## SATPURA-PENCH CORRIDOR PROFILE

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COALITION FOR WILDLIFE

CORRIDORS

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## SATPURA - PENCH CORRIDOR PROFILE





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## **Corridor Overview**

The Satpura-Pench Corridor connects Satpura and Pench tiger reserves near the southern boundary of Madhya Pradesh in Central India. The corridor covers approximately 4256 km<sup>2</sup> with a mosaic of forests and agriculture interspersed with villages, a few mines, and several intersecting roads and railway lines. Despite being fragmented, the Satpura-Pench Corridor facilitates functional connectivity for tigers and is home to several threatened species, including leopards (*Panthera pardus*) and four-horned antelope (*Tetracerus quadricornis*). However, expansion of linear infrastructure and habitat degradation pose an imminent threat to the forest and wildlife within the corridor.



Area of natural habitat High 59.77%



Area under forest department Medium 52.4%



Threatened species richnes Low 28 species/km<sup>2</sup>



Human population Medium 244 persons/km



Human modification index Medium 0.48



Natural habitat fragmentation index Medium 0.66



Landscape complexity index Medium 0.93



anduse change index.

Habitat connected: Satpura - Pench Area of corridor: 4256 km<sup>2</sup> Focal species: Tigers, leopards, four-horned antelope Major threats: Linear infrastructure, habitat degradation CWC members: Wildlife Conservation Trust, WWF-India



Satpura-Pench corridor

# **1** Corridor Significance

## 1.1 Importance of core habitats connected

### Satpura Tiger Reserve (STR):

This tiger reserve is located in the Narmadapuram (Hoshangabad) district of Madhya Pradesh, India. The core and buffer area of STR, spanning approximately 2133.3 km<sup>2</sup>, includes Satpura National Park and Bori and Pachmarhi Wildlife Sanctuaries. STR is home to 52 species of mammals, 300 species of birds, and 31 species of reptiles. The reserve supports a population of 40 tigers, with a density of 1.39 tigers/100 km<sup>2</sup> (Jhala et al., 2020). Despite currently having a lower population density of tigers than some other protected areas (PAs) in central India (Jhala et al., 2020), STR is part of a large and somewhat



contiguous forest patch. It, therefore, has the potential to see an increase in these numbers due to conservation actions taken by the forest department to secure critical wildlife areas in this area. The reserve's terrain is rugged with sandstone peaks, deep valleys, rivulets, reservoirs, and dense forests. Vegetation types found here include southern moist mixed deciduous, southern dry mixed deciduous, and dry peninsular Sal forests (Champion and Seth, 1968). STR also has significant stretches of mixed riparian forest along perennial streams. Moreover, this PA is important from a hydrological perspective since several rivers originate from STR. Perennial forest streams of STR also support a population of the near-threatened Eurasian otter (Lutra lutra), which was recently recorded from this landscape (Joshi and Pariwakam, 2017).

### Pench Tiger Reserve (PTR):

Spread across two states, this tiger reserve falls within the Seoni and Chhindwara districts of Madhya Pradesh and Nagpur district of Maharashtra. The area of PTR includes the Pench National Park, Mansinghdeo Wildlife Sanctuary, and Pench Mowgli Wildlife Sanctuary. The total area of PTR in Madhya Pradesh is 1179.63 km<sup>2</sup>, which includes a core area of 411.33 km<sup>2</sup> and an additional buffer of 768.302 km<sup>2</sup>. In Maharashtra, the tiger reserve covers an area of 452 km<sup>2</sup> (Jhala et al., 2020). PTR has 58 species of mammals, 325 species of birds, and 33 species of reptiles. The reserve is home to 87 tigers with a density of 5.5 tigers/100 km<sup>2</sup>(Jhala et al., 2020). The vegetation of this landscape is classified into southern tropical dry deciduous forests, southern Indian tropical moist deciduous forests, with teak dominated forests overlapping bamboo patches and ample shrub cover (Champion and Seth, 1968).

### 1.2 Wildlife utilising the corridor

Recent research provides evidence of genetic exchange among tigers of STR and PTR (Sharma et al., 2013; Thatte et al., 2018; Yumnam et al., 2014). While these studies point towards the successful dispersal of tigers across the corridor, on-ground validation of recent corridor use by tigers and other species has also been provided by cameratrapping exercises carried out over the last few years (WWF-India, unpublished data; Joshi and Pariwakam, 2017). The corridor also supports a good population of leopards with a density of 1.79 leopards/100 km<sup>2</sup> (Joshi and Pariwakam, 2017). A recent country-wide analysis that used species presence locations and occupancy modelling framework, estimated canids to have a moderate probability of occurrence in the tehsils overlapping with the corridor (Srivathsa



Chinkara (Gazella bennettii) has been reported to use the Satpura-Pench corridor. "Considerably smaller than the blackbuck, it prefers low jungle to open plain; and trusts more to its watchfulness and activity than to speed, which, however, it also possesses in a high degree," James Forsyth (Highlands of Central India)

et al., 2020). Camera trapping surveys captured several jackals and wolves and found them to be widely distributed in the corridor. There were fewer captures of foxes, dholes, and hyenas and they were restricted to specific areas (WWF-India, unpublished data; Joshi and Pariwakam, 2017). Overall, 24 species of mammals including sloth bears (Melursus ursinus), rusty-spotted cats (Prionailurus rubiginosus), chinkara (Gazella bennettii), four-horned antelopes, and honey badgers (Mellivora capensis) have been recorded using the corridor (WWF-India, unpublished data; Joshi and Pariwakam, 2017). Jungle cat (Felis chaus), Indian hare (Lepus nigricollis), Indian crested porcupine (Hystrix indica), golden jackal (Canis aureus), leopard, and rusty spotted cat were captured not only from the forested patches within the corridor but also from the surrounding farmlands (WWF-India, unpublished data). Agriculture across most corridors in the Central India landscape is likely to facilitate wildlife movement among natural habitat patches (Thatte et al., 2020).The Satpura-Pench Corridor is also home to several bird species,

including vulnerable, endangered, and critically endangered birds. Whiterumped Vulture (*Gyps bengalensis*), Red-headed Vulture (*Sarcogyps calvus*), and Indian Vulture (*Gyps indicus*) are critically endangered bird species found in the corridor. Endangered birds from the area include the Egyptian Vulture (*Neophron percnopterus*), Steppe Eagle (*Aquila nipalensis*), Black-bellied Tern (*Sterna acuticauda*), and Indian Skimmer (*Rynchops albicollis*).

### 1.3 Importance for landscapescale connectivity

With tigers as the focal species, (Dutta et al., 2015) carried out a study to evaluate the contribution of each wildlife corridor within Central India towards facilitating animal movement across the landscape. They found the Satpura-Pench Corridor to be among the linkages that are particularly important for maintaining landscape-level connectivity. Modelling to predict tiger movement patterns and connectivity across this landscape (based on data from Thatte et al., 2018) reveals a branching network of connections between the Satpura-Pench and Satpura-Melghat corridors (Figure 1). Thus, the Satpura-Pench Corridor also serves to provide connectivity to Melghat Tiger Reserve through inter-connected corridor networks in the region.



Figure 1: Tiger connectivity in the Pench-Satpura-Melghat region. The connectivity map was generated using a circuit theory based approach and a base map from Thatte et al. (2018). Green regions depict the areas most likely used by dispersing tigers and the brown regions depict areas that impede movement.

# **2** Corridor Characteristics

## 2.1 Boundaries



Figure 2: Satpura-Pench corridor delineated by a crude boundary

The Satpura-Pench Corridor lies in the southern part of Madhya Pradesh, India. Delineating the precise boundaries of a corridor is often a challenge. We carried out a crude delineation of the corridor boundary using a circuit theorybased modelling approach (Figure 2). The crude boundary corresponds to areas that have a high probability of tiger movement (delineation details are included in supplementary information).

Spanning an area of approximately 4256 km<sup>2</sup>, the corridor spreads across

the districts of Chhindwara and Betul in Madhya Pradesh, with a small portion overlapping with the Nagpur district of Maharashtra. Figure 3 shows the district tehsils that the corridor overlaps with. Administratively, forested parts of the corridor fall under the jurisdiction of East Chhindwara, West Chhindwara, South Chhindwara, North Betul, and South Betul territorial forest divisions in Madhya Pradesh, while a small part extends into Nagpur territorial forest division of Maharashtra (Figure 4).



Figure 3: Administrative map representing districts and tehsils overlapping the Satpura-Pench Corridor -Betul district: Ghoda dongari, Amla, Multai tehsils, Chhindwara district: Tamia, Jamai, Umreth, Mohkhed, Pandhurna, Sausar, Bichhua tehsils, Nagpur district: Savner tehsil



Figure 4: Administrative map representing the forest divisions overlapping the Satpura-Pench Corridor.

## 2.2 Physical characteristics

The corridor falls within the Satpura-Maikal region of the Central India landscape. The corridor landscape comprises the undulating sandstone mountains of Satpura, low-lying metamorphic, igneous rocks of Denwa formation, rivulets, and gorges in the north, graduating to the vast plains of Chhindwara towards the central and southern parts of the corridor (Bhattacharjee, 2017). The sandstonedominated northern part of the corridor lies within the Pench-Kanhan-Tawa coalfields (Choudhary and Kumar, 2021), the westernmost of the Gondwana coalfields (Singh and Shukla, 2004). Shallow, loamy soils cover the northern hilly regions, while the southern part of the corridor has black cotton soil ("Ministry of Water Resources," 2013). Vegetation in this region is dominated by southern tropical moist and dry mixed deciduous forests. Additionally, there are also several patches of teak plantations across the corridor. Patches of Sal forests can be found near STR. Alongside forest land, the corridor has a mosaic of towns, mines, agricultural fields, and a network of roads and railways.

## 2.3 Hydrology

The northern part of the corridor falls within the Narmada river basin, while the central and southern parts fall within the Godavari river basin. The majority of the area is drained by the Godavari basin (65%, north to south direction) followed by the Narmada basin (35%, south to north direction). The annual average rainfall in the corridor region is 1155 mm (Source: India Meteorological Department, Gridded data). Both rivers, Narmada and Godavari, are prone to flooding because of the quick response to rainfall events, and the streams and tributaries passing through the corridor likely contribute to that. The Kanhan/Kanha river, a tributary of Wainganga river, originates within the corridor boundary and is the main river passing through the corridor. The river flows north to south where several sub tributaries join and contribute flows to the Kanhan river. The length of Kanhan river within the corridor is 109 km. The river was perennial until a few decades ago, but now remains dry beyond the month of February. There is one Central Water Commission hydro observation station on Kanha river near Ramakona village, information from which can be used for understanding trends in river discharge over time. The major

tributaries of Kanhan in the corridor are: Bel river, Odhexa Nalla, Lalkhati Nalla, Wanghya nalla, Sampna Nalla, Sovna River. The Tawa River is another major river in the corridor, which is a tributary of Narmada River and has 47 km in length in the corridor. The major water resource infrastructure within the corridor is Satpura Reservoir, an earthen dam of 33 m in height, constructed for the purpose of drinking/ water supply. The inundated area of the reservoir extends to over 1000 ha. Apart from Tawa, smaller tributaries of Narmada river, Jhmru Nalla, Katta Nalla, Sonbhadra Nalla, and Bharanga Nalla, also originate from the northern portion of the corridor.

### 2.4 Land use within corridor

Most of the corridor area, around 59%, is covered by natural habitat. This includes open forests (~21%), closed forests (~30%), and shrubs and herbaceous vegetation (~8%). However, forests in the corridor are fragmented by linear infrastructure, reducing the size of individual forest patches in most of the corridor to less than 500 km<sup>2</sup> (Nayak et al., 2020). An extensive network of roadways exists within the corridor and includes national (69.18 km) and state (139.87 km) highways, and small roads connecting villages. Railway lines connecting Chhindwara to Nagpur and Chhindwara to Amla also pass through the corridor. The total length of railway lines intersecting the corridor is 118.6 km. Apart from this, a noticeable

deposit of the Pench-Kanhan-Tawa coalfield overlaps with the corridor and is being mined through underground and opencast mines. Permanent water bodies, including reservoirs, cover 0.2% of the corridor area. Satpura dam, situated on the Tawa river in Betul district; Kanhargaon dam, situated on the Kulbhera river (a tributary of Pench river), Umriya Dalel, situated on the Umra river (a tributary of Kulbehra river), and Waghyanala Dam, situated on Waghyanala river (a tributary of Kanhan river) in Chhindwara district are some of the dams within the corridor.

Agriculture covers 39% of the total corridor area. Major crops cultivated in the corridor are maize, cotton, pulses, orange, soybean, and small millets. Besides these, rice, wheat, groundnut, sorghum (jowar), and a wide range of vegetables like brinjal, potato, tomato, okra, flat beans, chilli, and cauliflower are grown in parts of the corridor. Maize is the dominant crop cultivated across the corridor. Owing to the large production of maize (6,80,000 metric tons/year is produced across Sausar, Mohkhed, Pandhurna, Bichua, Tamia, and Jamai tehsils), Chhindwara is called the 'corn city'. Cotton, an important cash crop, is cultivated in the southern part of the corridor, especially in Sausar, Mohkhed, Pandhurna, and Bicchua tehsils owing to the favourable black soil. About 20,000 metric tons of cotton (with seed) is produced per year in tehsils overlapping with the corridor. Soybean is produced dominantly in the Mohkhed, Pandhurna,



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An extensive network of roadways exists within the corridor and includes national (69.18km) and state (139.87km) highways, and small roads connecting villages. Bicchua tehsils of the corridor followed by Jamai block; 40,662 metric tons of soybean is produced in the corridor per year. Due to its proximity to Nagpur, the 'orange city', oranges are produced extensively in Pandhurna, Bicchua, and Sausar blocks of the corridor. About 4,59,082 metric tons of oranges were produced from 229.54 km<sup>2</sup> of area within tehsils overlapping with the corridor in the year 2020-21(WWF-India, unpublished data).

### 2.5 Critical corridor areas

We identified an area as critical if two or more studies provided evidence to support it. The three critical areas identified within the corridor are represented as boxes in Figure 5.



Figure 5: Critical areas in the Satpura-Pench Corridor. (Boxes 1, 2, and 3 represent the crtical areas).

#### Box 1:

This area falls within the Jamai range of the West Chhindwara territorial forest division. Bhatoriya, Morchhi, Khumkal, Hirdagarh, and parts of Badnoor, Navegaon, Madani, and Durgwara beats fall within this critical area. Visually, this area seems to have relatively poor structural connectivity compared to the rest of the corridor and it is also a part of a region where tiger movement is likely to be highly restricted (Dutta et al., 2015). Human modification (Figure 6, Kennedy et al., 2019) and the number and size of villages in this area is higher compared to other parts of the corridor. The railway line connecting Chhindwara and Amla passes through this area and Dutta et al., 2018 identify potential barriers to tiger movement associated with this railway line. Despite the challenges, camera trapping surveys in this area captured 11 mammal species (Joshi and Pariwakam 2017; WWF-India, unpublished data).



Figure 6. Map showing the extent of human modification (0–0.7) across the corridor based on Kennedy et al. (2019) that quantified the degree of human modification on the basis of multiple anthropogenic stressors

#### Box 2:

This area overlaps with the central part of the Lawaghoghri range, the eastern part of the Ambada range, and parts of other surrounding ranges in the South Chhindwara forest division. Based on a survey conducted by WWF-India, 19 of 24 mammal species reported from the corridor are found in this area, including the tigers. Based on data collected by the state forest department personnel and modelling exercises, Jhalla et al., 2016 had predicted the number of tigers in Sausar tehsil, which overlaps with the areas in boxes 2 and 3, to be around 13 (SE range: 11-15). Two recent camera-trapping surveys provide evidence of tiger presence in box 2. The tigers captured in both surveys were different individuals (Joshi and Pariwakam, 2017; WWF- India, unpublished data). With the evidence of tiger presence over the years within the corridor, such stepping stone habitats that support small clusters of individuals aid dispersal between larger, more robust populations and are critical for maintaining connectivity and reducing the probability of extinction of connected populations (Thatte et al., 2018). This

area, therefore, needs to be regularly monitored and conserved to maintain corridor functionality.

#### Box 3:

Two independent connectivity modelling exercises (Dutta et al., 2015 and connectivity modelling based on data from Thatte et al., 2018) identify this area to have a high probability of movement, but through a narrow and constricted area. Such areas are often called pinch points, where the movement of dispersing animals gets funnelled through narrow areas. Loss of permeable area within pinch points can disproportionately impact connectivity. Furthermore, (Dutta et al., 2016) suggest that this area is important for maintaining functional connectivity across the Satpura-Pench Corridor and keeping the entire landscape connected. NH547 and the Nagpur-Chhindwara railway line pass through this corridor, and potential barriers to tiger movement in this area associated with both these infrastructures have been identified (Dutta et al., 2018).



# **3** Stakeholders and Management

## 3.1 Legal status

Around 51% of the corridor area is under the jurisdiction of the territorial forest divisions of the MP forest department (Figure 4), with small patches across the corridor under the Madhya Pradesh Rajya Van Vikas Nigam Limited (Forest Development Corporation). Each territorial forest division manages its area based on a Working Plan that is revised every 10 years. About 20 km<sup>2</sup> of



Boundary between forest and village in the Damua Range (Chhindwara district) within the Satpura-Pench Corridor

the area in the corridor is mined ("India Under Construction," 2020). Most of the coal blocks in Damua and Parasia (Chhindwara district) and Patakhera (Betul district) have been allotted to Western Coalfields Limited, a subsidiary of Coal India Limited. A small part towards the northern side of the corridor falls within the Pachmarhi biosphere reserve.

Biosphere reserves promote integrating natural and social science research to improve human livelihoods and safeguard natural and managed ecosystems. Such an approach is essential in multi-use corridors, such as the Satpura-Pench Corridor, where innovative approaches are needed for connectivity conservation while ensuring economic development that is socially and culturally appropriate and environmentally sustainable. While being a part of the biosphere reserve can have implications for management of the corridor area, it does not affect the legal status of the land and the ownership continues to remain unchanged. A Management Action Plan for the biosphere reserve is prepared by the Environmental Planning and Coordination Organization, Bhopal and implemented through a District Level Coordination Committee.

### 3.2 Settlements and communities

The average population density across the corridor is 243 persons/km<sup>2</sup>. There are around 632 villages in the corridor with an average population of 721 persons/

village, with agriculture being the primary occupation of the communities in the corridor (Census of India, 2011) About 11.11% and 36.82% of the population belong to the scheduled caste and scheduled tribes respectively (Census of India, 2011). Major tribal communities living in the corridor include Gonds and Korkus (Mawasi) (Census of India, 2011). Small and marginal farmers dominate the entire corridor with an average land-holding of 1.4-1.8 hectares per farmer. Their livelihood is predominantly dependent on agriculture and the collection of non-timber forest products (NTFP) (WWF-India, unpublished data). The collection of NTFP is a traditional and common income generation activity in this region. NTFP like Bhilva flowers and fruits (Semecarpus anacardium), Imli fruits (Tamarindus indica), Tendu Mahua (Diospyros melanoxylon), flowers (Madhuca indica), Custard apple (Annona squamosa), Chironii (Buchanania lanzan), Hirda (Terminalia chebula), Behda (Terminalia bellirica) and Amla (Phyllanthus emblica) are among a few important products found in the corridor.

> Indian leopard (Panthera pardus)

## **4** Challenges

### 4.1 Infrastructure

Structural connectivity between Pench and Satpura tiger reserves is disrupted by multiple developmental and anthropogenic pressures, including mining activities, agriculture, habitations, major highways, and railway lines, which may restrict wildlife movement (Dutta et al., 2018; Nayak et al., 2020; Yumnam et al., 2014).

### Mining:

Open-cast and underground mining for coal, and at some places for dolomite, is carried out in certain regions of the Satpura-Pench Corridor. The Pench-Kanhan-Tawa valley coalfield, which has a considerable share of thermal grade non-coking coal reserves, overlaps the corridor towards the north. The size of the coalfield is 2426 km<sup>2</sup>, distributed among approximately 68 coal blocks, out of which several blocks are currently mined. Some of the active coal mines are situated around Damua, Parasia and Patakhera villages within the corridor. Dolomite mines are found in Sousar range towards the southern side of the corridor ("E-Khanij," 2022). Future mining expansion, intensification, associated development and of transportation infrastructure and settlements within the corridor area will likely impede animal movement and connectivity (Dutta et al., 2018).

### Roads:

There is an intersecting network of roadways within the corridor which includes National Highways 547 and 347, and State Highways SH 41A, SH 62, SH 45, and SH 46. Over the years, this network has grown through the construction of new roads and widening of existing ones ("Progress Report, Madhya Pradesh Road Development Corporation Limited," 2021). Despite recommendations from the Wildlife Institute of India for mitigation measures (2012), the Nagpur-Chhindwara (NH 547) road was widened into a fourlane highway, with upgraded twolane sections through the forest areas, without mitigation measures (Parivakam et al., 2018). Roadkills of multiple species including snakes, civets and monkeys were observed in the corridor during a wildlife occupancy survey (Patil, O., personal observation, 2021) despite the various boards placed on the roads instructing vehicles to drive slowly to aid animal crossing.

### Railway:

Railway lines connecting Chhindwara to Nagpur and Amla pass through the corridor. (Dutta et al., 2018) have identified several areas along the railway lines that can be potential barriers to tiger movement within the corridor. Although no recent reports were found from within the corridor, a carcass of a sub-adult tiger on the railway track near Bhoura (Free Press Journal, 2021) was reported from an area close to the corridor, on the Narmadapuram (Hoshangabad)-Betul railway line.



### 4.2 Human-wildlife conflict

Livestock loss due to depredation by wild carnivores is shown in Figure 7 ("Madhya Pradesh Forest Department," 2020). Most attacks on humans were reported in summers and winters during the collection of NTEP. A total of 95 incidents of attacks on humans and 2 human deaths by wildlife were recorded from the year 2007 to 2016 in the West Chhindwara forest division, which includes parts of the division inside and outside the corridor ("West Chhindwara Working Plan, West Chhindwara forest division, Madhya Pradesh Forest Department," 2017).

Pilot surveys to assess crop depredation by wildlife carried out in the South Chhindwara division, reveal that maize, groundnut, and vegetables are raided by wild pigs, langurs, macaques, hare, chital, and blackbuck (WWF-India, unpublished data). As a protective measure, farmers guard their crop fields day and night. Additionally, crackers, machans, fences, and live wires are used as a protective measure against herbivores. Managing human-wildlife conflict is necessary to prevent damage and loss to both humans and wildlife in the corridor.



Figure 7. Hotspot map representing areas with livestock losses

## 4.3 Land use change

A recent land use change study highlighted a phenomenal reduction in dense forests, by 54.93%, from 2002 to 2019. Additionally, the area of scrub forests has increased by 150% owing to the degradation of dense and open forests (Banerjee et al., 2020). The reduction in forest cover on a large scale in the corridor can be attributed to anthropogenic activities like mining, increasing settlements and conversion of forest land into agriculture. The study also highlighted a reduction in water bodies by 26% in the corridor (Banerjee et al., 2020).

## 4.4 Illegal activities

### Wildlife poaching:

Between 2011 and 2021, 218 incidents of crime have been reported from the five territorial divisions that overlap with SatpuraPench corridor (data obtained from Madya Pradesh Forest Department). Of these, a total of seven incidents involving tigers were reported from East Chhindwara (2 cases), North Betul (2), South Chhindwara (2), and West Chhindwara (1). A total of 16 leopard-related incidents were also reported from the five divisions during this period. In addition, 136 incidents related to prey species, including barking deer, blackbuck, chital, four-horned antelope, Indian gazelle, nilgai, sambhar, and wild boar, were recorded. The most common prey species involved in wildlife crime incidents included wild boar, followed by sambhar, barking deer, and chital. In addition, about 24 skin, 199 pieces, 34 kg of bones, over 1800 kg of meat, 37 teeth, 29 antlers, 73 nails, paws, and hair of wild animals were seized from these divisions. However, seizure of body parts might not necessarily imply that the wildlife crime was committed within the corridor. The most common methods of poaching involved use of local weapons (21%), electrocution (12%), and snaring (9.8%).



#### Forest fires:

Forest fires are common in the dry season (Figure 8) and, in some ways, indicate human impacts on the forest's understory as fires in central India are mostly human-initiated. Often, these fires are unintentional but spread due to negligence. For example, localised burning of the forest floor while collecting Mahua (*Mahua longifolia*) flowers and Tendu (*Diospyros melanoxylon*) leaves, if not controlled, can spread to surrounding areas fuelled by the dry-grass understory that is typical across the corridor. Fire setting is currently a punishable offence under the Indian Forest Act (Thekaekara et al., 2017). However, (Ratnam et al., 2019) argue that dry deciduous forests, the primary forest type within the corridor, are drought-prone, fire-driven mesic savanna-like ecosystems where seasonal water stress and fire are essential drivers of forest composition and structure. Thus while unregulated, human-induced fires remain a challenge, a better understanding of the corridor forests and their management needs further research.



Figure 8. Forest fire intensity in the Satpura-Pench corridor (based on data from 2016)

### 4.5 Other challenges

#### Disease transmission:

Feral dogs have a widespread presence in the corridor area, as shown by photographic evidence (Figure 9). Dogs host several infectious pathogens including Canine distemper virus and Carnivore Parvovirus 1 (CP1) that can exist in multiple hosts and have been reported from wild carnivores in central India including tigers and leopards. Additionally, CP1 was also detected in sloth bears, dholes, striped hyenas among other carnivores in India. Such multi-host pathogens are an emerging threat to wildlife and have the potential to cause species decline and population extinction (Shetty, 2019). Multi-host surveillance programs are likely to be beneficial for long-term conservation of tigers and other carnivores (Shetty, 2019). Such programs would be especially helpful in the Satpura-Pench Corridor and other corridors where several carnivores co-occur with a large number of domestic dogs. They are likely involved in disease transmission to wild canids. In the Central Indian landscape, there have been several instances of decline and even local extinctions in populations of dholes due to diseases (Joshi and Pariwakam, 2017).



Figure 9. Domestic dog camera-trap capture intensity

## **5** Recommendations

- 1. Allocation of new coal blocks and expansion of existing mining projects should be avoided in areas of the Pench-Kanhan-Tawa valley coalfield that overlap with the corridor. Restoration of exhausted mining sites should be carried out. Recognizing the need for restoration, the Madhya Pradesh forest department formed a working group in 2016 for ecological restoration of the Satpura Pench wildlife corridor that includes representatives from Chhindwara Forest Circle, Western Coalfields Ltd. and WWF India chaired by the Chief Conservator of Forests, Chhindwara. The overarching objective of the working group is to address impacts of mining in the corridor through sharing of knowledge, expertise and resources. The working group has had a few meetings with a focus on exploring ways of biodiversity centric restoration of two exhausted opencast mines - Damua and Kotidev - located in the corridor. Restoration of these two mines needs to be prioritised.
- 2. To enhance forest cover, the Madhya Pradesh forest department carries out plantation activities in degraded and understocked forest areas (Green India Mission, 2016). However, acknowledging the importance of grasslands for chital populations, the forest department recommends prohibiting plantations in grasslands. The current working plan

of the West Chhindwara forest division notes that chital, once abundant in the Delakhari and Tamia forest ranges, have reduced in number in the corridor owing to a loss of suitable habitat. As the corridor landscape comprises grasslands, especially in ranges close to STR, caution should be heeded to avoid plantations in this region. Afforestation of grasslands has been found to lead to an unnatural change in the underground water-table levels (Clark et al., 2021; Jobággy et al., 2011) and it also affects mammalian communities (lezzi et al., 2020). A first step towards protecting the grasslands within the corridor would be mapping their extent and assessing their composition and habitat quality.



Golden jackal (Canis aureus)

- 3. Pilot surveys that included 80 semistructured interviews conducted in a part of the corridor (WWF-India, unpublished data) found that people hesitated or avoided filing for compensation regarding crop losses by wildlife, primarily due to late and insufficient compensation amounts provided by the authorities. Despite an existing system for compensation of crop loss, efficient execution of this system requires an understanding of the limitations, barriers, and challenges implementation. Surveys facing towards understanding these need to be conducted.
- 4. Satpura-Pench and Satpura-Melghat corridors have several connections between them (section 1.3). Conservation planning in this area would require considering both these corridors as inter-connected linkages, also allowing the conservation of branches connecting these corridors that are used by wildlife. This will require, among other things, congruence

between the tiger conservation plans of STR, PTR, and Melghat tiger reserves along with working plans of the territorial forest divisions that are a part of the two corridors.

5. The decrease in the area under dense forest within the corridor over the last two decades is of serious concern. Preserving forest cover in the Satpura-Pench Corridor is important because loss of natural habitat will not only affect wildlife but also the river ecosystem services. This corridor lies within the Narmada and Godavari river basins and two major rivers, Tawa and Kanhan, and several smaller tributaries originate within the corridor. The loss of riparian vegetation can cause narrowing of streams, which directly affects the freshwater fauna, quality of dissolved organic matter and pesticide degradation. Forest buffers, if protected, prevent pollutants from entering streams thus reducing their impact on downstream rivers and estuaries (Sweeney et al., 2004).

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## **6** Current Conservation Activities

1. Madhya Pradesh Forest Department is implementing the World Bank assisted 'Biodiversity Conservation and Rural Livelihood Improvement Project (BCRLIP) in selected villages within East, West, and South Chhindwara territorial forest divisions. The aim of this project is to encourage different models of participatory conservation to improve institutional capacity and provide better livelihood opportunities to people living in the corridor (<u>https://www.paryavaran.</u> com/photo/biodiversity-conservation-andrural-livelihood-improvement).

sect

2. WWF-India has been working with 6000 smallholder cotton farmers within the corridor and has facilitated the adoption of organic cultivation. In addition to capacity building for organic cultivation, market linkages are created for organic cotton so that farmers receive a premium for their produce.



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# 8 Supplementary Information

The crude corridor boundary was delineated as follows: Circuit theory-based modelling approach was used to identify the corridor based on resistance surface generated using genetic data (Thatte et. al. 2018). The cumulative current output values were classified into 10 quantiles and top four quantiles were chosen. Corridors were also identified based on the same resistance surface separately using linkage mapper for comparison. While most of the areas identified by the two approaches overlapped, linkage mapper did not identify some areas that are known to be used by wildlife. Hence, the two outputs were combined and overlaid with the least-cost-corridor identified in (Qureshi et al., 2014). A 5 km x 5 km grid was overlaid on the combined output and grid cells that overlapped with the identified potential corridor areas were selected and dissolved to get the final boundary represented on the map (Figure 2).



Asiatic wild dog (Cuon alpinus)







COALITION FOR WILDLIFE CORRIDORS The Coalition for Wildlife Corridors is a collaborative network of people and organizations working to advance connectivity conservation in India.

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