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CONNECTING HABITAT CORRIDORS FOR TIGERS IN PANNA LANDSCAPE

*A rapid assessment of forests
around Panna Tiger Reserve*



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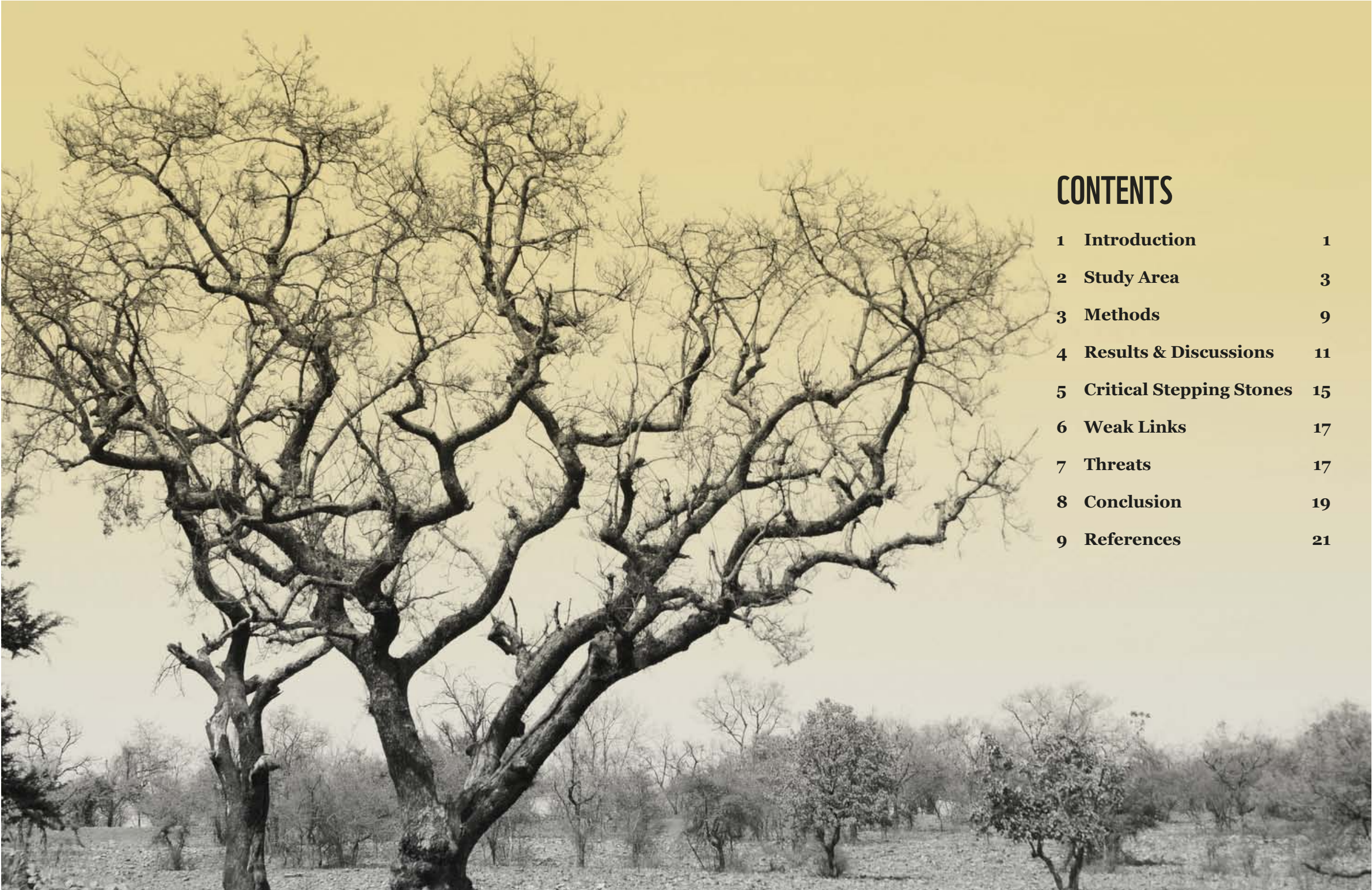
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I. INTRODUCTION

1.1 Background & Context

The population of Tiger (*Panthera Tigris*) in India has undergone a sharp decline over the past few years. In the past, many protected areas (PAs) have even seen their worst in terms of their tiger numbers. One of such PA is Panna National Park, wherein the tiger population literally came to 0 in 2009 (WII, 2009). But today, thanks to the efforts of a dedicated forest department, different government institutions and NGOs, it is proudly (and protectively) home to 28 striped cats after the Tiger Reintroduction programme was initiated in 2009. The 1549 sq. km of park (547 sq. km of core area and 1002 sq. km buffer area) can easily support 25-30 tigers. But in recent past, tigers from PTR have been found to be migrating to adjoining forest areas, travelling more than 100 km to reach different PA like Bandhavgarh (WII, 2009). There have been reports on 7 tigers – T3, Panna 112, 121, 211, 212, 121 and 123-from Panna using these corridor between 2009 and 2014 (per comms-field director PTR). The main point of tiger straying out of PTR into the adjoining forest areas has certain credibility, in that home ranges of tigers are very large and includes areas of adjoining territorial forest (Chundawat et al., 1999). In order to provide them a safe passage between PTR and different PA, it's critical that potential habitat be identified and that needs of tigers be incorporated in development plans of the region. This process requires incorporating the tiger landscape conservation strategy and action plan into the national and regional social and economic development plans. Although there is no confirmed evidence, there are regular reports of tigers from the region, crossing across different forest divisions.

As part of their ecology, large carnivores like tigers require larger area for their survival, breeding and dispersal (WWF & WCS, 2010). In order to provide safety and security to these mammals, it's important to protect them not only inside any protected areas but also outside these areas, mainly in Forest Territorial Division adjoining PTR. Many tigers are likely to be living outside protected areas, mainly in Forest Territorial Division adjoining PTR. The adjacent territorial forest divisions can play the most important role as dispersal corridor provided they have some degree of connectivity and prey population to accommodate few tiger individuals.

This report presents the findings of the rapid assessment carried out in the Panna landscape (Forest divisions surrounding Panna Tiger Reserve- North Panna, South Panna, Damoh, Sagar, Chhatarpur) to identify the existing corridor or linkages between the Panna tiger reserve and nearby territorial forest divisions. In the present study, an effort has been made to document baseline information of the status of tigers, co-predators and prey species in the study area. The value of this study can be increased if regular monitoring of these target species can be done which will reflect the degradation or remediation of the concerned environment.

1.2 Objectives of study

1. To identify critical areas for dispersing tigers, and providing immediate as well as long term conservation measures.
2. To identify different threats prevailing in the area.

2. STUDY AREA

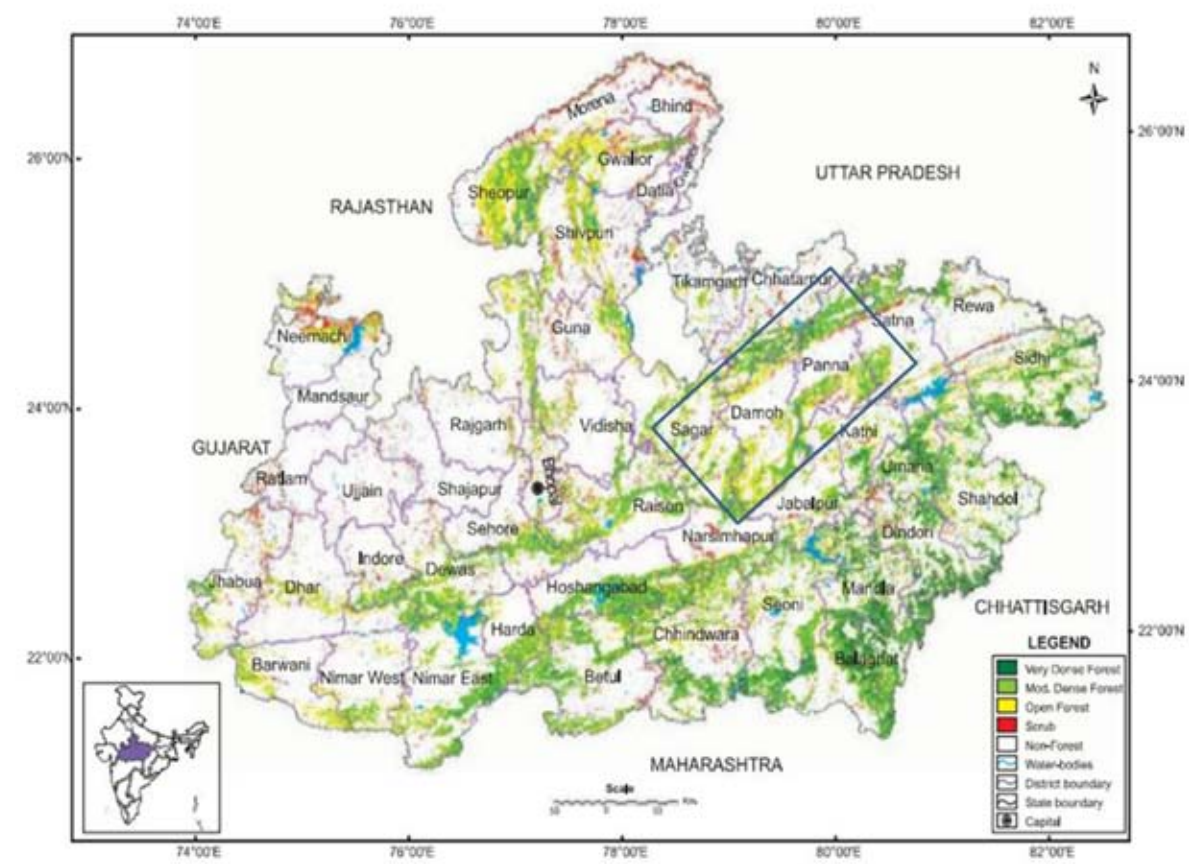


Fig.1
Forest map of Madhya Pradesh
where the inset box shows the study
area covering Panna, Sagar, Damoh
and Chattarpur Forest Division
(Source: Forest Survey of India,2011)

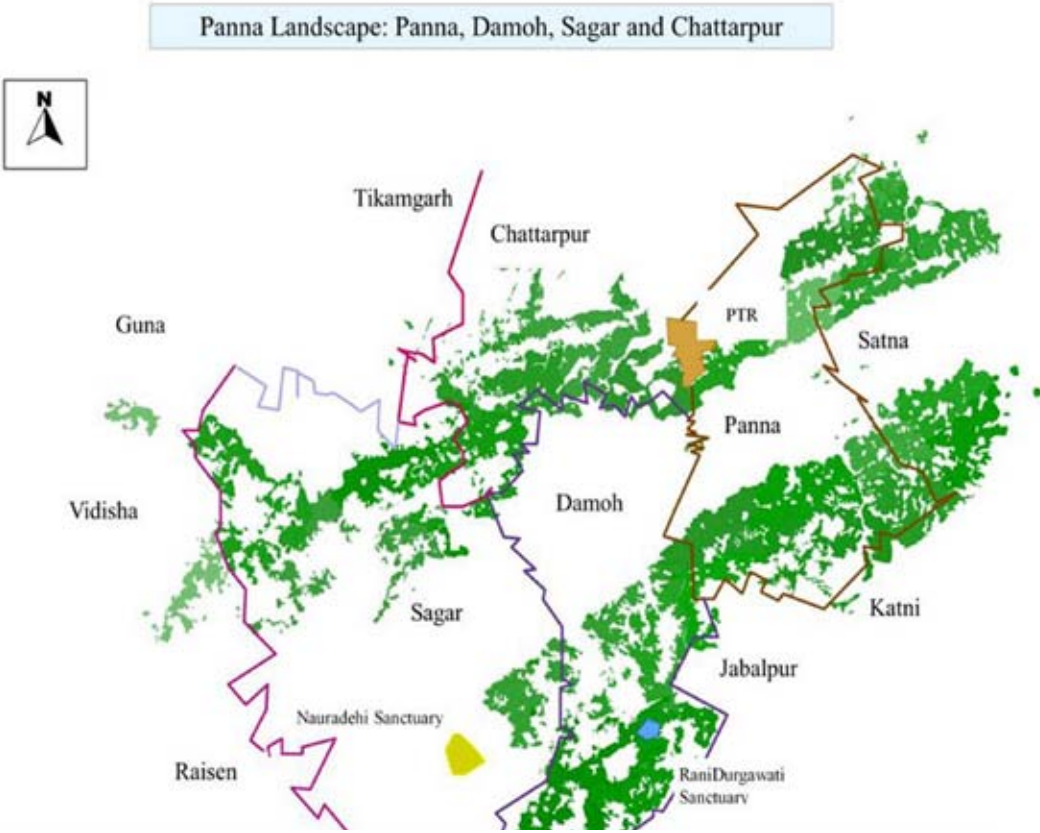


Fig. 2
Map of Panna Landscape

2.1 Study area

The study area is spread over different territorial forest divisions within the landscape - Panna (North and South), Damoh, Sagar and Chhatarpur, in the state of Madhya Pradesh, India and covers a land area of about 33,653 km² (Fig 1 and Fig 2).

Within these divisions, three ranges of North Panna, five ranges of South Panna, three ranges of Damoh, three ranges of Sagar and three ranges of Chhatarpur were covered during the survey.

The geographic location of all the forest divisions in the study area can be seen in table 1.

S.NO.	FOREST DIVISION	GPS LATITUDE	GPS LONGITUDE	GEOGRAPHICAL AREA IN KM ²
1	North Panna	24°28' to 25°12' North	79°45' to 80°40' East	2155.76
2	South Panna	23°45' to 24°30' North	79° 45' to 80°40' East	4521.91
3	Damoh	23°09' North	79° 03' East	7,306
4	Sagar	23°10' to 24°27' North	78°4' to 79°21' East	10,252
5	Chhatarpur	24°06' to 25°20' North	78°59' to 80°26' East	8687

Table 1
Location and area of all forest divisions

There are 3 tiger reserves (Satpura Tiger Reserve, Ratapani Tiger Reserve, Bandhavgarh Tiger Reserve) and 1 wildlife sanctuary (Nauradehi Wildlife Sanctuary) adjoining study area making this landscape crucial for facilitating tiger movements to these habitat in future.

2.2 Forests

The total landscape encompasses 33,653 km² out of which the forest cover is around 9919 km² (29.47 %) (Forest Survey of India, 2011). The forest cover in districts in 2011 is shown in Figure 3.

The report of Forest Survey of India shows that more than a quarter of the landscape is still forested and between 2007 and 2011 there has been an increase in total area of forest. But if we see Figure 4 we will find that this increase in area is only due to increase in the area of open forest and there is no substantial increase in any other very dense or moderately dense forest (Forest Survey of India, 2011 and 2007).

Fig.3
Forest cover (in km²) in 2011 in different districts around PTR where study was carried out

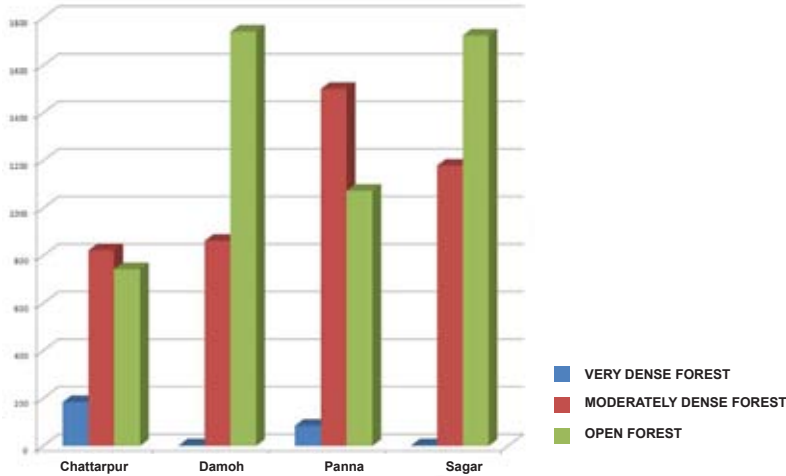
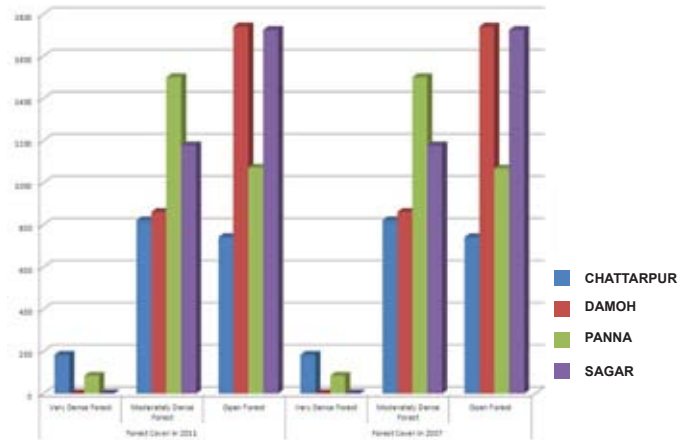


Fig.4
Difference in forest cover (in km²) in the study area in between 2011 and 2007



2.3 People

District wise decadal growth and density of population of Madhya Pradesh, (Census, 2011) is shown in Table 2. Sagar and Chattarpur has experienced high rate of increase in population in comparison to Damoh and Panna in 2011. In terms of density of population, Chattarpur scores highest followed by Panna, Sagar and Damoh.

DISTRICT/CITY	GROWTH RATE 2011	DENSITY PER KM ²
Chhatarpur	826,951	19.5
Panna	483,162	18.6
Sagar	1,124,044	17.6
Damoh	603,225	16.6

Table 2
Growth and density of population in 2011 of Madhya Pradesh

2.4 Biodiversity

Forest type is mixed dry deciduous, almost in the entire landscape. The terrain is mostly undulating with ridges and valley. The dominant tree species in North Panna is teak (*Tectona grandis*) and other areas are of mixed deciduous forest with some of the prominent species being Saja (*Lagerstroemia parviflora*), Jamun (*Syzygium cumini*), Shisham (*Dalbergia Latifolia*), Mahua (*Madhuca Indica*), Kusum (*Schleichera oleosa*) etc.

Among fauna, presence of tigers, leopard, sloth bear, nilgai, sambhar, chital, wild pig, jackal, hyena, black naped hare etc. could be asserted either through direct sighting or verified through their signs.



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3. METHODS

3.1 Survey design

For the present study, a rapid assessment was carried out in different beats of various ranges of a forest division on the presence and absence of tiger, co predator and prey species. Due to constrain in resources, time and manpower, instead of surveying each beat in every range of a forest division few beats were randomly picked up for this study. Surveys were conducted either in early morning or evening in which the team was supposed to walk a minimum of 5 km. along forest trails, river bed etc. looking for the sign of target species. These surveys in the landscape provided the data to map distribution of different target species and also helped in identifying critical and weak links in the landscape.

3.2 Field Protocol

The survey was conducted in the dry season of June to minimize variations in animal detection probabilities induced by rainfall. Typically, tigers move along forest trails to hunt or to locate, avoid or deter conspecifics (Karanth and Sunquist, 2000). Their passage is marked by tracks and occasional scat deposits (Sunquist and Sunquist, 1989; Smith et al. 1987). Fresh signs of tigers, leopards, jackals and major ungulate prey species in landscape were identified and recorded by team. Only unambiguously identified signs were recorded. We photographed and recorded signs of tigers, leopards, jackals and ungulate prey species, as well as signs of livestock or human presence.

3.3 Analytical details

3.3.1 Encounter rates

Encounter rate is the count of the number of individuals of a species recorded/detected within a given sampling unit i.e. it provides an estimate of the animal’s distribution over the sampling unit (Pramod et. al, 2012). The measurement of encounter rate was done using the formula.

Encounter rate = Total no. of species of interest/Total distance travelled

3.3.2 Habitat Suitability Index

HSI scoring system is a means of evaluating habitat quality and quantity. Greater value of HSI indicate optimal habitat while lower values indicate unsuitable habitat. The HSI for the tiger, in our study, incorporates nine suitability indices – Forest type, Terrain, Encounter rate of Nilgai, Encounter rate of Chital, Encounter rate of

Wild pig, Encounter rate of Sambhar, Presence of water, disturbance in area (fuel wood collection, grazing) - all of which are factors known to affect this species (Hebbelwhite et al, 2012; Carroll and Larsen, 2003). These nine factors were scored for each habitat on a scale of 0 to 1, 0 depicting less probability of being used by tiger and as score reaches to 1 this probability increases. On the basis of these criteria habitat can either belong to any one of four suitability position: Highly Suitable, Moderately Suitable, Less Suitable and Least Suitable. For scoring disturbance in any area, fuel wood collection and grazing was taken into account, absence of these activities got the score of 1 which decreased to 0 as their presence became more evident.

In general, habitat or areas with high HIS scores are more likely to support tigers than those with low scores. The HIS is a sum of nine suitability indices (Table 3):

HIS = SI1 + SI2 + SI3 + SI4 + SI5 + SI6 + SI7 + SI8 + SI9

HABITAT PREFERENCES	FOREST TYPE		TERRAIN		ER OF NILGAI/ CHITAL/WILD PIG/SAMBHAR		WATER	DISTURBANCE (FUEL WOOD COLLECTION, GRAZING)
Highly Suitable	Dense	1	Flat	1	0.9	1	1	1
Moderately Suitable	semi dense	0.67	Semi undulating	0.5	0.6 – 0.9	0.85	0.80	0.80
Less Suitable	Scrub	0.33	Undulating	0.25	0.3 – 0.6	0.65	0.60	0.60
Least Suitable	Open	0			0 – 0.3	0.2	0.25	0.25

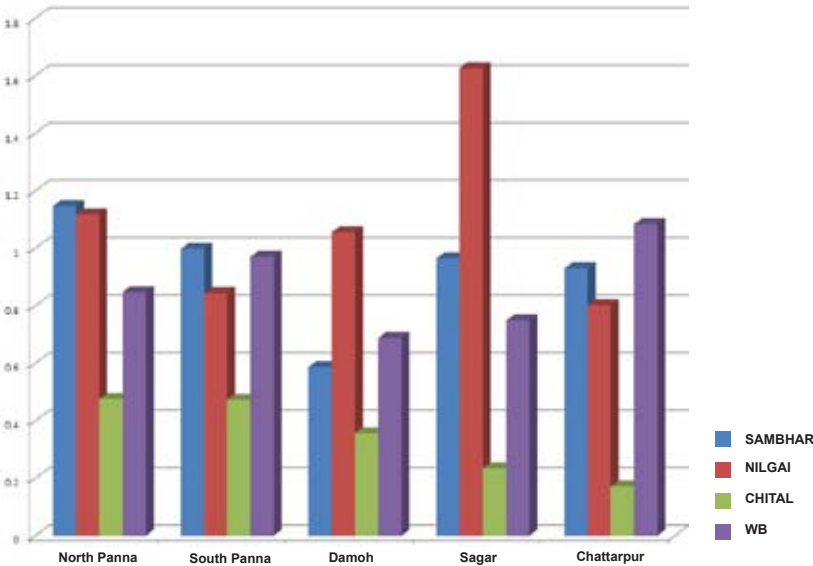
Table 3
Details of suitability indices

4. RESULTS & DISCUSSIONS

4.1 Encounter rate

The highest encounter rate was found for Nilgai in Sagar division (1.6 per km) followed by Sambhar in North Panna Division (1.19 per km) and Wild Pig in Chattarpur Division (1.14 per km). Figure 5 shows that Chital of all the four prey species exhibited least encounter rate varying from 0.476 per km in North Panna to 0.17 per km in Chattarpur. Wild Pig was least encountered in Sagar (0.748 per km). Though Sambhar was least encountered in Damoh (0.56 per km), it was the most evenly distributed species among all the four animals. The encounter rate at different divisions can be explained on the basis of different preferences of different species for different forest condition, water availability and level of disturbance at the place. Of all the species, Chital was least encountered at every division which can be attributed to the fact that Chital is primarily a grazer and the habitat during study period was more suited to browsers than to grazers (Ahrestani 1999). Chital is also the most vulnerable species impacted by various types of disturbances. Not only human settlements, but being largely a grazer chital is in direct competition with cattle unlike the other ungulates which were also browsers and so were not in competition with cattle so intensely (Sankar 1994, Khan 1996). As per the preferences of Sambhar, greater shrub cover, greater number of tree species, was quite available in the study area and thus describes their even distribution in the area (Jathanna, 2000). Nilgai, on the other hand, don't have any such particular preference for vegetation and habitat and in fact preferred more open and flat areas (Habib et al 2010) which is also easy to find in the study area.

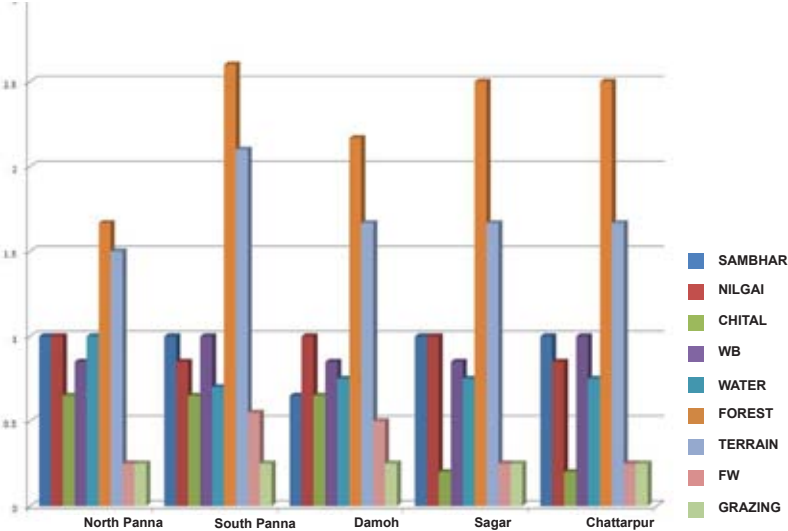
Fig. 5
Graph showing encounter rate (per km) of all 4 prey species in different ranges.



4.2 Habitat Suitability Index

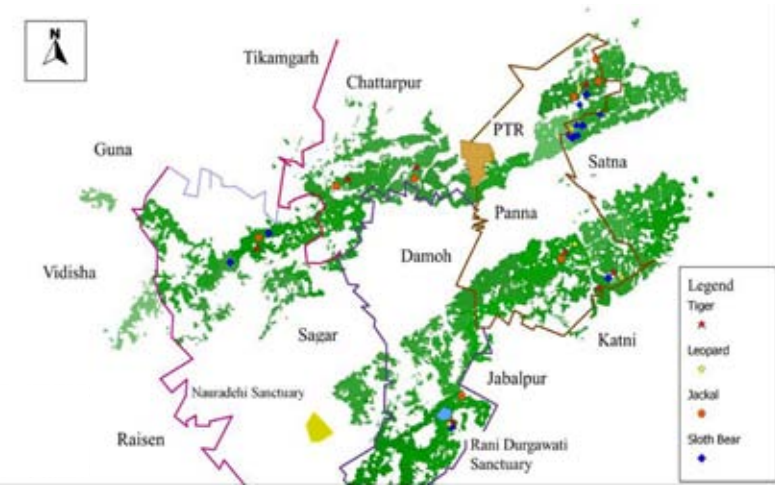
South Panna got the highest HSI of 9.7 followed by Sagar and Chattarpur (8.48), Damoh (8.46) and North Panna (8.16). The result could be attributed to the findings like South Panna still has some ranges (e.g. Kalda, Pawai) which are still not much disturbed, human settlement is less, forest and water availability is relatively more suitable than other divisions.

Fig. 6
Graph showing HSI in different forest ranges



4.3 Distribution of carnivores in study area

Fig. 7
Presence of different carnivores in study area



Chital was least encountered at every division which can be attributed to the fact that Chital is primarily a grazer and the habitat during study period was more suited to browsers than to grazers.



5. CRITICAL STEPPING STONES

The forests around PTR fall under several territorial divisions, which have different levels of legal protection status, i.e. reserve forest, protected forest and some under the corporation division as well, permitting harvesting of timber and bamboo. To manage and maintain the connectivity among these forest ranges and between different tiger reserves, it is essential to identify area with high importance and that maintenance of these linkages should be given immediate priority. In the present study, we have identified major stepping stones and the weak linkages between them, based on tiger presence, prey base and current human pressure.

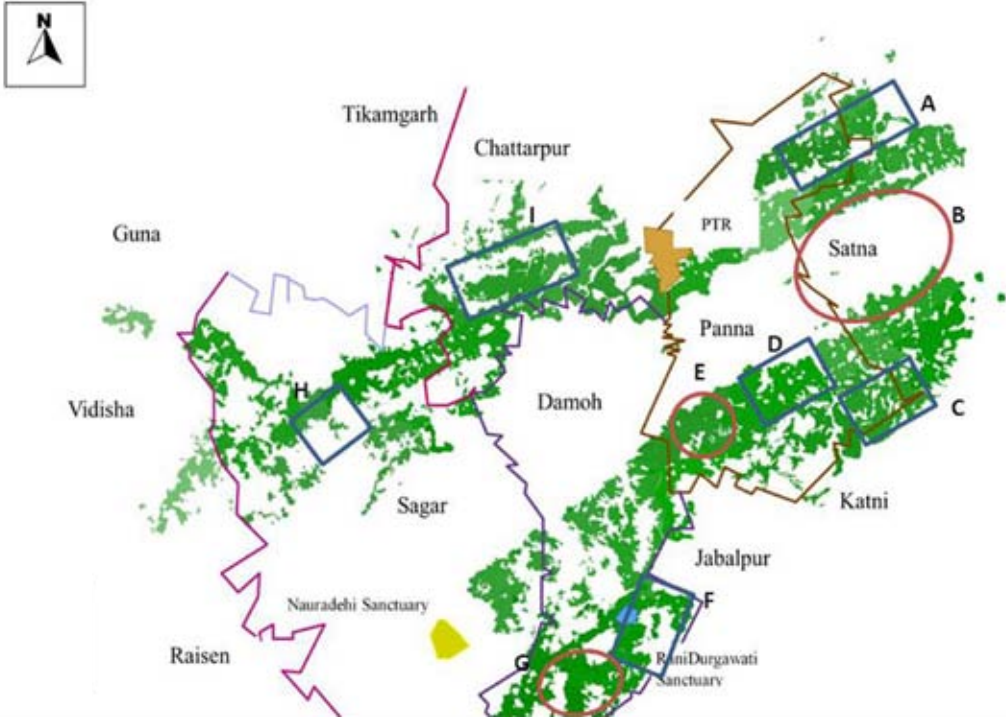


Fig. 8
Critical stepping stones (boxes) and Weak links (circles): A- Vishramganj, Devendranagar, D: Pawai, C: Kalda, F: Singrampur, H: Banda, I: Badamalehara, E: Mohandra, G: Tendukheda

5.1 Vishramganj

Vishramganj is one of the most crucial connections for dispersing tigers from Panna to rest of the area. While lying towards north of PTR with good prey base, it can be used as a passage for tiger to move into different adjoining areas like Devendranagar to its south.

5.2 Devendranagar

The importance of Devendranagar can be attributed from the fact that it lies to the south of Vishramganj, to the west of tiger reserve and to the north of south Panna forest division. So it acts as an important block between North Panna and South Panna Forest Division. The

area needs to be secured as a large portion of this area is non-forest (act as weak link) which can provide deterrence to movement of tigers. Both Devendranagar and Vishramganj supports a good prey base and in the past these areas have been used by tigers while dispersing to other areas as per communicated by forest staff.

5.3 Pawai

Pawai (and Saleha) at the boundary of South Panna Division, acts as a critical block for further movement of tigers and other species either towards others PA or forest division lying south of North Panna Division.

5.4 Kalda

Lying at the extreme of south Panna division, it is not only one of the most forested areas encountered during the survey but also least disturbed as there were very few villages in the surrounding of area. It is not only important for movement of tigers but if steps are taken, it can form part of a critical habitat too.

5.5 Singrampur

The presence of Rani Durgawati Sanctuary in Singrampur range increases its score in terms of potential for supporting dispersal of tigers. Both the survey and secondary information supports the presence of a good prey base and other co predators inside the sanctuary. As per the forest staff this site is often visited by tigers and recently tiger Panna 121 was captured in one of those camera traps set up in sanctuary (per comms, FD, PTR). It acts as a good dispersal for tiger to Nauradehi Wildlife Sanctuary in Sagar.

5.6 Banda

It has a good prey base and has been visited by tigers of PTR in past. As was observed during study and through secondary information, Nilgai is in good population in area which is also hampering crops of local people. What makes it important is extreme fuel wood collection being practiced in area, which if not stopped soon, will definitely lead to loss of its precious forest area.

5.8 Badamalehara

Lying adjacent to reserve with good prey base and thick forest cover, it is one of few areas for tiger to disperse to other forest divisions lying in west of PTR.

6. WEAK LINKS

6.1 Non-forest area between North & South Panna

There is a patch of non-forest area between North Panna and South Panna, where in there is sufficient traffic going on, enough to disturb the movement of tiger and other species between the respective forest divisions. Securing this part is very important for supporting the dispersal of tigers between north Panna and south Panna division.

6.2 Mahindra and Tendukheda

Mahindra lying at the top of South Panna Forest Division and Tendukheda with Singrampur on one side and Tejgarh on the other side acts as a crucial point for moving inside the South Panna Forest Division and Damoh Forest Division. The survey showed lack of prey species and non-availability of water in these two places which if not taken care of can hamper the movement of tiger across the landscape.



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7. THREATS

Different developmental activities in the Panna landscape exhibit a great challenge towards managing wildlife habitat. Among these, the most severe threats that were noticed during study period were the fuel wood collection and cattle grazing.

Overabundant livestock population is going to be a big concern in future for viability of these linkages for wildlife passage. Livestock seems competing with their wild counterparts for limited fodder resources. Besides grazing, lopping of trees to use as fodder for the livestock is very much evident which affect the vegetation quality of forest areas.

All the forest divisions have numerous human settlements. Most of these villagers depend on the forest for their livelihood, either through cattle grazing or through collection of different timber and non-timber forest products.

Our observations indicate that cattle rearing was part of the livelihood activity for the people of villages, most of which stray in forest regions and deter regeneration of trees and plants over there. We recommend that further studies needs to be done in order to better understand the effect of cattle grazing, fuel wood collection on forest resources and to suggest measures to mitigate the same.

Apart from these two activities which were visible in all forest divisions, other infrastructure activities like illegal mining and road construction also poses a great challenge in protection of wildlife.

In 2010 the ministry of environment and forest (MoEF) closed all the mining activities, which were till now operative in the forest lands. The forest department is trying to recover the lost forest area owing to these mining activities through facilitating plantation in those areas (Yogesh, 2013). However in few areas mining is still going on, such as in Devendranagar range of North Panna and Pawai and Saleha ranges of South Panna division. Though mining is not exactly on the corridor or linkages but associated activities such as transportation of the material on heavy vehicle disturbs the entire habitat.

Studies have already documented the dreadful impact of these infrastructures, roads and timber collection on the dispersing animals (Vattakaven, 2010).

Water is the key resource for tigers and other species, which is even considered to be one of the population limiting factors for tiger (Karanth, 2003; Wildlife Institute of India, 2009). Vulnerability of wildlife towards scarcity of resources was quite clear during the survey. The signs of target species were even found quite close to the human habitation in order to access the only source of water in those areas. They not only have to travel through unsafe areas but this also makes them more prone towards being poached. In order to curb this, monitoring of water sources, like water holes and *naala* should be undertaken in a regular and effective manner.

8. CONCLUSION

The present report is a preliminary study on current scenario within the Panna landscape and provides baseline information on the presence of different wildlife in the area. The study was carried out for assessing the potential of area around Panna Tiger Reserve as a corridor for movement of tigers and for identifying stepping stones and weak links in the corridor apart from different threats experienced by the species in the area.

As per FD of Panna Tiger Reserve, in an ongoing process taken by Forest Department in identifying critical linkages around PTR, 4 corridors around PTR have come into picture on the basis of dispersal of different tigers from PTR. These corridors are (1) South west corridor falling under five district of Panna, Chattarpur, Damoh, Sagar and Katni and used by 4 tigers between 2009 and 2014. (2) Southern Corridor covering 3 districts of Panna, Chattarpur and Sagar which was used by 2 tigers in 2013. (3) North Eastern Corridor used by two tigers between 2011 and 2012 and falls under Panna and Satna districts (4) Eastern corridor used by one tiger in 2014 and falls in Panna, Satna, Rewa districts. Out of these the most promising is South West corridor which has been providing movement opportunity to maximum number of tigers for last 4 years. The study that was carried out covers 4 out of 5 districts of this South West corridor and study confirms the importance of this area for future tiger dispersal as also suggested by FD of PTR.

Even though the study was carried for a short time span, it clearly shows that majority of connectivity between different divisions has already been lost due to increasing human population in the area.

But still in spite of growing development in area, the study provided evidence in terms of tiger signs or direct visual sighting through camera trap and showed use of area by tigers while moving towards other tiger reserves. Presence of other carnivores like leopards, sloth bears, jackal, hyenas and dhole was registered during our study.

As far as prey base is concerned, indirect evidence in form of pellet counts revealed good distribution over the study area. But along with protection to critical areas identified, even these wild preys have to be protected to ensure their availability when tigers disperse.

A detailed study needs to be undertaken on the current land use patterns, socio-economic status and the extent of forest dependency by these villages. Depending on different livelihood concerns of villagers, local important resources should be identified and accordingly suitable management strategies be implemented. As a part of management plan one remedial measure that can be taken to facilitate movement of wildlife through this corridor would be enabling the cultivation of corridor crops in potential corridor



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routes along with propagating *Ficus Hispida*, *Terminalia arjun* and *Dendroclamus strictus* along the moist nallahs. Corridor crops may include castor, sugar cane, cashew, chikoo and mango orchards (per comms-AJT Johnsingh)

Awareness should be created among local communities about importance of wildlife and forest, and they should be motivated to get involved in conservation programs.

Protecting Panna landscape is critical for the long-term conservation of the tiger population within this landscape. We can't afford to witness again what happened in 2009 in the Tiger Reserve, when it was asserted that combined factors of 1) difference in working with adjacent territorial divisions leading to more tigers being poached in the adjoining fringe areas 2) lack in protection mechanism and any intelligence gathering about poachers both inside and outside the reserve led to Panna debacle (Special Investigation Team, 2009). Engagement with local communities, supporting the Forest Department and continuous monitoring of the tiger population in these corridors are some of the major activities, which would ensure that the functionality of the landscape is maintained in long run.

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