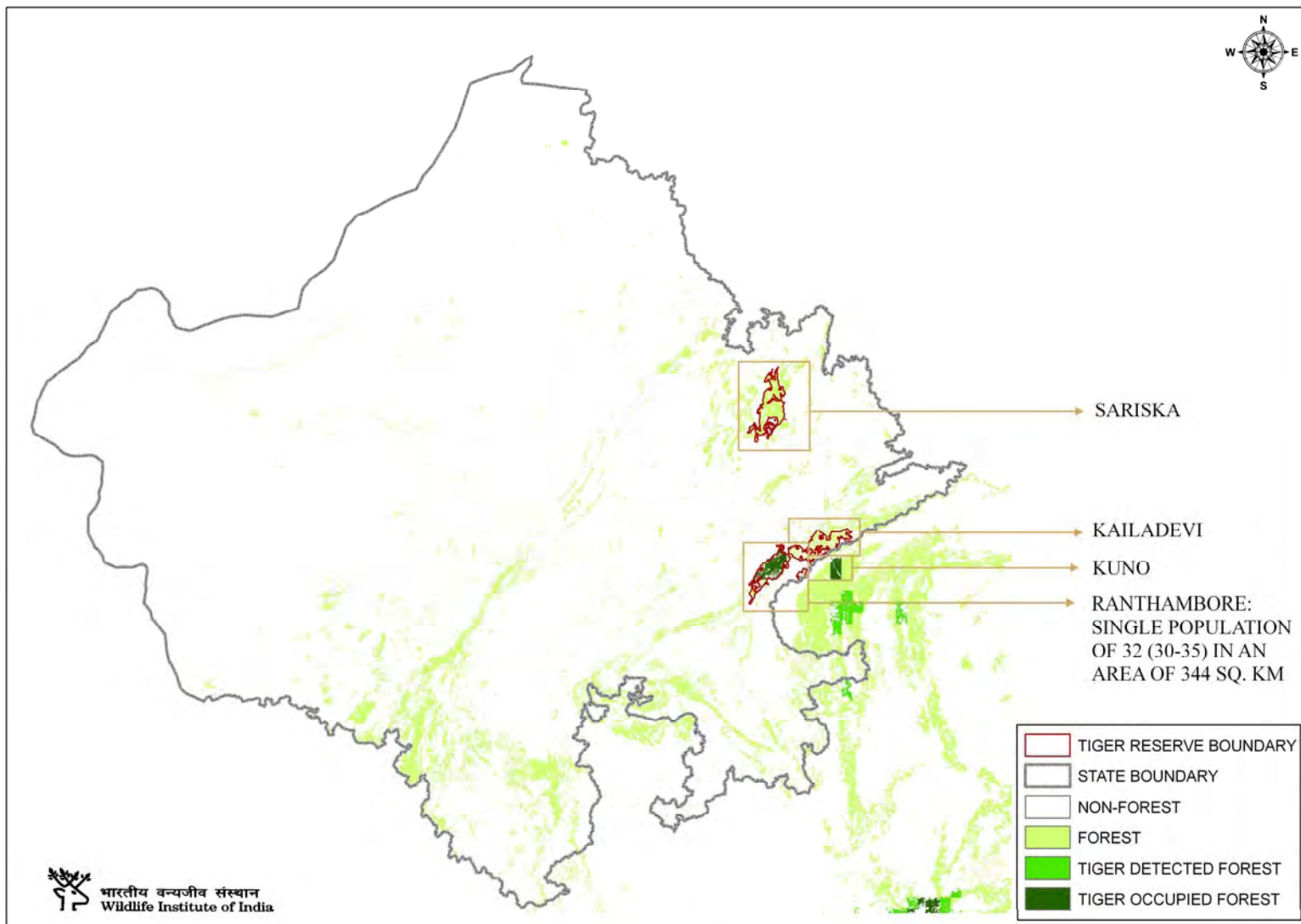


Figure 1: Tiger occupancy, population extent and potential habitat connectivity in Rajasthan.

## Madhya Pradesh

Madhya Pradesh has a forest cover of 80,717 km<sup>2</sup>, comprising 26% of the geographic area of the State.

Madhya Pradesh reported tiger presence in 15,614 km<sup>2</sup>, leopard presence in 34,736 km<sup>2</sup>, dhole presence in 28,508 km<sup>2</sup> and Sloth bear presence in 40,960 km<sup>2</sup> of forested habitat. Amongst prey species wild pig occupied 59,903 km<sup>2</sup> nilgai 41,704 km<sup>2</sup>, gaur 5,577 km<sup>2</sup>, chital 41,509 km<sup>2</sup>, and sambar 33,550 km<sup>2</sup> of forested habitats. The relict population of Barasingha was restricted to a single landscape of Kanha (231 km<sup>2</sup>).

Tigers were distributed in four major populations, namely the landscapes of

a) Kanha having a recorded tiger presence in 3,162 km<sup>2</sup>, supporting a population of 89 tigers ( $\pm 1$  se range 73-105).

b) Pench having a recorded tiger presence in 718 km<sup>2</sup> and supporting a population of 33 ( $\pm 1$  se range 27-39) tigers. The Kanha-Pench landscape is still a contiguous forest patch of 16,000 km<sup>2</sup>, having sporadic tiger presence recorded besides the 2 major source populations constituting about 7-12 ( $\pm 1$  se range) tigers.

c) Satpura landscape of 12,700 km<sup>2</sup> has its largest tiger population located in and around the Satpura Tiger Reserve with a tiger occupancy in 1,503 km<sup>2</sup> and supporting 39 ( $\pm 1$  se range 26-52) tigers. Five other smaller tiger populations occur, one towards the north-east of the tiger reserve and the other 4 between Satpura Tiger Reserve and Melghat Tiger reserve in Maharashtra. These populations harbour between 9-15 tigers.

d) Bandhavgarh landscape covers an area of 2000 km<sup>2</sup> and has a tiger occupancy in 1575 km<sup>2</sup>. The major tiger population is in and around the Bandhavgarh Tiger reserve comprising 47 ( $\pm 1$  se range 37-57) tigers

e) Panna landscape covers an area of 3500 km<sup>2</sup> and has 2 discrete tiger occupied areas of 787 and 187 km<sup>2</sup>. The larger population of Panna Tiger

reserve and its surrounds sustains 24 ( $\pm 1$  se range 15-32) tigers. The smaller population is a relict, comprising of 1-2 tigers likely sustained by north eastern dispersal of tigers from Panna.

There are eight small tiger populations in the State. These are either historical relicts or are sustained by dispersing individuals from the major populations. Habitats harboring these small tiger populations form crucial linkages for existence of metapopulation structure. It is essential to explore some means of providing an enhanced legal status or other mechanisms for conserving these areas and populations to ensure long term tiger survival in the larger landscapes.

Sheopur-Shivpuri population (3-6 tigers,  $\pm 1$  se range) has remnant linkages with the western most arid zone tiger population of Ranthambore, but has lost its connectivity with the Panna Tiger landscape. Jabalpur-Damoh-Sagar tiger population (14-23 tigers,  $\pm 1$  se range) historically formed the connecting link between Bandhavgarh and tiger populations on the Northern banks of the Narmada. Bandhavgarh's linkages through Nagod and Pawai to Panna are now severed. Relict tiger populations exist on the northern banks of Narmada forming the Raisen population consisting of 7-12 ( $\pm 1$  se range) tigers. These populations have no linkages to any major source population and their future seems bleak. The remnant tigers in Betul-Hoshangbad-East Nimar form an intermediate presence between two source populations the Satpura Tiger reserve in Madhya Pradesh and Melghat Tiger Reserve in Maharashtra. Few Tigers tenaciously hold their ground in the forests of Seoni-Balaghat intervening Kanha and Pench Landscape. This population forms a crucial linkage for the largest metapopulation unit in Central India connecting the populations of Kanha and Pench (Madhya Pradesh and Maharashtra). Scattered tiger presence is reported in Mandla district, these tigers are likely dispersing individuals from Kanha, Bandhavgarh and serve to genetically connect tiger populations of Eastern Madhya Pradesh to Chattisgarh (Achanakmar Sanctuary). Dispersing tigers from Bandhavgarh source sustain a sporadic tiger occupancy in the district of Shahdol and Sidhi forming potential linkages through Sanjay National Park to Palamau in Jharkhand.

**Population Size: Total tiger population in the State of Madhya Pradesh was estimated to be 300 with a standard error range of 228 to 364 tigers).**

**Conservation Recommendations:**

- 1) Manage the Kanha-Pench landscape and the Satpura-Melghat (Maharashtra) landscape within the framework of a metapopulation. This requires landscape level landuse planning targeted for each district harbouring connecting forests.
- 2) The Kanha tiger reserve buffer needs to be extended south-west in the tehsil of Baihar in Balaghat district so as to enhance the conservation value of this major source population.
- 3) Tiger habitat in Betul-Hausangabad-East Nimar needs protection and restorative management for enhancing the value of these forests for sustaining dispersing tigers from Melghat and Satpura Tiger Reserve and maintain connectivity between these 2 sources.
- 4) The contiguous forest North–East of Satpura Tiger Reserve in the tehsils of Parasia and Amarwara of Chindwara district need more protection and restorative management to enhance the source value of the Satpura Tiger Reserve. A unified administrative control of these forests would be beneficial.
- 5) The stepping stone connectivity forests (about 10 km stretch) in Parasia tehsil of Chindwara district that form the connecting link between Maikal and Satpura Landscape needs restoration and protection to reconnect these two major tiger occupied landscapes in MP.
- 6) The connecting forests North East of Bandhavgarh Tiger Reserve in the tehsil of Beohari, Jaisingh Nagar in Shadol district and Jopad banas tehsil of Siddhi District need protection and restorative management.



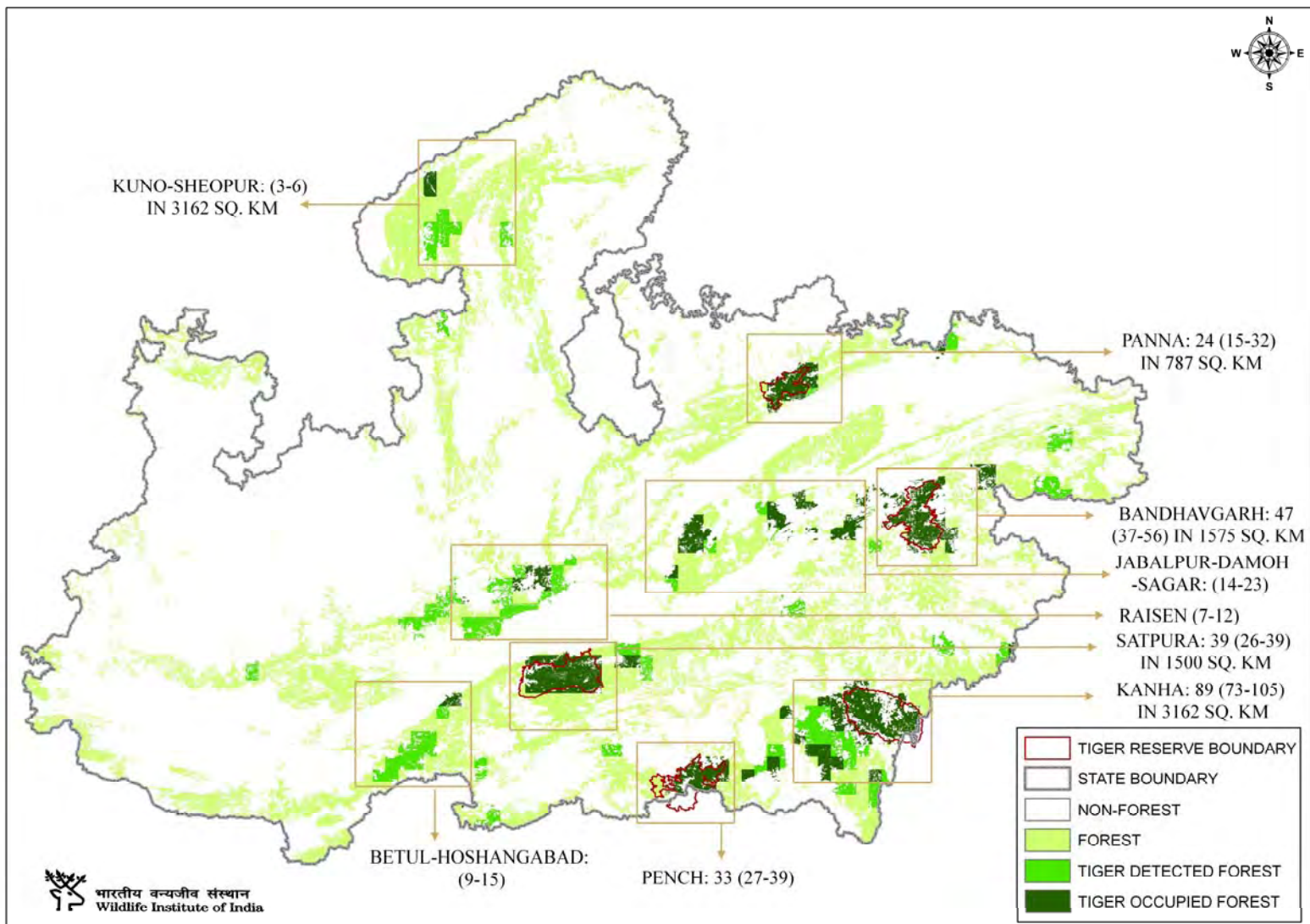


Figure 2: Tiger occupied forests, individual populations, their extents and habitat connectivity in Madhya Pradesh.

These forests will then serve as a conduit for dispersing tigers from the high density Bandhavgarh source and help repopulate Sanjay and Chhattisgarh forests.

- 7) Low density Tiger presence is distributed all along the forests on the Northern banks of Narmada extending from Jabalpur all the way to West Nimar. These tigers tenaciously hold their ground in spite of all odds. Urgent restorative actions to enhance protection, habitat quality especially in terms of prey availability are required for ensuring their survival in the future (Figure 2).

## Maharashtra

The state has a total forest cover of 53,619 km<sup>2</sup> with mapable (Table 3) tiger occupancy reported in 4,273 km<sup>2</sup>. Maharashtra reported leopard presence in 4,982 km<sup>2</sup>, dhole presence in 4,352 km<sup>2</sup> and Sloth bear presence in 6,557 km<sup>2</sup> of forested habitat. Amongst prey species wild pig were reported from 7,370 km<sup>2</sup>, nilgai 4754 km<sup>2</sup>, chital from 5,970 km<sup>2</sup> and sambar from 5,730 km<sup>2</sup> of forested habitat.

Tigers were distributed in three major populations, namely

a) Melghat comprising a part of the Satpura Landscape, having a recorded tiger presence in 1,828 km<sup>2</sup>, supporting a population of 30 ( $\pm 1$  se range 21-39) tigers. The tiger distribution in Melghat is contiguous with the population in Madhya Pradesh forming a meta population with the Satpura Tiger Reserve as the other source population.

b) Pench (Maharashtra) being contiguous with the forest patch of Pench Tiger Reserve in MP forming a part of the Maikal landscape, has a recorded tiger presence in 424 km<sup>2</sup> and supports a population of 19 ( $\pm 1$  se range 16-23) tigers, some of which it shares with MP.

c) Tadoba-Andhari landscape of 2000 km<sup>2</sup> has a tiger occupancy in 775 km<sup>2</sup> and supports 34 ( $\pm 1$  se range 27-41) tigers. This landscape has potential to serve as a source for the Navegaon-Indravati Landscape through the Northern forest patches in the Districts of Chandrapur, Garhchiroli and Bhandara. In the south stepping stone forest patches exist in the Tehsils of Gond Pipri and Sirpur.

Sporadic tiger presence of about 12-27 ( $\pm 1$  se range) tigers is recorded in the forests of Bhramपुरi, Garhchiroli, Nagbir, Chimur, and Ahiri tehsils. This possibly indicates habitat connectivity to populations in Indravati Tiger Reserve in Chattisgarh and the Northern forests of Anhdra Pradesh.

**Population Size: Total tiger population in the State of Maharashtra was estimated to be 103 with a standard error range of 76-131 tigers.**

**Conservation Recommendations:**

Tiger source populations of Melghat, Tadoba, and Pench need to be consolidated through enhanced protection and habitat management especially in forest areas surrounding these tiger reserves. This would increase the survival of dispersing tigers thereby increasing the tiger population and its effective source value. Interstate cooperation for management of Melghat and Pench is vital for the long term survival of the Satpura and Maikal Landscape tiger populations. Habitat connectivities of the Tadoba-Andhari population towards the north and south need protection and restorative management to maintain and enhance the value of this source for the larger landscape (Figure 3).

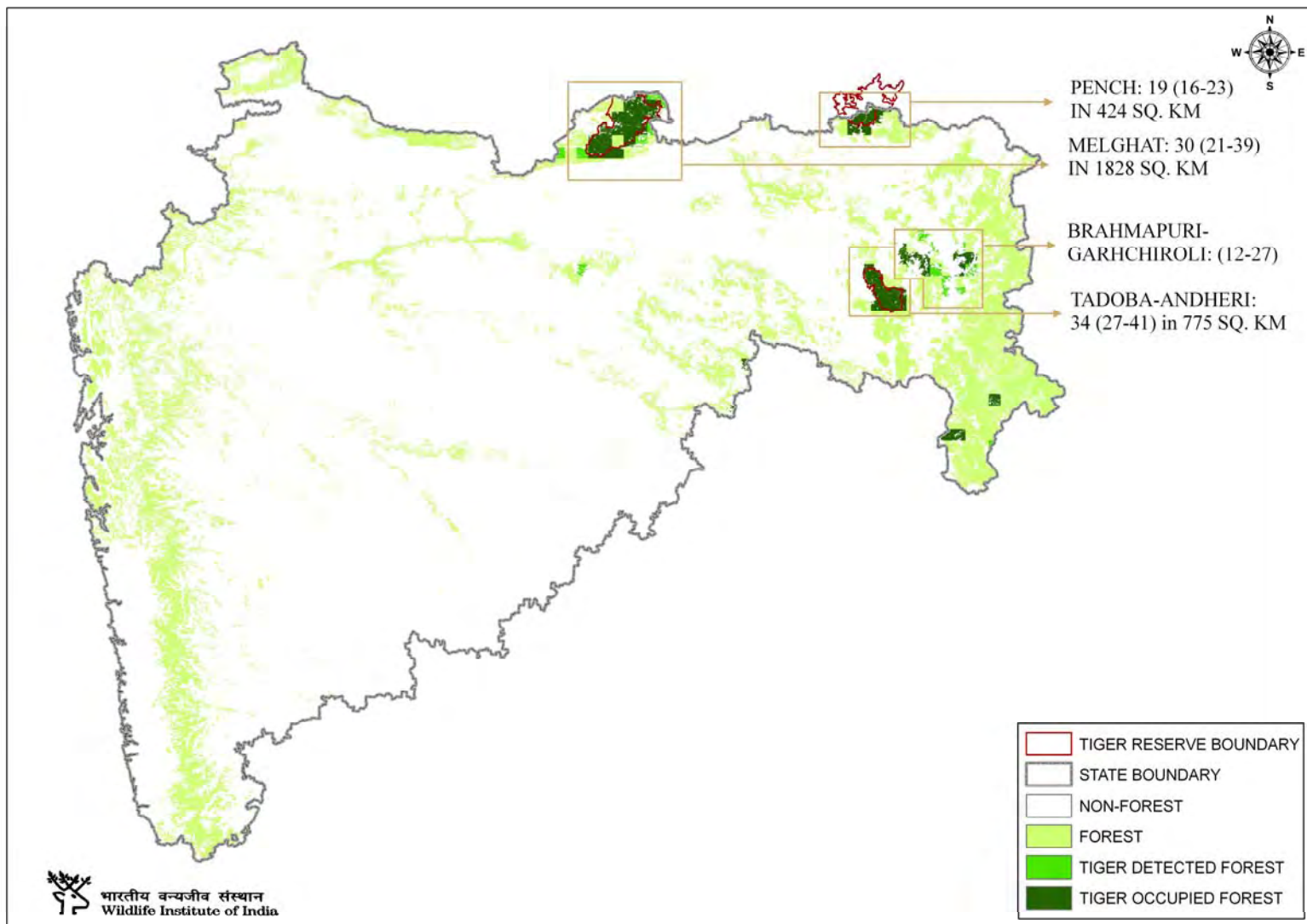


Figure 3: Tiger occupied forests, individual populations, their extents and habitat connectivity in Maharashtra.

## Chattisgarh

The state has a total forest cover of 27,967 km<sup>2</sup> with tiger occupancy reported in 3,609 km<sup>2</sup>. Chattisgarh reported leopard presence in 14,939 km<sup>2</sup>, dhole presence in 3,794 km<sup>2</sup> and Sloth bear presence in 20,951 km<sup>2</sup> of forested habitat. Amongst prey species wild pig were reported from 25,058 km<sup>2</sup>, nilgai 9,250 km<sup>2</sup>, chital from 18,540 km<sup>2</sup>, gaur from 3,369 km<sup>2</sup>, and sambar from 7,604 km<sup>2</sup> of forested habitat.

Tigers were distributed in three populations, namely the landscapes of

a) Achanakmar having a recorded tiger presence in 1,066 km<sup>2</sup>, supporting a population of 19 ( $\pm 1$  se range 18-22) tigers. Forested habitat of Achanakmar is a part of the Maikal landscape and is contiguous with the tiger habitat of Kanha-Pench landscape in Madhya Pradesh likely forming a meta population.

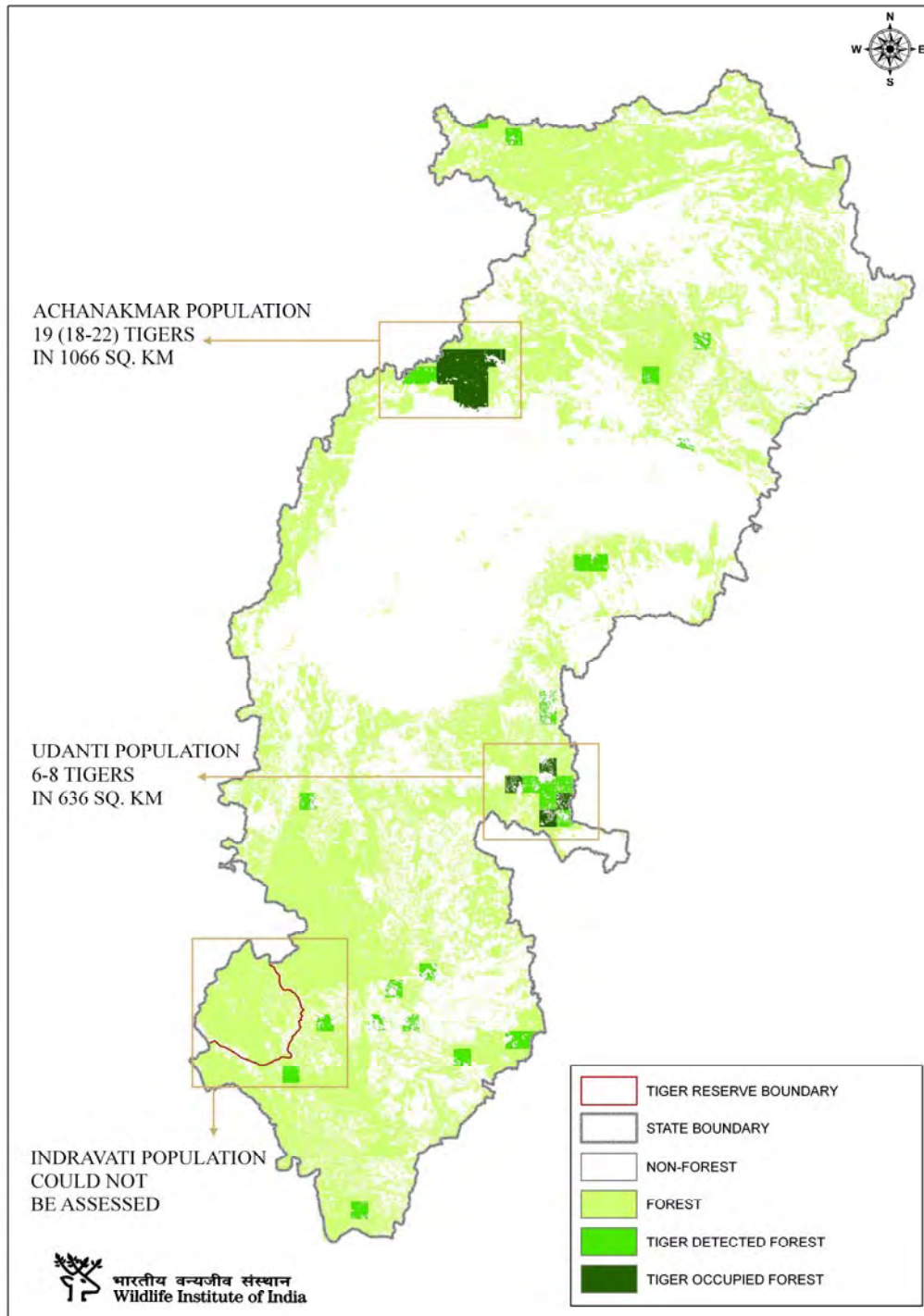
b) Few tigers (6-8,  $\pm 1$  se range) are recorded in the forests of Udanti having an occupancy of 636 km<sup>2</sup>. The habitat and tiger occupancy in this block is contiguous in Orissa with Sonabeda Wildlife Sanctuary and forms a part of the larger Indravati Landscape.

c) Indravati likely forms a major source in the largest intact habitat patch of 34,000 km<sup>2</sup>. It has habitat connectivity with tiger source populations of Tadoba, and Kanha and is also connected with tiger occupied forests in Northern Andhra Pradesh and Western Orissa. Unfortunately no information is available to assess the occupancy or population size of this important Tiger occupied landscape.

Sporadic tiger occurrences are recorded in Northern and Southern Chattisgarh (Figure 4).

**Population Size: The tiger population for the state of Chattisgarh (except Indravati) is estimated to be 26 with a standard error range of 23-28 tigers.**

**Figure 4: Tiger occupied forests, individual populations, their extents and habitat connectivity in Chattisgarh.**



**Conservation Recommendations:**

Tiger population status and associated threats for the Indravati Tiger Reserve needs to be assessed urgently as it is vital to sustain tiger occupancy of this large landscape. Achanakmar-Kanha (MP) and Udanti-Sonabeda (Orissa) linkages need to be sustained through protection and restorative management for long term survival of these populations.



## Andhra Pradesh

Andhra Pradesh comprises of two major disjunct landscape complexes namely the Godavari basin Landscape in the Northern portion of the state and the Eastern-Ghat Complex in the South Central part of the State.

The state has a total forest cover of 54,544 km<sup>2</sup> with tiger occupancy reported in 22,128 km<sup>2</sup>. Andhra Pradesh reported mapable leopard presence in 37,609 km<sup>2</sup>, dhole presence in 41,093 km<sup>2</sup> and Sloth Bear presence in 54673 km<sup>2</sup> of forested habitat. Amongst prey species wild pig were reported from 58,336.00 km<sup>2</sup>, nilgai 26526 km<sup>2</sup>, chital from 37,814 km<sup>2</sup>, gaur from 3,139 km<sup>2</sup>, and sambar from 33,159 km<sup>2</sup> of forested habitat.

In the part of the Central Indian highlands and Northern Eastern Ghats Landscape, Andhra Pradesh has four distinct tiger populations interconnected through forested habitat. These populations are :

- a) In the district of Adilabad having a tiger occupancy of 3900 km<sup>2</sup> distributed in 2 major blocks with a few sporadic occurrences.
- b) The second population is in the district of Karimnagar, Warangal and Khamam (West) having a tiger occupancy of 2200 km<sup>2</sup> in two blocks.
- c) The third population is in the district of Khamam (East), East Godavari, Vishakapatnam and Vijaynagaram having a tiger occupancy of 6000 km<sup>2</sup> distributed in two blocks.

Among the Southern Eastern Ghats the major tiger population is located in the Srisailem-Nagarjuna Sagar Tiger Reserve and adjoining forests in the districts of Kurnool, Parakasam, Chuddapah, Mahbubnagar and Guntur having a tiger occupancy in a single block of 7772 km<sup>2</sup>.

**Conservation Recommendations:**

The source population of tigers in Srisaillam needs to be fostered through preybase enhancement and protection so that it sustains a larger high density tiger population. This population can then provide dispersing tigers to repopulate the Southern Eastern Ghats (eg. Tirupati forests). The Northern tiger population is disjunct though the habitat in terms of forest cover is contiguous. These populations can be interconnected by prey base restoration. Tiger populations in Northern Andhra Pradesh are a part of the larger tiger occupied landscape of Indrawati, extending through Chattisgarh, Maharashtra and Orissa. These populations need to be managed with interstate cooperation and a holistic landscape management plan (Figure 5 and Figure 7).

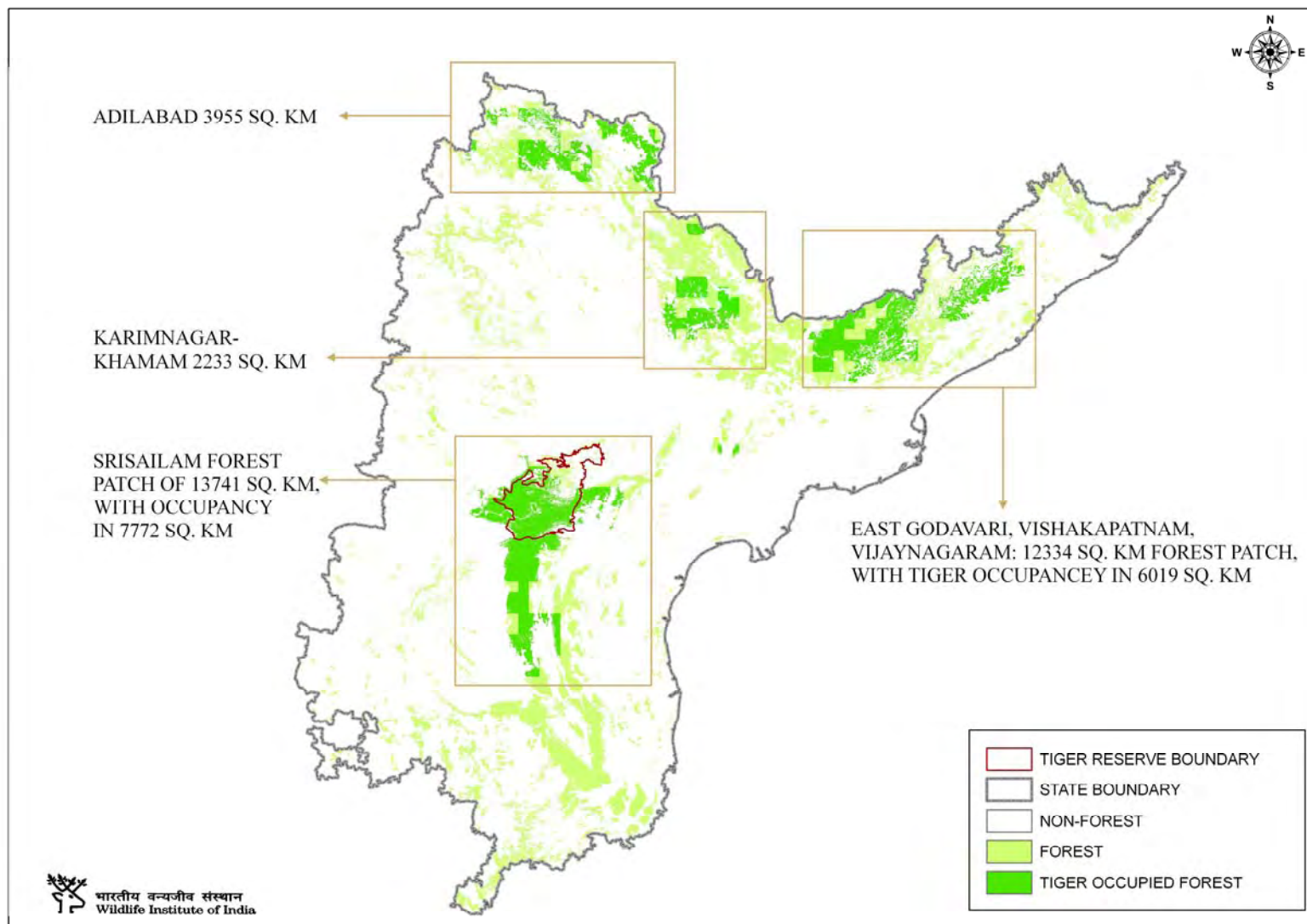


Figure 5: Tiger occupied forests, individual populations, their extents and habitat connectivity in Andhra Pradesh.

## Orissa

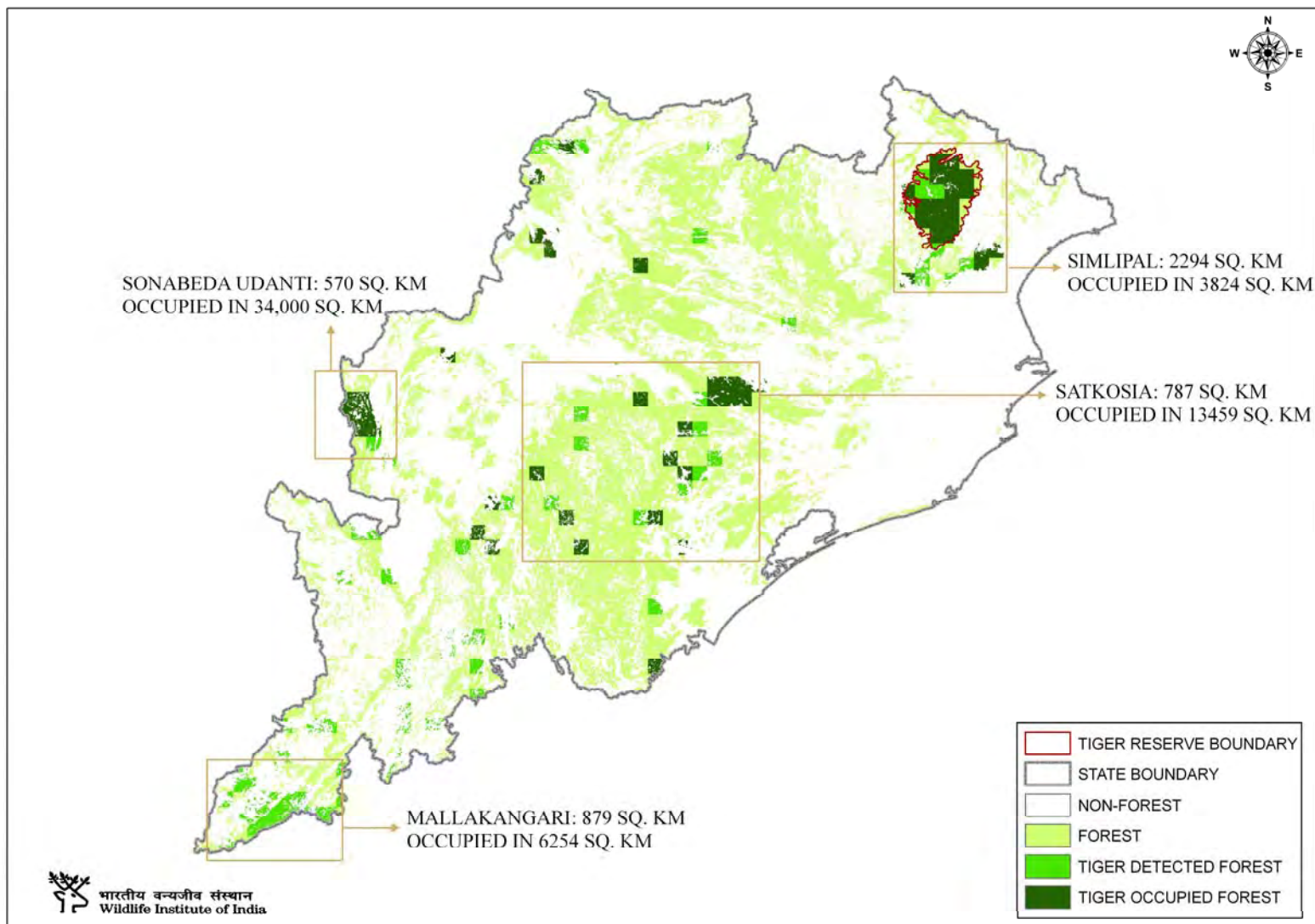
The state has a total forest cover of 27,427 km<sup>2</sup> with mapable tiger occupancy reported in 9,144 km<sup>2</sup>. Orissa reported mapable leopard presence in 25,516 km<sup>2</sup>, dhole presence in 8,215 km<sup>2</sup> and Sloth bear presence in 43,236 km<sup>2</sup> of forested habitat. Amongst prey species wild pig were reported from 21,525 km<sup>2</sup>, nilgai 711 km<sup>2</sup>, chital from 6,040 km<sup>2</sup>, Gaur from 2,772 km<sup>2</sup> and sambar from 6,112 km<sup>2</sup> of forested habitat.

Tigers were distributed in four larger occupied units, three smaller units and sporadic occurrences largely in Southern and Central part of the State. The larger occupied units comprise of :

- a) Simlipal Landscape comprising of 3824 km<sup>2</sup> patch of forest has recorded tiger presence in 2 units having a total tiger occupancy of 2297 km<sup>2</sup>.
- b) Sonabeda-Udanti-Indravati Landscape is part of a contiguous forest patch of 34,000 km<sup>2</sup> having a tiger occupancy in Orissa of 570 km<sup>2</sup>.
- c) Tiger population in the tehsil of Malakangari in the district of Koraput comprising the sanctuary of Balimela and Kondakamberu comprises a part of the forested patch of 6254 km<sup>2</sup> that extends from East Godavari, Khammam and Vishakapatnam of Andhra Pradesh. Tiger occupancy in this forest patch in Orissa was reported in 879 km<sup>2</sup>. Sporadic tiger presence is recorded in several places within Koraput district.
- d) Satkosia Landscape is part of a forest patch of 13,459 km<sup>2</sup> and has tiger occupancy in 787 km<sup>2</sup> with several smaller pockets reporting tiger presence. The area covers the districts of Kulbani, Gangam, and Kalahandi.

The smaller tiger occupied units were :

- a) In the forested area of Raigarha tehsil in Koraput district with a tiger occupancy of 97 km<sup>2</sup>.
- b) The second small tiger occupancy of 221 km<sup>2</sup> was recorded in Sundergarh tehsil.



**Figure 6: Tiger occupied forests, individual populations, their extents and habitat connectivity in Orissa.**

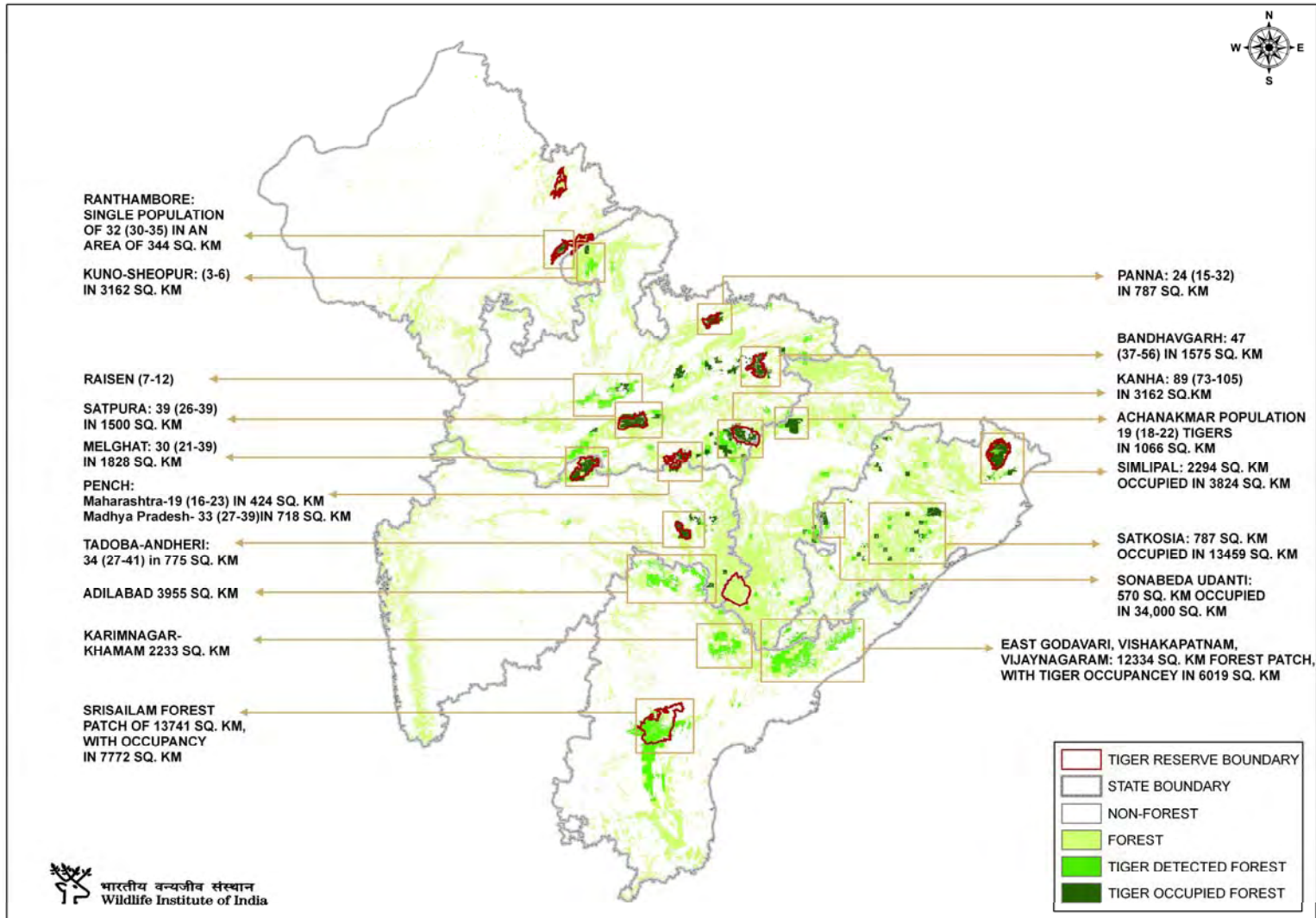
- c) The third in Bargarh tehsil having an occupancy of 142 km<sup>2</sup>.

**Conservation Recommendations:**

The major source population of tigers in Orissa is in Simlipal. Due to its large size and good habitat it can potentially sustain a viable population for long term conservation. It also has the potential to connect with the forests of Sarenda in Jharkhand. The tiger population in Sonabeda has to be conserved through inter state cooperation and coordination with Chattisgarh. The Southern tiger population shares its gene pool with the tiger populations of eastern Andhra Pradesh and need to be managed as a meta population (Figure 6 and 7).

**The total Tiger population for the states of Madhya Pradesh, Maharashtra, Rajasthan and Chattisgarh was estimated to be 457 with a standard error range of 356 to 558 tigers (Table 2).**

Estimating tiger numbers with precision is a daunting task over such vast geographical areas. Herein we attempt to provide estimates of tiger numbers in some of the states, however, we caution that these numbers are not what we propose for monitoring tiger status. Monitoring of the tiger status is to be done by mapping site specific spatial occupancy (Table 2). The report is intended to be used as baseline information for monitoring tiger occupancy status, distribution, relative abundance population extent, limits and connectivities and to guide policy and land use planning in the tiger landscapes of Central India (Figure 7).



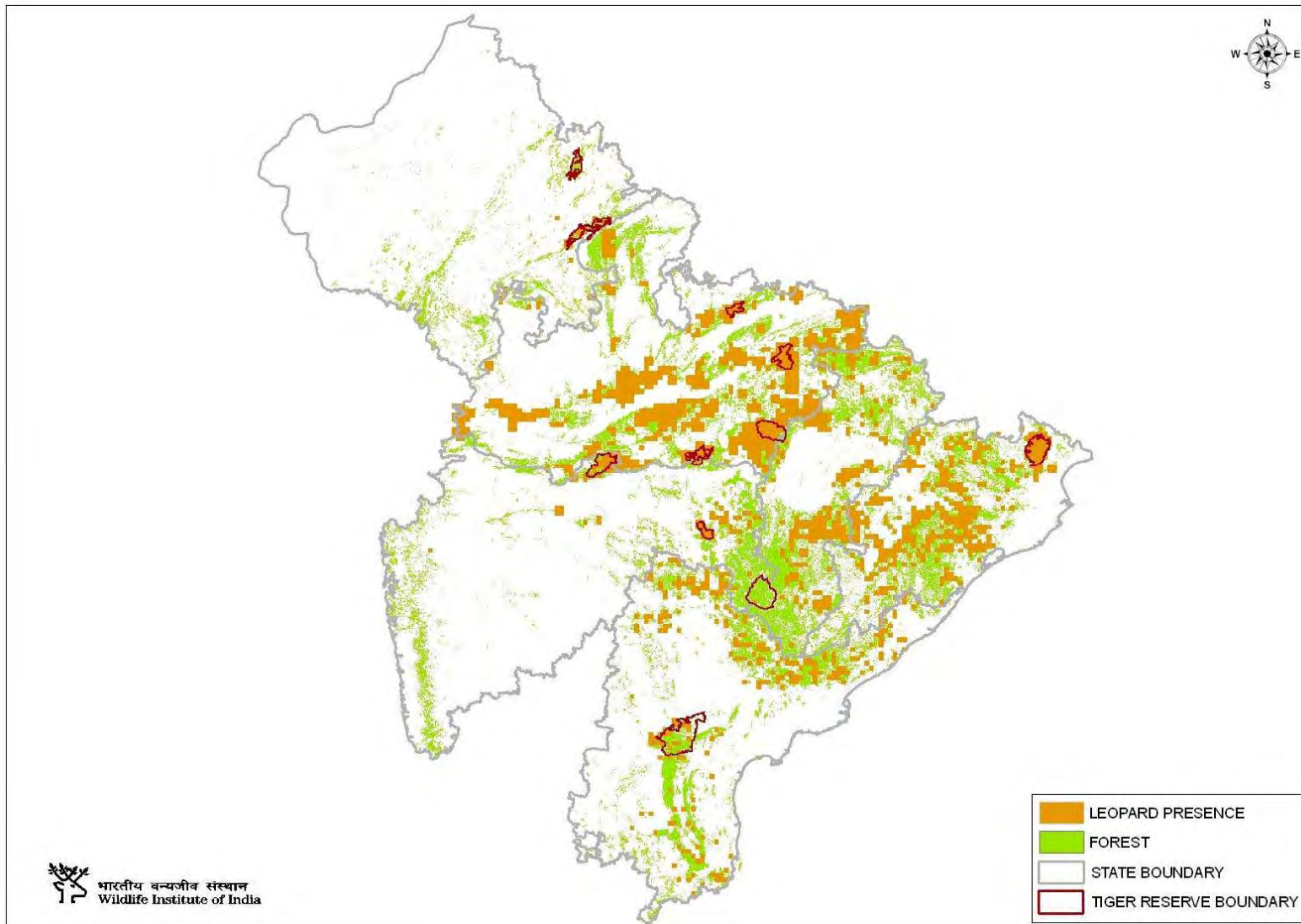
**Figure 7: Tiger occupied forests individual populations and their habitat linkages in the Central Indian Landscape Complex**

## Leopards Distribution in Central India

Leopard distribution in the Central Indian Landscape is more contiguous in comparison to tigers and forms 9 occupied blocks of forested habitat with some intervening scattered presence. Total occupancy of leopards in central India was 117,800 km<sup>2</sup>.

- 1) In Rajasthan Sariska leopard occupancy is likely contiguous with Jaipur and Alwar forest divisions.
- 2) Ranthambore leopard population is contiguous with that of Kuno, Sheopur (Morena) and Shivpuri districts in Madhya Pradesh.
- 3) The Panna population is distributed in a linear stretch North into Uttar Pradesh and South into Chattarpur district.
- 4) Bandhavgarh population is contiguous Eastward to Sanjay (Sidhi) and Westward to Jabalpur, Damoh, Raisen upto Sehore on the Northern banks of Narmada. It is linked to the Kanha population through the forests of Jabalpur. Leopard distribution from Kanha extends North West through Mandla into Chattisgarh-Achanakmar (Bilaspur) and Southwards into Balaghat district.
- 5) A separate occupancy is recorded in the forests of Dhar and Jhabua neighboring Gujarat.
- 6) The Leopard occupancy from Satpura population (Hoshangabad) is contiguous through East Nimar into Melghat (Amrawati) in Maharashtra and may have distribution connectivity with Pench (MP & Maharashtra). This population has distribution linkage with Kanha through the corridor connectivity in Seoni district.
- 7) Continuous Leopard occupancy is recorded from Tadoba (Chandrapur district), through Gadchiroli district into Chattisgarh.
- 8) Leopard occupancy from Northern Andhra Pradesh to Eastern Andhra Pradesh is contiguous with the population in Orissa and Indrawati in Chattisgarh.
- 9) Southern Eastern ghat has a patchy leopard presence recorded, which is likely to be contiguous (Figure 8), throughout the forested habitat of Srisailem Tiger reserve to Sri Venkateshwara Sanctuary in the south.



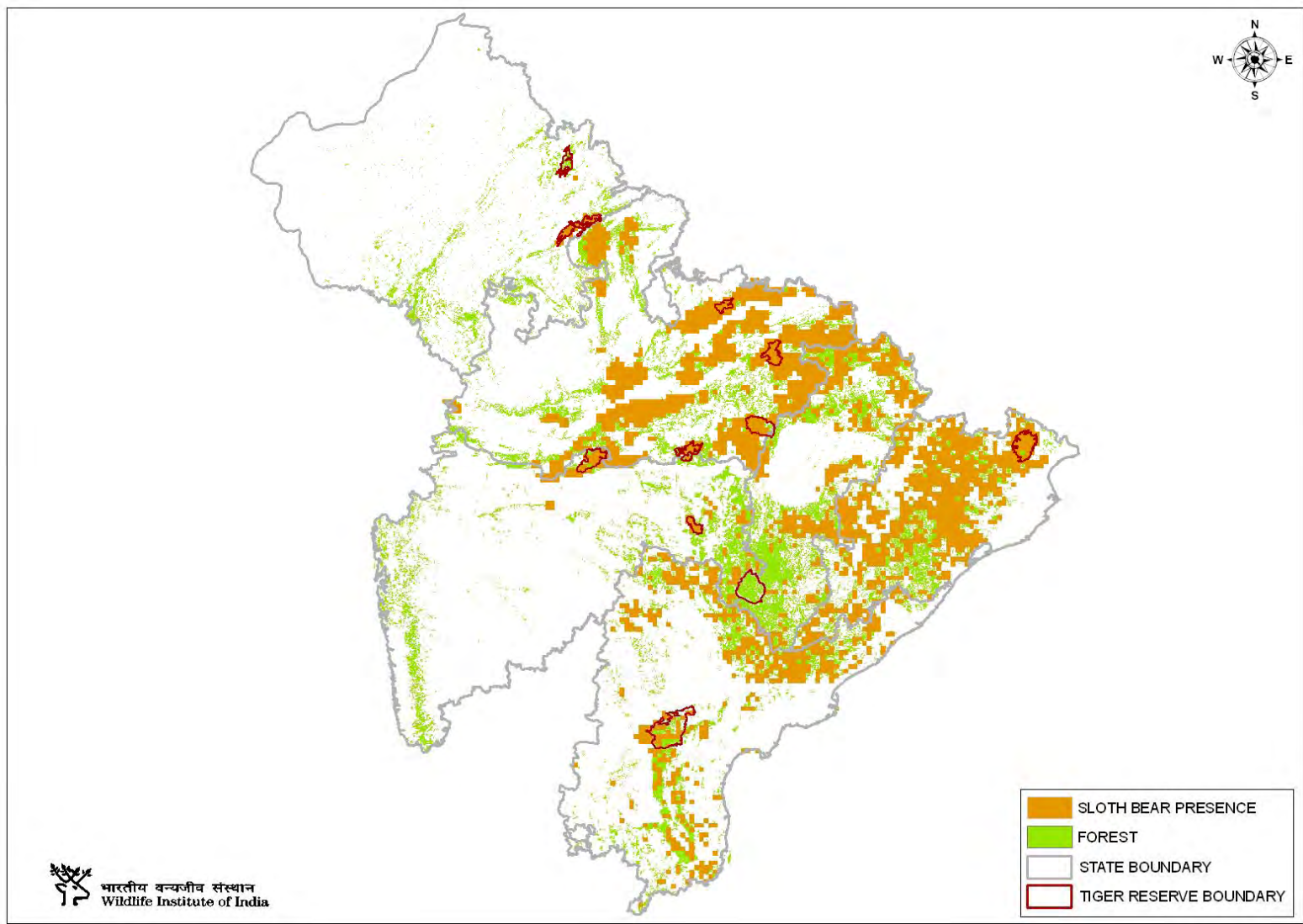


**Figure 8: Leopard distribution in Central Indian Landscape Complex**

## **Sloth Bear Distribution in Central India**

Sloth bear distribution is reasonably contiguous forming 11 different blocks in Central India. They occupy about 166,400 km<sup>2</sup> of forested habitat.

- 1) Sloth bear occupancy from Ranthambore, Kailadevi and Kota (Rajasthan) is contiguous with Kuno (Morena), Gwalior, Guna and Shivpuri district forests in Madhya Pradesh.
- 2) Sloth bear occupancy from Panna extends East into Uttar Pradesh and South into Chhatarpur and Damoh districts.
- 3) A separate block of bear occupancy is observed in Southern part of Panna district (Pawai tehsil), Satna district and Southern part of Damoh district.
- 4) Sloth bear distribution from Bandhavgarh (Shahdol) is contiguous with Sidhi, Mandla, Balaghat (Kanha T.R.). Seoni (Pench T.R.), in the South and Eastward into Achanakmar (Koriya district) Sarguja, Jashpur and Korba districts in Chattisgarh.
- 5) Satpura Tiger Reserve Sloth bear occupancy is continuous upto Melghat covering the forested habitat of Narsinghpur, Hoshangabad, Betul, East Nimar in Madhya Pradesh and Amravati in Maharashtra. This distribution is likely linked to the North to the Raisen and Bhopal forests.
- 6) A small distribution patch is recorded in Bagli tehsil of Dewas district.
- 7) Few Sloth bears likely survive in Jobat tehsil of Jhabua district adjoining Panchmahal, Devgadhi Baria in Gujarat.
- 8) Tadoba likely forms an isolated patch of Sloth bear occupancy.
- 9) Sloth bear distribution in Gadchiroli district (Maharashtra) Southern Chattisgarh, Northern to Eastern Andhra Pradesh and entire forested habitat of Orissa is contiguous forming the largest single block of occupied forests.
- 10) Southern Eastern ghats from Sarisailam to Venkateshwara Sanctuary (Tirupati forests in Cuddapah district) form a single occupied block.
- 11) An isolated occupied block is recorded in Banaswada and Armur tehsils of Nizamabad districts (Figure 9).

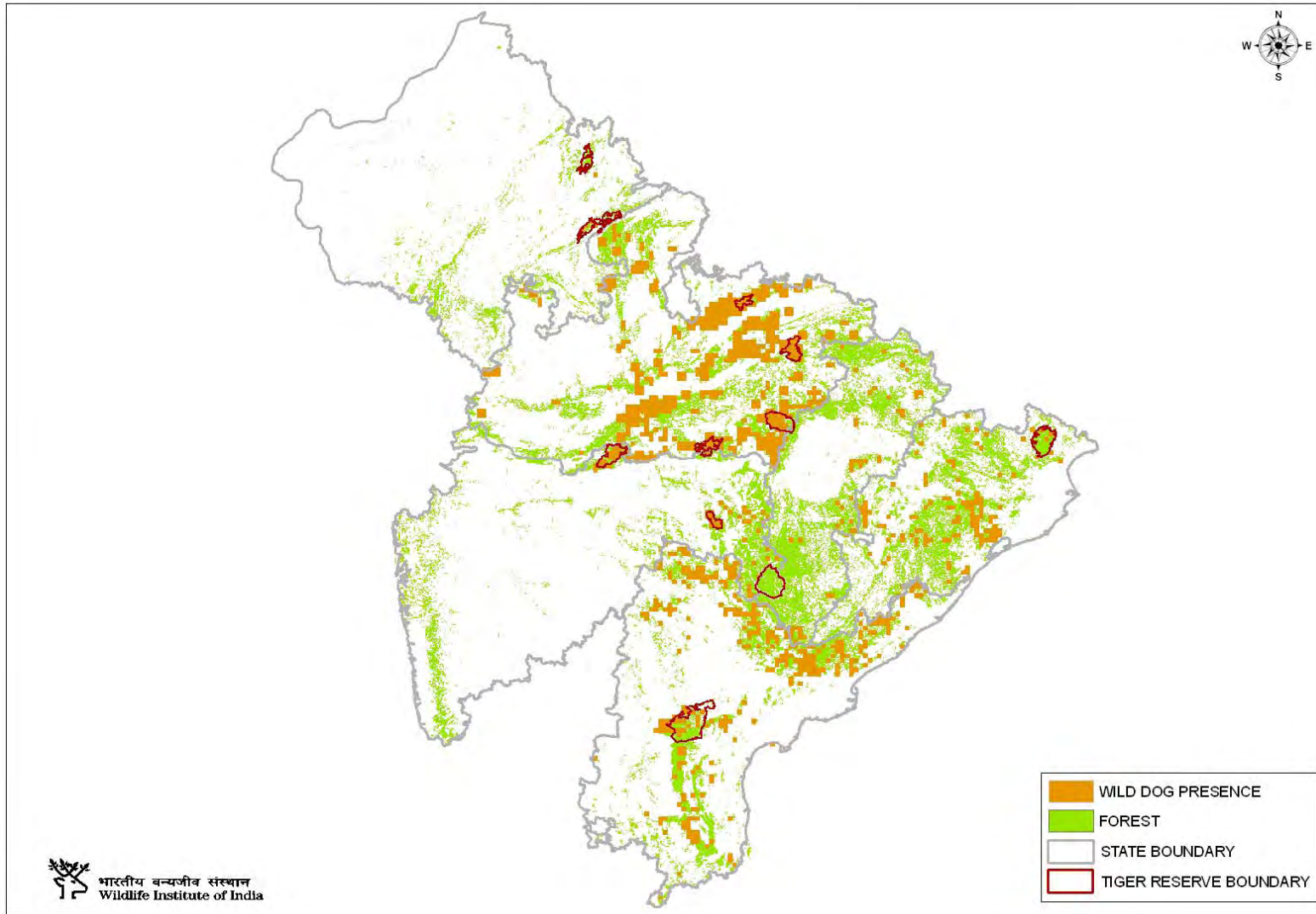


**Figure 9: Sloth Bear distribution in Central Indian Landscape Complex**

## **Wild Dog (Dhole) Distribution in Central India**

In Central India Madhya Pradesh likely has the largest population of Dhole. In Central India Dhole distribution seems to be made up of 7 distinct populations and several scattered occurrences. The total forested area occupied was 86,000 km<sup>2</sup>. The major distribution blocks are:

- (1) Kanha-Pench (MP & Maharashtra)-Satpura-Melghat (Maharashtra) population.
- (2) Bandhavgarh-Jabalpur-Damoh population.
- (3) Panna-Chhatarpur population
- (4) Kuno, Sheopur Shivpuri population. Scattered presence is recorded on the Northern banks of Narmada in Jhabua and Banaswara districts.
- (5) A connected distribution is reported from Maharashtra-Tadoba through Gharcharoli district to Western Chattisgarh, Northern Andhra Pradesh (Adilabad Karimnagar Khammam, East Godavari and Vishakhapatnam) and Southern Orissa (Ganjam, Phulbani, Kalahandi, Koraput and Puri). Scattered Dhole presence is reported in Orissa in the districts Mayurbhanj and Sambalpur districts.
- (6) In Chattisgarh Dhole presence is reported from Raipur, Dhamtari and Surguja.
- (7) In the Southern Eastern ghats Dhole presence is recorded from Shrisailam Tiger Reserve (Mahbubnagar) through Gurutala tehsil of Guntur and Giddalur tehsil of Prakason upto Shri Venkatehwara Sanctuary in Cuddapah district (Figure 10).



**Figure 10: Wild Dog distribution in Central Indian Landscape Complex**

**Table 1: Population Estimates of Tigers in select Central Indian States**

State	Tiger Population Estimate	Lower SE limit	Upper SE limit
Madhya Pradesh	296	228	364
Maharashtra	103	76	131
Rajasthan	32	29	35
Chhattisgarh	26	23	28

**Table 2: The forest occupancy of Tigers, Co-Predators and Prey in Central Indian Landscapes (km<sup>2</sup>)**

Name	Andhra Pradesh	Chhatisgarh	Madhya Pradesh	Maharashtra	Orissa	Rajasthan
Tiger	22128	3609	15613.69	4273	9144	355.88
Leopard	37609	14939	34736.12	4982	25516	-
Dhole	41093	3794	28507.69	4352	8215	-
Sloth Bear	54673	20951	40959.47	6557	43236	-
Chital	37814	18540	41509.26	5970	6040	-
Sambar	33159	7604	33550.70	5730	6112	-
Wild Pig	58336	25058	599033.23	7370	21525	-
Gaur	3139	3369	5577.37	2753	2772	-
Neelgai	26526	9250	41703.82	4754	711	-
Livestock	29198	40582	65836.13	3762	28328	-

**Table 3 State wise summary of beats with tiger presence used for analysis.**

<b>State</b>	<b>Tiger Presence Reported (Beats)</b>	<b>Tiger Presence Mapped</b>	<b>Percent not mapped</b>
Andhra Pradesh	208	208	<b>0</b>
Chattisgarh	66	60	<b>9</b>
Madhya Pradesh	489	404	<b>17</b>
Maharashtra	445	169	<b>62</b>
Orissa	340	329	<b>3</b>
Rajasthan	32	29	<b>9</b>

## Appendix 1

Faculty Members involved in conducting Training and Research Team associated in data collection in the Central Indian and Eastern Ghat Landscapes:

Dr. P.K. Mathur  
Sh. B.C. Chaudhary  
Dr. S.P. Goyal  
Mrs. Bitapi Sinha  
Dr. K. Sankar  
Dr. S.A. Hussain  
Dr. Bivash Pandav  
Dr. D. Chakraborty  
Dr. B.S. Adhkari

Dr. S. Chowdhury  
Dr. P.K. Malik  
Dr. V.P. Uniyal  
Dr. S.Sathyakumar  
Dr. Ruchi Badola  
Dr. K. Vasudevan  
Dr. Parag Nigam  
Dr. K. Sivakumar

### Research Team

Dr. Jimmy Borah  
Dr. Karabi Deka  
Dr. Rashid Raja  
Dr. Sumit Dhokia  
Mr. Agni Mitra  
Mr. Aishwarya Maheshwari  
Mr. Ajay Singh Nagpore  
Mr. Amit Kotia  
Mr. Aniruddha Majumdar  
Mr. Asheem Rahul Singh  
Mr. Ashish K. Gharai  
Mr. Ashish Kumar Bais  
Mr. Bhaskar Acharya  
Mr. Durg Singh Rajjpurohit  
Mr. Harshad Mangave  
Mr. J.Peter Prem Chakravarthi  
Mr. Janmajay Setty  
Mr. Jayasooryan K.K.  
Mr. John C.E.  
Mr. Joseph Vettakaven  
Mr. Jyotirmay Jena  
Mr. Kamal Singh Negi  
Mr. Kuladeep Roy  
Mr. Kunwar Sain  
Mr. M. Selvan  
Mr. Manish Bharadwaj  
Mr. Mohit Bodyal  
Mr. N.Sridharan  
Mr. Navonil Das  
Mr. Peer Muzamil Shams

Mr. Pridhuvi Raj.  
Mr. R.K. Jagdish Singh  
Mr. Rajarshi Chakraborti  
Mr. Rajendra Prasad Gupta  
Mr. Satyaranjan Behra  
Mr. Shirish Kayatham  
Mr. Shubhadeep B.  
Mr. Shubham Dutta  
Mr. T. Ramesh  
Mr. Tamo Dadda  
Mr. Udaya Kumar Das  
Mr. Umesh Kumar Tiwari  
Mr. Ved Prakash Ola  
Mr. Vibhav Srivastava  
Mr. Vidyadhar M. Atkore  
Mr. Vishal Vasant paitl  
Mr. Hem Singh Gahlot  
Ms. Chandrima Home  
Ms. Indrani Sasmal  
Ms. Jyoti Singh  
Ms. Parabita Basu  
Ms. Purnima Manar  
Ms. Rajni Sharma  
Ms. Rinima Hazarika  
Ms. Shalini Bharadwaj  
Ms. Shilpi Gupta  
Ms. Tana Mewada  
Ms. Tripti Negi  
Ms. Tripti Shah



## Appendix 2

### National and International Peers who participated in developing and implementing the monitoring exercise

#### National Peers

Andhra Pradesh	Shri M.G. Gogate
Chattisgarh	Shri P.K. Mishra
Madhya Pradesh	Shri A.S. Negi
Maharashtra	Shri P.K. Mishra
Orissa	Shri P.K. Mishra
Rajasthan	Sh. P.K. Mishra
	Dr. A.P. Dwivedi

#### International Peers

Dr. Luigi Boitani, Prof. University of Rome, Italy

Dr. John Seidensticker, (IUCN) Smithsonian Institution, USA

Dr. Chris Carbone, Zoological Society of London, UK

Dr. Ramona Maraj, IUCN, Canada

Dr. Andrew Royale, Bio Statistician, Patuxent Wildlife Research Center (USGS), USA

National Tiger Conservation Authority  
Ministry of Environment & Forests  
Government of India  
Bikaner House, Annexe-V  
Shahjahan Road, New Delhi-110011  
Ph.: +91 11 23389645  
Telefax : +91 11 23384428  
[www.projecttiger.nic.in](http://www.projecttiger.nic.in)

Wildlife Institute of India  
Post Bag # 18  
Chandrabani,  
Dehradun-248001  
Uttarakhand  
Ph.: +91 135 2640111-115  
Fax: +91 135 2640117  
[www.wii.gov.in](http://www.wii.gov.in)