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**MAHARASHTRA
FOREST
DEPARTMENT**



**COALITION
FOR WILDLIFE
CORRIDORS**

2024

PENCH-NAWEGAON NAGZIRA CORRIDOR PROFILE

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PENCH-NAWEGAON NAGZIRA CORRIDOR PROFILE



**COALITION
FOR WILDLIFE
CORRIDORS**



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Date : 20th December, 2023

Central India, with its vast expanses of forested areas and the presence of several wild species, has long attested to the rich natural heritage of India. But as we advance further into the 21st century, this region continues to encounter unprecedented challenges. The primary causes are human activities such as uncontrolled mining, haphazard urbanization, and relentless agricultural expansion. These pressures have caused fragmentation of the once-continuous habitats that are essential for the survival of the diverse wildlife of this region.

While these challenges are certainly daunting, it is important to recognize that wildlife corridors - such as the Pench-Nagzira Corridor - can uphold the ecological balance of this region. These corridors act as lifelines, bridging isolated habitats and allowing the animals to freely move about. In a world where habitat fragmentation poses a significant threat to biodiversity, these corridors act as lifelines that allow species to roam, mate, and adapt to changing environmental conditions. They also serve as critical links that ensure genetic diversity, which is a fundamental component of a healthy ecosystem.

This document offers a comprehensive and detailed account of the Pench-Nagzira corridor, exploring its ecological value, tracing the wildlife found here, and identifying action able steps to safeguard its integrity in the future. I am confident that this document will become an important reference for all stakeholders, providing insights into the challenges and solutions related to conservation in Central India.


(Dr. Prabhu Nath Shukla, IFS)




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DATE: 23 February 2024

In the face of rapid land-use change and fragmentation, it has become crucial to maintain functional connectivity between protected areas. Wildlife corridors serve as vital conduits linking two or more habitats, enabling the dispersion and migration of species across fragmented landscapes. By connecting habitats that have been disrupted by human activities, wildlife corridors facilitate the free movement of animals, ensuring genetic diversity, access to resources, and adaptation to changing environmental conditions. Moreover, they can help mitigate human-wildlife conflicts and enhance the overall resilience of wildlife in the face of mounting challenges such as habitat loss and climate change.

Wildlife corridors in India spread across diverse land use types. Maintaining connectivity, therefore, requires a multifaceted approach that combines conservation strategies, community engagement, policy interventions, and sustainable development initiatives. Collaborative efforts involving government agencies, conservation organizations, local communities, and stakeholders are essential to ensure the long-term viability of wildlife corridors.

For efficient collaboration and effective corridor planning strategies, it is indispensable to meticulously document and develop a comprehensive understanding of existing knowledge about specific corridors. In this regard, this document presents an overview of different aspects and characteristics of corridor which will help all the stockholders to ensure wildlife connectivity in the region.


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Corridor Overview

The Pench-Nawegaon Nagzira Corridor connects the Pench habitat block (comprising Pench Tiger Reserves of Madhya Pradesh and Maharashtra) with the Nawegaon-Nagzira Tiger Reserve. The corridor lies in the Satpura–Maikal region at the northern border of the Eastern Vidarbha Landscape and spans across Maharashtra (Nagpur, Bhandara, and Gondia districts) and Madhya Pradesh (Seoni and Balaghat districts). Spread over ~3,002 km², the corridor primarily comprises agricultural fields (54.1%) and forests (41.1%), and is crisscrossed with several road, rail, and canal networks. It lies in the northern Godavari basin and is drained by the Wainganga river system. Long-term camera trapping exercises from the region have not only revealed records of tigers using the corridor for movement but also provided evidence of a resident breeding tiger population.

Other wildlife found in the corridor area include leopard, dhole, Indian grey wolf, sloth bear, Indian fox, Indian pangolin, honey badger, rusty-spotted cat, among others. Three critically endangered vulture species and the vulnerable Sarus crane are also reported from the corridor. The major threats to connectivity in the corridor include indiscriminate development of linear infrastructure without incorporating robust mitigation measures as well as land-use change from agriculture to other land-use types, especially dense cities, factories, mines, or industries that can hinder animal movement. The corridor area is rich in iron ore and manganese and has several large mines, thermal power plants, and stone quarries. Better coordination between tiger reserves and stricter criteria for mining lease clearances and extensions are necessary to maintain long-term connectivity of the corridor.



Habitat amount
Medium
44.42%



Area under forest department
NA



Threatened species richness
Low
30 species/km²



Human population
Medium
296 persons/km²



Human modification index
Medium
0.58



Fragmentation index
Low
0.85



Landscape complexity
Medium
0.68



Landuse change index
NA

Habitat connected: **Pench and Nawegaon-Nagzira tiger reserves**

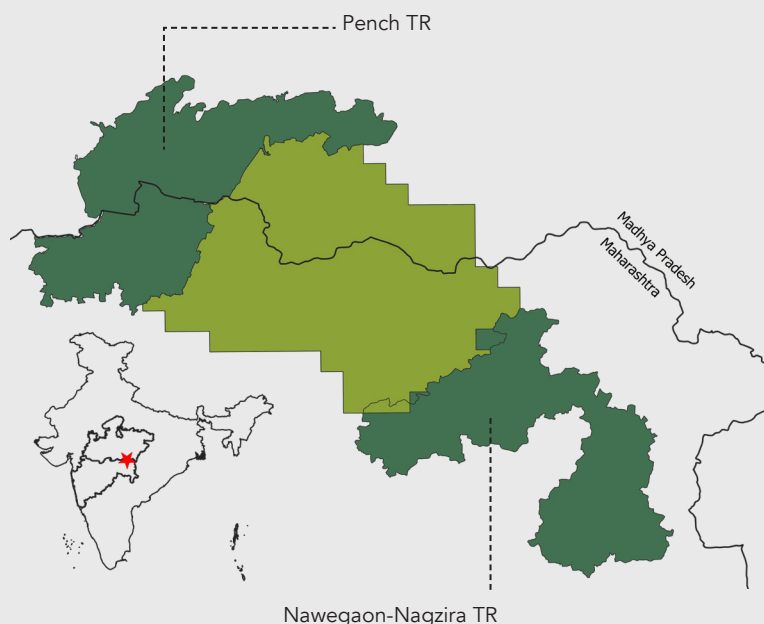
Area of corridor: **3002 km²**

Focal species: **Tiger, Leopard, Dhole, Sloth Bear**

Major threats: **Mining, land-use change, linear infrastructure**

Coalition for Wildlife Corridors member(s):

Wildlife Conservation Trust



★ Pench-Nawegaon Nagzira Corridor

1 Corridor History

Geological History

Bhandara Craton, which primarily covers parts of the Bhandara district and surrounding areas in the Pench-Nagzira corridor, is located in the eastern part of Maharashtra and is known for its diverse geological features. Cratons are the oldest and most stable parts of continental crust, and they typically have a long history of geological stability compared to other regions. The Bhandara Craton, like other cratons, has a complex geological history dating back billions of years. It is composed of ancient rocks, including Archean and Proterozoic rocks, which are some of the oldest rock formations on Earth. Cratons have not experienced significant tectonic activity or mountain-building events in a long time. Owing to their ancient geological history, cratons often contain valuable mineral resources.

The Bhandara Craton, for example, has mineral deposits such as iron ore and manganese, both of which have considerable economic significance.

Modern History

During the early 20th century, British surveyors recorded the presence of scattered patches of teak (*Tectona grandis*) along the Wainganga River in the corridor area (The Imperial Gazetteer of India, 1921). Other timber trees that were recorded from the corridor area, especially in the Bhandara and Balaghat districts, included saj (*Terminalia tomentosa*), lendia (*Lagerstroemia parviflora*), and bijasal or beula (*Pterocarpus marsupium*). Under the colonial zamindari system, some of the forests were controlled by landlords or Zamindars who



enjoyed special rights to timber. These forests were known as zamindari forests and primarily consisted of salai (*Boswellia serrata*). The corridor area was also abundant with "clumps of bamboo". In the open country, mahua (*Bassia latifolia*) thrived abundantly, whereas villages were surrounded by typical fruit-bearing and sacred trees such as mango (*Mangifera Indica*), pipal (*Ficus religiosa*), and banyan (*Ficus benghalensis*). Villagers primarily utilised Kusal and ghonar grasses for thatching, while musyal served as fodder. The primary crop grown in the region included rice, along with jowar, wheat, gram, linseed, and pulses. The practice of growing second crops in rice fields and irrigating rice started around the region in 1864. The British surveyors also noted that "*tigers, leopards, and deers were found in most of the forests, snipe and duck were fairly plentiful, and large fish were obtained in Wainganga and Nawegaon lake.*"

In addition, the British explored the mining potential in the corridor and the surrounding areas after it was established that the region was rich in iron and manganese. Several prospecting licences and mining leases were granted, especially in the Nagpur and Balaghat districts. In the Imperial Gazetteer of India, British surveyors noted that "an important mining industry had sprung up" in this region. Manganese Ore (India) Limited (MOIL), currently the largest producer of manganese ore in India that owns several mines within the corridor area, was originally set up as a British company in 1896, the assets of which were later taken over by the Government of India in 1962. Most of the mines currently active in the corridor area are almost a century old.



2 Corridor Significance

2.1 Importance of connected core habitats

Pench Habitat Block:

The Pench Habitat Block comprises two contiguous namesake tiger reserves—Pench Tiger Reserve, Madhya Pradesh (PTR-MP) and Pench Tiger Reserve, Maharashtra (PTR-MH). PTR-MP spreads across the districts of Seoni and Chhindwara, whereas PTR-MH is situated in Nagpur district. Originally demarcated as a wildlife sanctuary, PTR was notified in 1992 when it was included under Project Tiger. The Pench Habitat Block comprises a total area of 1,920.89 km², of which approximately 60% lies in Madhya Pradesh and 40% in Maharashtra. Pench Priyadarshini National Park and Pench Mowgli Wildlife Sanctuary form the core area (411.33 km²) of PTR-MP, which has an additional area of 768.3 km² as buffer. PTR-MH includes Pench National Park and Mansingh Deo Wildlife Sanctuary and has a core of 257.3 km² and buffer of 483.96 km². The recent census recorded the tiger densities in PTR-MP and PTR-MH as 5.5 tigers/100 km² and 5.1 tigers/100 km², respectively (Qureshi et al., 2023). In this profile, we have considered PTR as a single unit for ecological purposes even though administratively it is divided into two tiger reserves. The vegetation in PTR is classified as southern tropical dry deciduous forests (Champion and Seth, 1968). The large carnivore species found here include Bengal tiger (*Panthera tigris tigris*), Indian leopard (*Panthera pardus fusca*), dhole (*Cuon alpinus*), and Indian grey wolf (*Canis lupus pallipes*). Some of the other species include sambar (*Rusa unicolor*), chital (*Axis axis*), gaur (*Bos gaurus*), barking deer (*Muntiacus muntjak*), nilgai (*Boselaphus tragocamelus*), jungle cat (*Felis chaus*), rusty-spotted cat (*Prionailurus rubiginosus*), honey badger (*Mellivora capensis*), palm civet (*Paradoxurus jerdoni*), small Indian civet (*Viverricula indica*), Indian pangolin (*Manis crassicaudata*), four-horned antelope (*Tetracerus quadricornis*), Indian giant flying squirrel (*Petaurista philippensis*), and golden jackal (*Canis aureus*).

Nawegaon-Nagzira Tiger Reserve (NNTR):

This tiger reserve is located in Bhandara and Gondia districts in northeastern Maharashtra. Spread across 1894.94 km², NNTR has a core area of 653.67 km². Declared as a tiger reserve in 2013, NNTR includes five protected areas (PAs), namely Nawegaon National Park, Nagzira Wildlife Sanctuary, Nawegaon Wildlife Sanctuary, New Nawegaon Wildlife Sanctuary, and Koka Wildlife Sanctuary. Similar to PTR, the vegetation in this tiger reserve is classified as southern tropical dry deciduous (Champion and Seth, 1968). It supports a low density of tiger population of only 0.64 tigers/100 km² (Qureshi et al. 2023). Latest census exercises have reported the presence of 11 tigers and 76 leopards within the tiger reserve (Qureshi et al. 2023, Jhala et al. 2021). Recently, translocation of five tigers from Bramhapuri Forest Division to NNTR was approved by the government, with two of them being released in NNTR in May 2023 (Pinjarkar, 2023a). NNTR supports several wildlife species, including 34 species of mammals, 36 species of reptiles and amphibians, 202 bird species, and 49 butterfly species. The wild mammal species that inhabit the reserve include tiger, leopard, dhole, sloth bear (*Melursus ursinus*), gaur, chital, Indian pangolin, sambar, honey badger, palm civet, small Indian civet, Indian giant flying squirrel, four-horned antelope, mouse deer (*Moschiola indica*), and golden jackal.



Black-tailed godwit
(*Limosa limosa*)

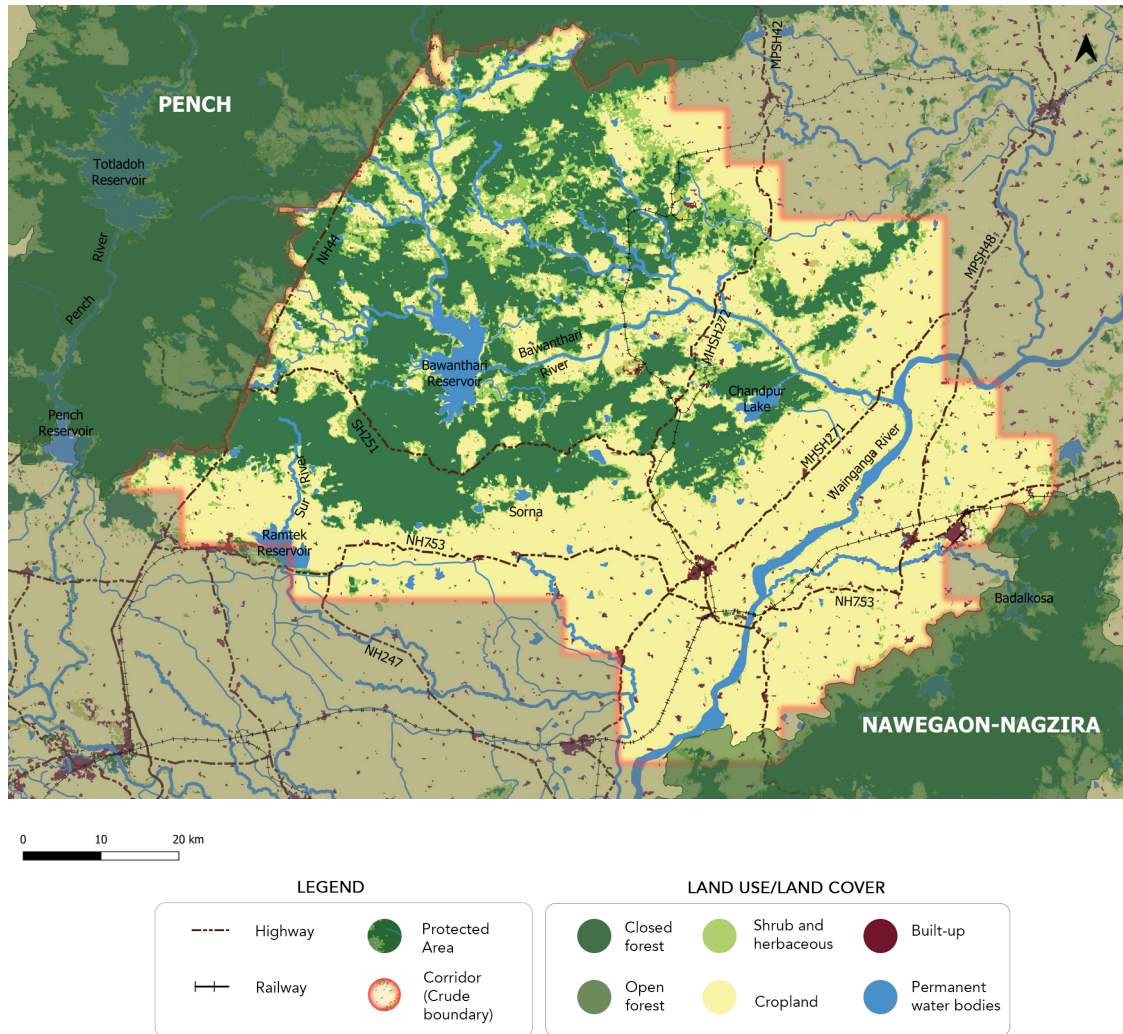


Figure 1: Map showing a crude boundary of the corridor between Pench and Nawegaon-Nagzira tiger reserves along with the river, road, and railway networks

2.2 Wildlife utilising the corridor

Long-term camera trapping exercise conducted by WCT shows evidence of resident breeding populations of tigers within the Pench-Nawegaon Nagzira Corridor (Joshi et al. 2015, 2018, 2019 and 2020). Additionally, there are several tiger dispersal records (based on camera trap photos) from PTR and NNTR to the Bawanthadi forest block in the corridor area. There are also a few records of tiger dispersal from NNTR to PTR. A well-known example includes a male tiger named 'Prince', who was first observed in NNTR in 2010 and later photo-captured in PTR in 2014 (Pinjarkar, 2014), thereby indicating the viability of animal movement within the corridor. In addition to tigers, other species that use the corridor as habitat include leopard, dhole, Indian grey wolf, sloth bear, Indian fox, Indian pangolin, honey badger, rusty-spotted cat, jungle cat, palm civet, small Indian civet, Indian

grey mongoose, and ruddy mongoose (Joshi et al., 2015, 2018, 2019 and 2020; Thatte et al. 2020). Herbivores recorded in camera trap surveys in the corridor include sambar, chital, gaur, wild pig, nilgai, grey langur, four-horned antelope, rhesus macaque, black buck, and Indian hare. Camera trap records have also shown the presence of a few melanistic leopards within the corridor area (Joshi et al., 2022).

About 289 species of birds are found within the corridor, including 87 migratory species. Three critically endangered species of vulture, namely red-headed vulture, white-rumped vulture, and Indian vulture have been reported from the corridor area, along with the endangered Egyptian vulture. The State of India's Birds report 2023 identified 45 high priority birds in this corridor based on the

abundance trends and distribution ranges. Some notable species designated as high priority include common pochard, Sarus crane, black-capped kingfisher, great thick-knee, and black-tailed godwit, among others. A small population of the vulnerable Sarus crane (*Grus antigone*), the tallest flying bird, is found within the corridor area in the vicinity of the Siroha and Wahini villages in the Bhandara district of Maharashtra. Apart from mammals and birds, several species of snakes, including Common Catsnake, Saw-scaled Viper, Indian Rock Python, Red Sand Boa, Duméril's Black-headed Snake, Oriental Ratsnake and Banded Racer, have been reported from the corridor (Deshmukh et al., 2020).



Saw-scaled viper
(*Echis carinatus*)



© Aditya Joshi

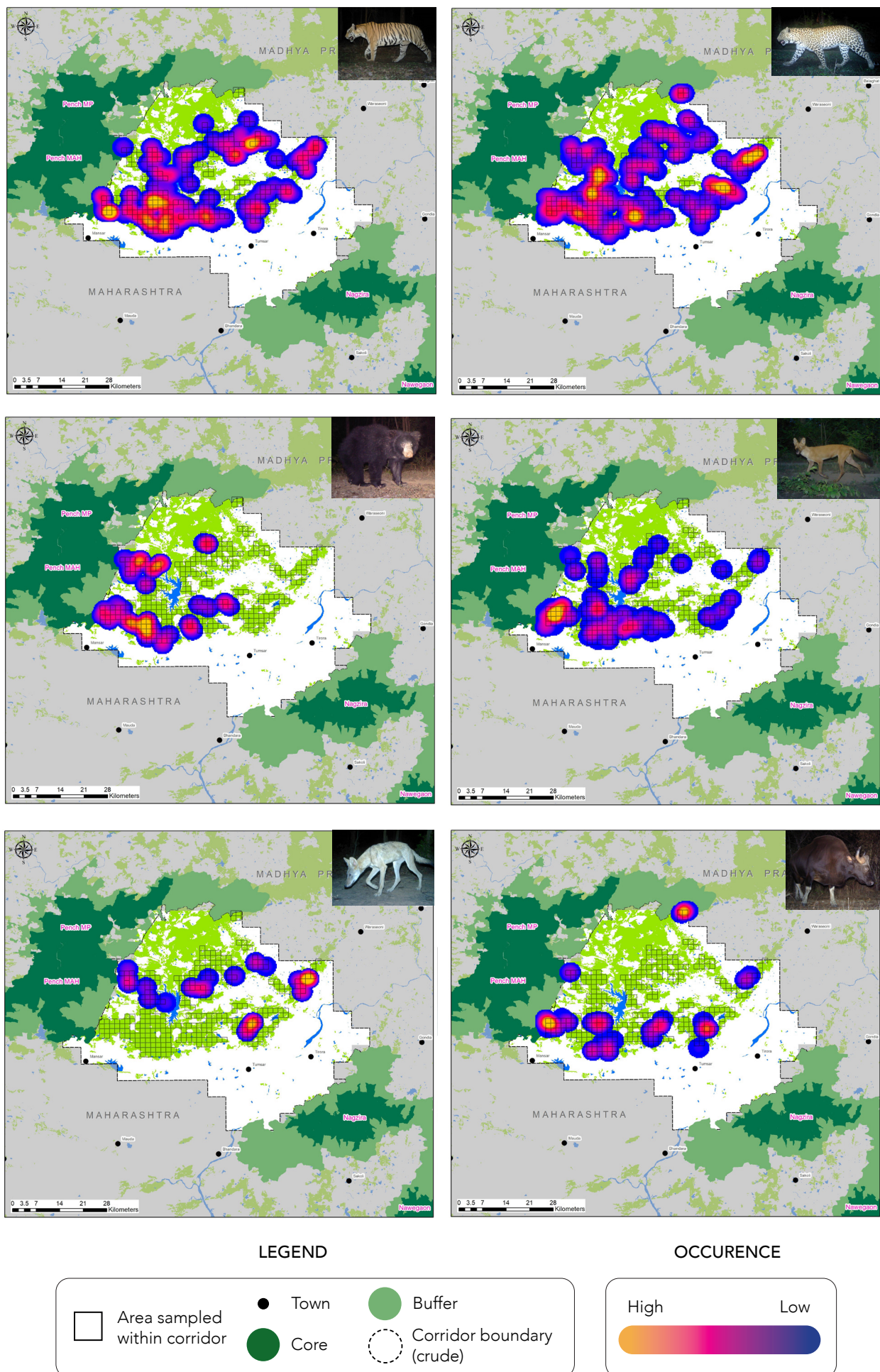


Figure 2: Occurrence of tiger, leopard, sloth bear, dhole, Indian grey wolf, and gaur within the Pench-Nawegaon Nagzira Corridor.



Four-horned antelope
(*Tetracerus quadricornis*)

2.3 Importance for landscape-scale connectivity

Habitat connectivity models have revealed that the Pench-Nawegaon Nagzira Corridor provides a critical linkage between PTR and NNTR, both of which are further connected to other PAs in the Central Indian Landscape (Dutta et al., 2018, Joshi et al., 2018 and Pariwakam et al., 2018). PTR forms strong linkages with both Satpura and Kanha Tiger Reserves, whereas NNTR is connected to Kanha Tiger Reserve in the north east, Umred Karhandla Wildlife Sanctuary in south west, and Tadoba-Andhari Tiger Reserve and Gadchiroli forests in the south (Figure 3).

Genetic data has provided evidence for gene flow between tiger populations in NNTR and those in Melghat Tiger Reserve, which lies to the west of PTR (Joshi et al., 2013); this gene flow likely occurs via the Pench-Nawegaon Nagzira Corridor. Further, Dutta et al. (2018) categorised linkages in Central India by measuring the resistance to animal movement, width of intervening corridor, and tiger

population in the PAs connected by the corridor. They reported that the Pench-Nawegaon Nagzira Corridor has high potential of supporting animal movement, and efforts must focus on protecting and strengthening this linkage.

In addition to these connections between PAs, a branch from the north-eastern side of Pench-Nawegaon Nagzira Corridor merges with the Kanha-Pench Corridor. This interconnected network of PAs and corridors elevates the importance of the Pench-Nawegaon Nagzira Corridor as it may facilitate the dispersal of wildlife between multiple PAs in the landscape.

Recent reports have also suggested that an elephant herd from Chhattisgarh has reached the southern boundary of the Nawegaon National Park (Pinjarkar, 2023c). Though the herd has not entered the corridor area yet, there is a possibility of them moving up north to the corridor area.

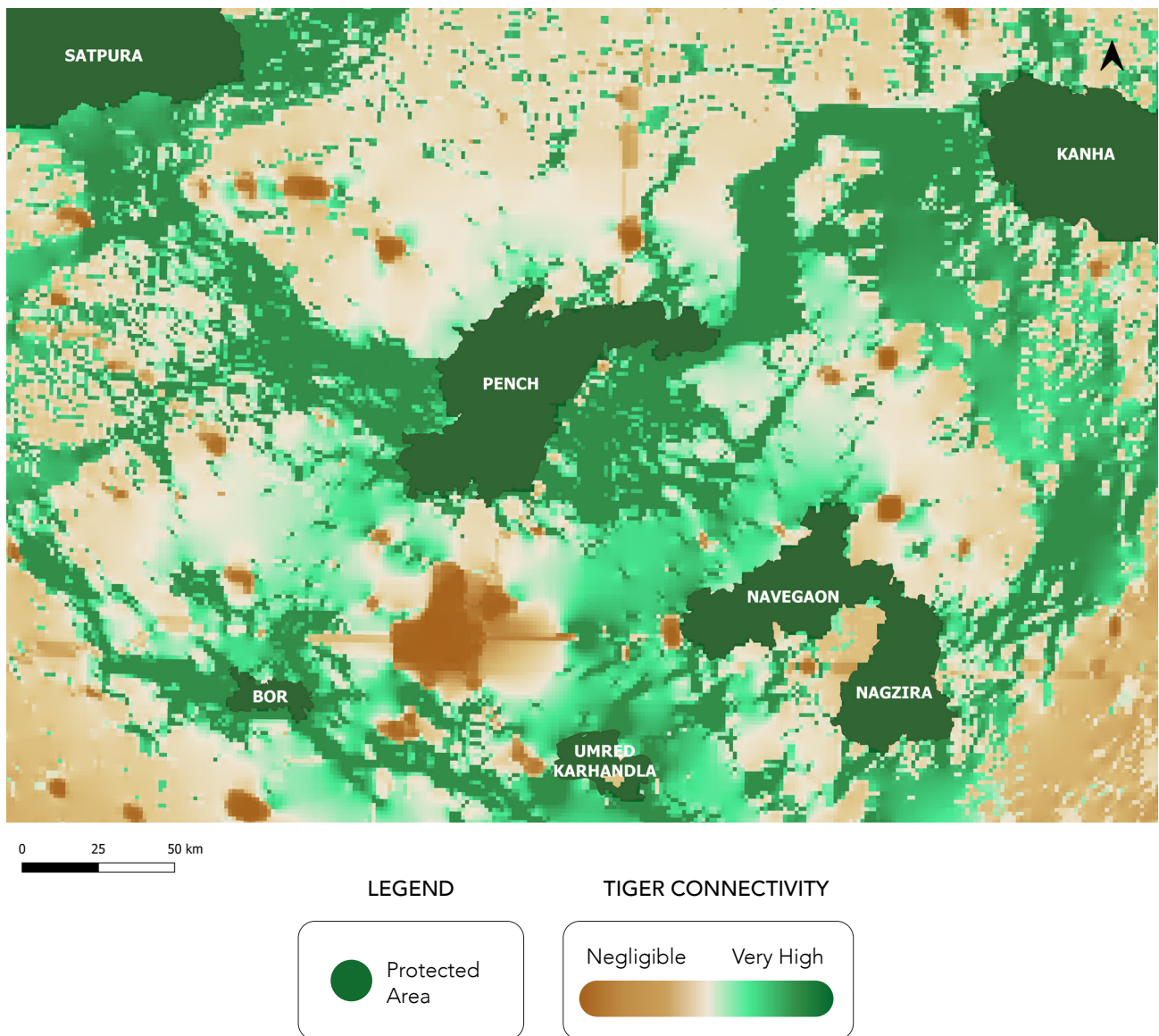


Figure 3: Tiger connectivity in the Kanha-Pench-Nawegaon Nagzira region. Connectivity map was generated using a circuit theory based approach and a base map from Thatte et al., (2018). Green regions depict the areas most likely used by dispersing tigers and the brown regions depict areas that impede movement.

2.4 Recognized biodiversity conservation sites within the corridor

The PAs that are connected via the Pench-Nawegaon Nagzira Corridor, namely Nawegaon National Park, Nagzira Wildlife Sanctuary, PTR-MH, and PTR-MP have been identified as Important Bird Areas (IBAs).



3 Corridor Characteristics

3.1 Boundaries

We delineated the crude boundary of the corridor using a circuit theory-based modelling approach. Figure 1 depicts the crude boundary of the Pench-Nawegaon Nagzira Corridor. Details of the delineation process are provided in Supplementary Information (Section 8). The Pench-Nawegaon

Nagzira Corridor is spread across Seoni and Balaghat districts in Madhya Pradesh and Nagpur, Bhandara, and Gondia districts in Maharashtra (Figure 4). The corridor covers an area of 3,002 km², with about 35% and 65% falling in Madhya Pradesh and Maharashtra, respectively (Table 1).

Table 1: List of territorial forest divisions and the corresponding ranges that overlap with the Pench-Nawegaon Nagzira Corridor.

Territorial Forest Division	Range Name
South-Seoni	Khawasa and Kurai
South Balaghat	Waraseoni, Katangi, and Khairlanji
Nagpur	Deolapar, Pauni, Ramtek
Bhandara	Lendezhari, Nakadongari, Jamkandri, Tumsar
Gondia	Tiroda

Table 2. List of districts, tehsils, and tehsil areas overlapping the Pench-Nawegaon Nagzira Corridor.

District	Tehsil	Tehsil area overlapping with the corridor (in km ²)
Seoni	Kurai	361
Balaghat	Katangi	48
Balaghat	Tirodi	410
Balaghat	Khairlanji	224
Nagpur	Ramtek	586
Nagpur	Mauda	11
Bhandara	Tumsar	837
Bhandara	Mohadi	142
Gondia	Tirora	358
Gondia	Gondia	28

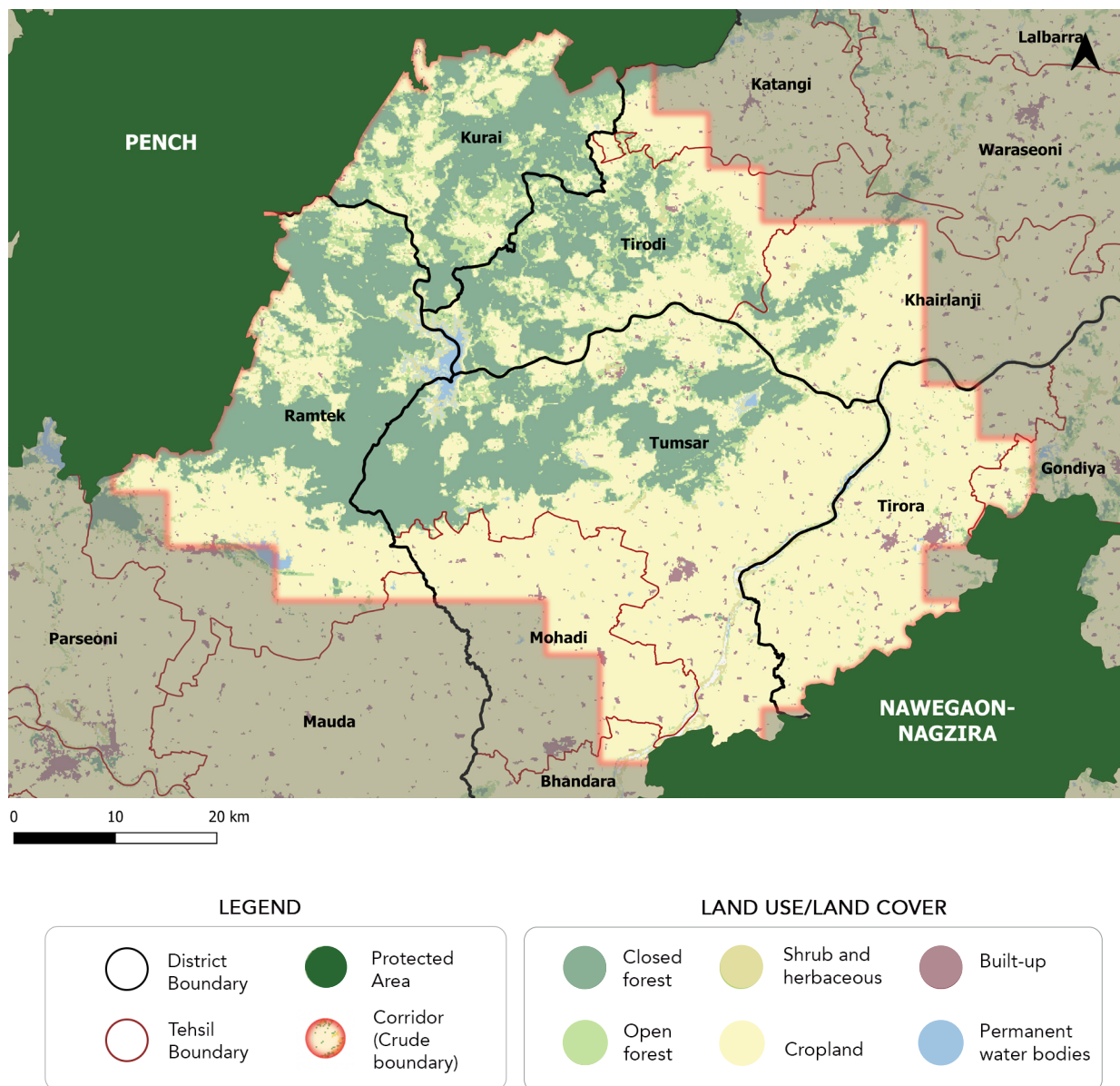


Figure 4. Administrative map representing the districts and tehsils overlapping the Pench-Nawegaon Nagzira Corridor. Seoni district: Kurai tehsil; Balaghat district: Katangi, Tirodi, and Khairlanji tehsils; Nagpur district: Ramtek and Mauda tehsils; Bhandara district: Tumsar and Mohadi tehsils; Gondia district: Tirora and Gondia tehsils.

3.2 Physical characteristics

The Pench-Nawegaon Nagzira Corridor lies within the Satpura-Maikal region at the northern border of the Eastern Vidarbha Landscape. The corridor sits on the metamorphic belt of the northern Deccan Plateau, and large basaltic rock formations are found throughout the corridor area. In particular, the

Bhandara and Gondia districts are entirely covered by metamorphic rock and alluvium (Ali et al., 2017). The main formations in the Balaghat district include gneissic and metamorphic rocks (Banerji et al., 2019). The transition or metamorphic rocks primarily comprise quartzite, shale, and limestone.

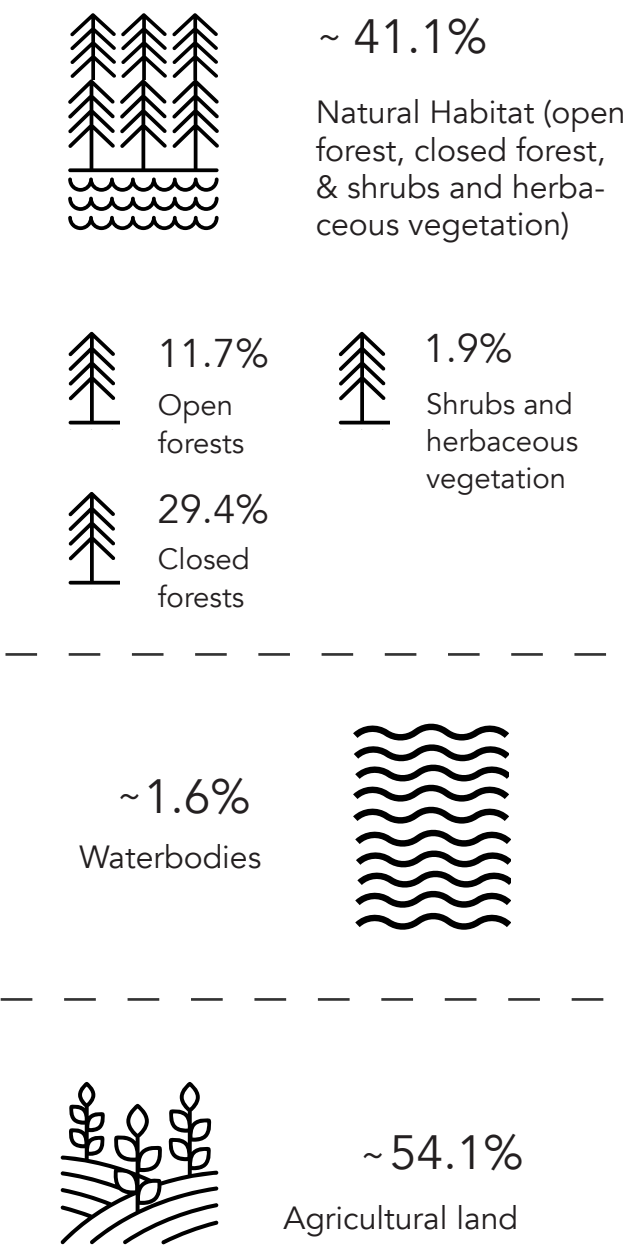
3.3 Freshwater and hydrology

The Pench-Nawegaon Nagzira Corridor is home to several rivers and water bodies, which play a vital role in the hydrological cycle of the region. The corridor lies in the northern part of the Godavari basin and is drained by the Wainganga (a tributary of Godavari) river system. Wainganga River covers a length of 43 km in the corridor area, and meets several of its tributaries within the corridor area, including Bawanthadi, Badalkosa nala, Risara, Ambagarh, and Sur rivers. The Bawanthadi river—a major right tributary of Wainganga—flows eastwards through the corridor and divides the corridor area between Madhya Pradesh and Maharashtra.

The major water bodies in the corridor include the Bawanthadi reservoir across Bawanthadi river (3,200 ha), Chandpur Talab across Chandpur nala (570 ha), Ramtek reservoir across Sur River (650 ha) and Sorna tank across Chimta nala (120 ha). In addition, Kawlewada Dam is situated across the Wainganga River within the corridor area in Gondia. These water bodies provide important habitats for aquatic flora and fauna and are also a vital source of water supply for the communities living in the surrounding areas.

The region experiences a tropical monsoon climate, with high humidity and precipitation during the monsoon season from June to September. The annual average rainfall in this region is 1,255 mm (Indian Meteorological Data, 2023), with the highest rainfall occurring in the months of July and August. The region is not considered as a highly flood-prone area, but there is a risk of flash floods and inundation of low-lying areas during heavy rainfall events. During the dry season (October to May), the region receives low to moderate rainfall, the region can experience periods of water scarcity and drought, especially during prolonged dry spells or below-average monsoon seasons; however, the corridor is generally not considered to be a highly drought-prone region.

3.4 Land use within corridor



More than half of the area within the corridor is under agricultural use (54.1%). The major crops in the corridor are paddy, wheat, sorghum, and oilseeds, whereas primary cash crops grown in the region include sugarcane. Other crops that are cultivated in the region include maize, chickpea, pigeon pea, minor pulses, and sorghum. Though smaller farms are interspersed throughout the corridor area, the majority of agricultural farms are concentrated across a width of about 40 km between the Bawanthadi forest block and NNTR.

Telemetry-based studies have shown that the functional tiger corridors in this landscape extend beyond structurally connected forests, and tigers extensively use agricultural lands for movement (Habib et al., 2021).

Forests constitute nearly 41.1% of the total corridor area, which includes 11.7% and 29.4% of open and closed forests, respectively. Shrubs and herbaceous

vegetation constitute another 1.9% of the total area. The corridor area within Seoni, Balaghat, and Nagpur districts are predominantly forested, whereas that within Gondia district of Maharashtra is primarily agriculture-based.



Tiger (*Panthera tigris*) crossing an agricultural land.

4 Stakeholders and Management

4.1 Land tenure, holding and legal status

Most of the forested land in the corridor area comes under the jurisdiction of the overlapping territorial divisions of the forest department. Each territorial division manages the forested area based on a working plan, which is revised every ten years. The remaining land is either privately owned or comes under the administration of different government agencies. The corridor area predominantly has small and marginal farmers; the average land-holding in South Seoni forest division is < 1 ha.

Recently, a forested area in the Ramtek tehsil of Nagpur has been proposed as Mogarkasa Conservation Reserve. Spanning across an area of 104 km², it is one of the 12 new conservation reserves declared by the State Board of Wildlife of Maharashtra (notification pending; 19th SBWL Minutes of the Meeting). The forest department has announced plans for undertaking an eco-tourism project in this conservation reserve (Pinjarkar, 2023a).

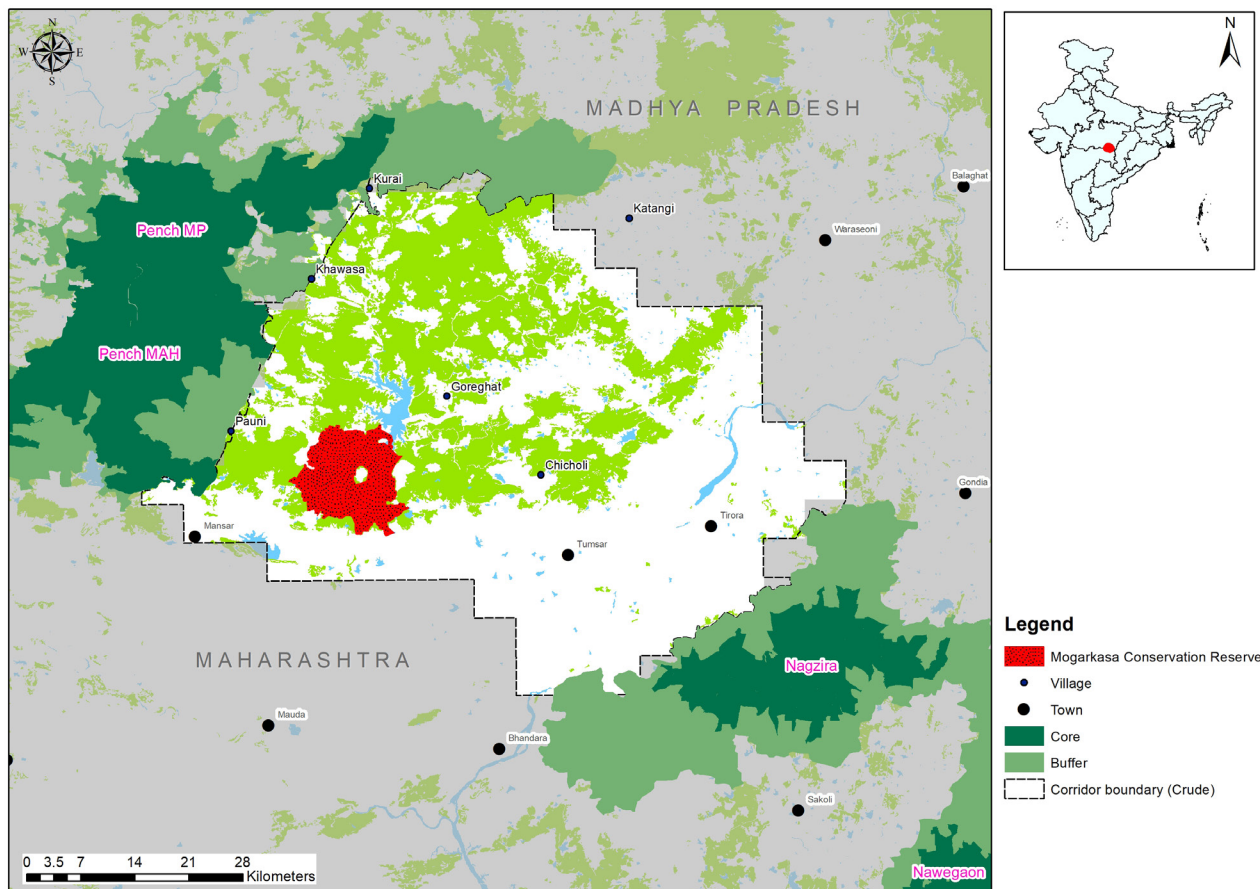


Figure 5. The location of the newly proposed Mogarkasa Conservation Reserve

4.2 Settlements and communities

There are around 503 villages in the corridor area with an average population of 1,158 people/village. The average population of the corridor area is 296 persons/km², with 16.15% belonging to the tribal community and another 11.32% belonging to the scheduled caste community. The major tribes found in the tehsils overlapping the corridor areas include Arakh, Gond, Rajgond, and Halba (Census, 2011). Some of the major non-timber forest produce (NTFPs) collected across the forest divisions overlapping with the corridor area include tendu leaves (*Diospyros melanoxylon*), mahua (*Madhuca indica*), achar or chironji (*Buchanania*

lanzan), and amla (*Phyllanthus emblica*). Kurai tehsil, part of which overlaps with the Pench-Nawegaon Nagzira Corridor, has been identified as a Scheduled Area owing to the preponderance of tribal population. Under the Fifth Schedule of the Indian Constitution, Scheduled Areas are defined as regions predominantly inhabited by indigenous tribal communities. They receive special protection and provisions, including restrictions on land transfer to retain tribal control and provisions against exploitation of natural resources without the consent of tribal communities.

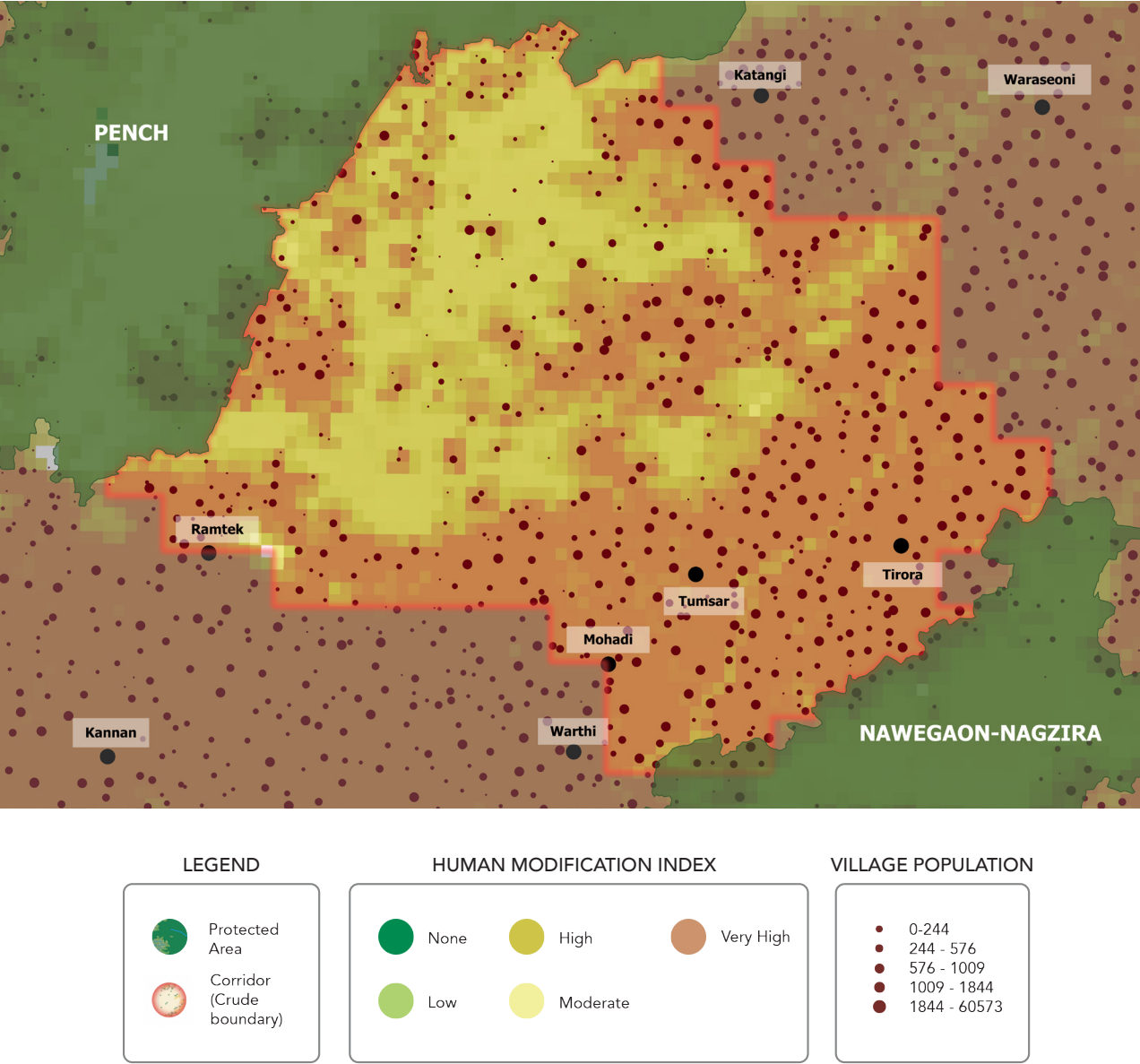


Figure 6. Distribution of villages within and around the Pench-Nawegaon Nagzira Corridor



5 Challenges

5.1 Infrastructure

PTR and NNTR have high quality linkage that must be maintained and strengthened to prevent loss of connectivity in the landscape. However, a network of infrastructure, including roads, railways, power transmission lines, and mines, affect habitat contiguity in the Pench-Nawegaon Nagzira Corridor. The density of linear infrastructure within the corridor is 129 m/km².

Mining and Thermal Power Plants:

Pench-Nawegaon Nagzira corridor is dotted with several thermal power plants, mines, and stone quarries. Tiroda Thermal Power Project, which is located within the corridor area close to NNTR boundary in the Gondia district, is one of the largest coal-based thermal power plants in India. With a total capacity of 3300 MW, the thermal power plant was commissioned in 2012 (Adani Power, n.d.), and in 2018, 141.99 hectares of forest

land—of which, about 26 hectares was protected forest—was diverted for the power plant (Forest Clearance, 2018). Detailed studies are warranted to investigate the impact of the thermal power plant on the movement of wild animals in the region. Further, the Pench-Nawegaon Nagzira Corridor is rich in manganese ore and has several open-cast and underground mines. All three open-cast mines of Manganese Ore (India) Limited are located within the corridor area, which include Tirodi and Sitapatore mines in the Balaghat district (Madhya Pradesh) and Dongri Buzurg Mine in Bhandara district (Maharashtra) (MOIL, 2022). In 2018, a private company was awarded a prospective lease for opencast mining in Guguldoh (near Ramtek) in Maharashtra, which is located towards the edge of a breeding tiger population area in the Mogarkasa forest block within the Pench-Nawegaon Nagzira corridor (Pinjarkar, 2022). About 99.15 % of the



total area (105 ha) auctioned for mining forms a part of Guguldoh reserve forest, which supports several wild animals including tigers, leopards, dholes, and porcupines, among others (Pinjarkar, 2023d). Mining projects are often followed by development of infrastructure, including roads, railway, and settlements, that can change the land-use and negatively affect animal movement in the area.

Roads:

A total of 111 km of national highways (including NH44, NH753, and NH247) and 159 km of state highways (SH271, SH272, SH273, SH48, SH42, and SH251) pass through the corridor (Figure 1). Several smaller roads connecting villages and towns also traverse the corridor area. A stretch of NH44—the longest highway of the country—runs almost parallel to the western boundary of the corridor. This stretch was part of a 117 km, four-lane expansion programme of NH44, which was undertaken in 2010 (Sharma, 2020). The construction took a total of four years and was completed in 2019 (Sharma, 2020). In addition, the National Industrial Corridor Programme, which aims to facilitate the development of futuristic industrial cities by creating world-class infrastructure, has identified Delhi–Nagpur corridor as one of the 11 industrial corridors across the country (NICDC, 2023). This industrial corridor is still in the conceptualisation phase, but it is expected to utilise the existing NH44. The Madhya Pradesh government has proposed a longer alternate route in place of the proposed fastest route for the industrial corridor to protect the forests of PTR (Tomar, 2022). Nonetheless, it is crucial that expansion, construction, or upgradation of highways include constructing mitigation measures, such as underpasses and overpasses, at appropriate locations that are identified after an all-season survey to ensure that connectivity is maintained in the corridor area.

Canals:

A complex network of canals criss-cross through the corridor area, bisecting the Bawanthadi forest block, which is critical for ensuring connectivity between PTR and NNTR (Figure A4). A preliminary review suggests that several canals within the

corridor are currently being extended or are under construction. These canal networks lack mitigation measures to facilitate animal movement. Though more information is warranted in understanding how the canals may affect connectivity in the corridor area, it is important that mitigation structures are incorporated whenever large canals are extended or constructed.

Railways:

A total of 131 km of railway tracks intersect the corridor area (Figure 1). A railway line from Nagpur branches out at Tumsar before entering the southern boundary of the corridor. One branch traverses northward and after entering Madhya Pradesh moves eastward to Balaghat, whereas the other branch moves eastwards from Tumsar to Gondia. In addition to the existing rail network, the Indian Railways is developing dedicated freight corridors (DFCs) to improve freight transportation capacity. Not only will the number of coaches be more in DFC compared to the existing railway system, but the minimum speed is expected to be 100 km/hr. The East-West DFC, which is proposed to connect Palghar in Maharashtra to Dankuni in West Bengal, will likely cross the corridor area (map on DFCCIL website). Although no recent instances of animal kill have been reported from the railway tracks within the corridor, the Nagpur–Balaghat railway line crosses the forested patch of Tirodi tehsil. Hence, any future infrastructural development in this region should be undertaken post extensive investigation.

5.2 Illegal activities

Wildlife Poaching:

Maharashtra–Madhya Pradesh belt is reported as the major tiger poaching site in India (Nittu et al., 2022). In June 2022, a beheaded body of a tigress was found in Rajiv Sagar Dam in Balaghat district of Madhya Pradesh (Naveen, 2022). Several other instances of possible tiger poaching have been reported from within the corridor area, including Bapera (Bhandara division) and Deolapar (Nagpur division) (Pinjarkar, 2021).



High traffic volume, speeding vehicles, and lack of mitigation structures can increase the risk of collisions between vehicles and wildlife.



Mitigation structures like underpasses constructed along NH44 offer a solution to minimizing the threat of roadkill incidents.

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5.3 Critical corridor areas

We identified critical areas within the corridor as those areas that currently exhibit tiger connectivity (based on analysis by Pariwakam et al. 2018) but face human-induced challenges that can act as barriers to wildlife movement. In the absence of mitigation measures, linear infrastructure within the corridor

such as mines, railway lines, highways, and human settlements, can act as potential barriers to animal movement and hinder the connectivity between PTR and NNTR. Policy makers must prioritise these critical areas to ensure that the connectivity of the Pench-Nawegaon Nagzira Corridor is maintained.

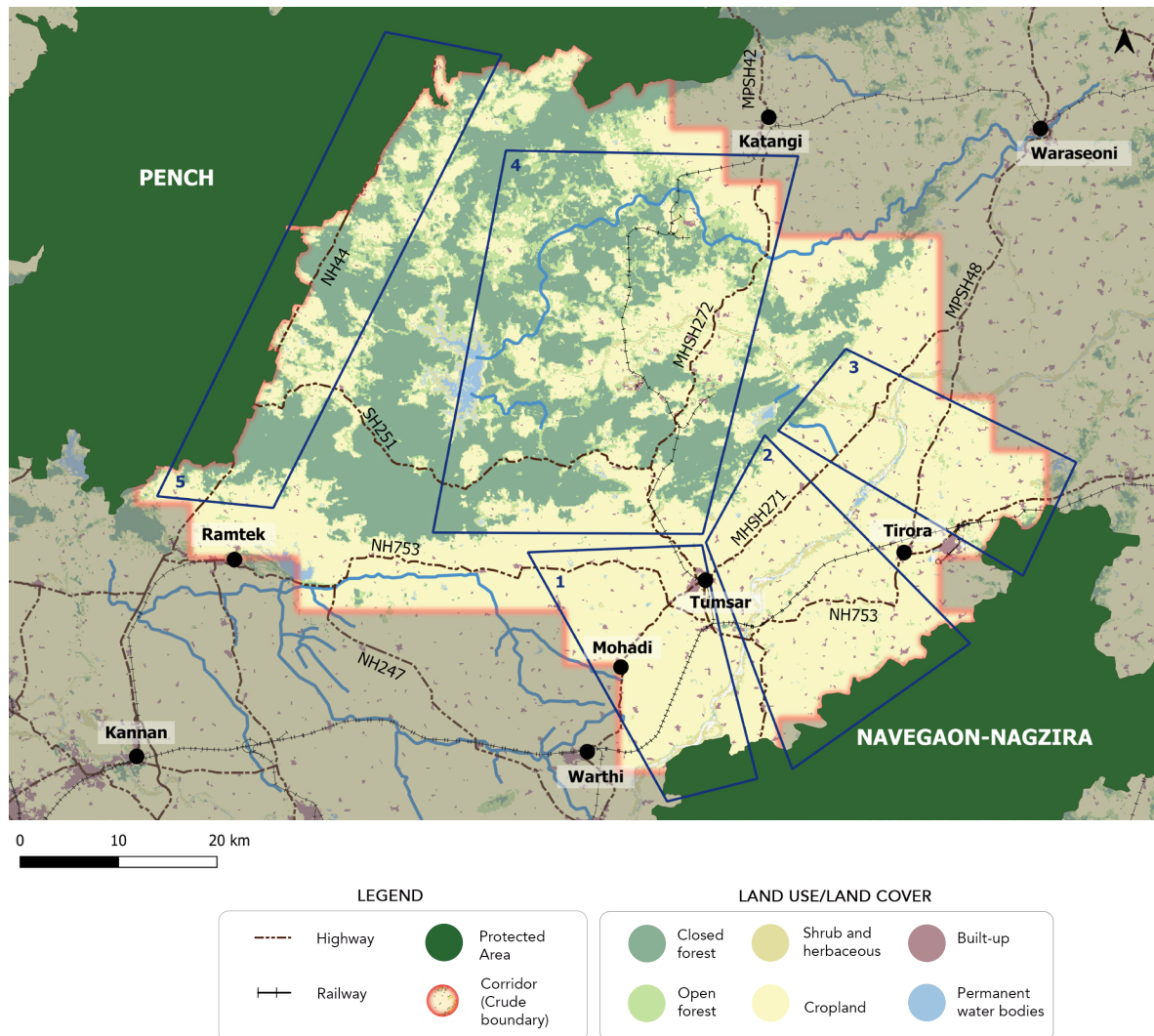


Figure 7. Critical areas (represented by Boxes 1–5) in the Pench–Nawegaon Nagzira Corridor.

Critical Areas 1–3:

The area between Bhandara Forest Division and the buffer area of NNTR is highly fragmented, which poses a major threat to the movement of wildlife within the corridor. Several villages (with population > 1000) are scattered across this area, resulting in a very high human modification index (> 0.7). Tiger connectivity analysis (Pariwakam et al. 2018) shows that this agriculture-dominated region has three main branches of high permeability that are separated by Tumsar and Tiroda townships, as

shown in Figure 7 (Boxes 1, 2, and 3, respectively). Telemetry and genetic studies have reported that tigers use agricultural farms for movement in this landscape (Thatte et al. 2018, Habib et al. 2021). However, further expansion of these towns or land-use change (from agriculture to other land-use types, especially dense cities, factories, mines, or industries) can choke these pinch-points and disproportionately affect the movement of wildlife in the corridor area.

Critical Area 4:

A dense network of linear infrastructure, including railway tracks, highways, and canals criss-cross through the corridor area, even extending into the forests of Bawanthadi that provide high permeability to the movement of tigers (Figure 7). In future, upgradation and expansion of highways and canals that cross through this region might be inevitable. In particular, two roads that are vulnerable to upgradation in future include the roads connecting Tumsar-Seoni and Tumsar-Pauni, majority of which pass through the corridor area (Figure 7). Hence, future expansion must include robust mitigation structures to avoid reduction of permeability within the corridor area.

Critical Area 5:

The western border of the corridor is entirely flanked by NH44 (earlier NH7) (Figure 7), which essentially separates PTR from the Pench–Nawegaon Nagzira Corridor. Though previously infamous for wildlife roadkills, a part of NH44 was upgraded from two-

lane to four-lane highway on the condition that appropriate animal crossing structures be set up. Wildlife Institute of India recommended a total of 48 wildlife mitigation structures (including 38 structures proposed by National Highway Authority of India) on the NH44 stretch passing through Maharashtra (Habib et al., 2015). Camera trap images have provided evidence that these animal underpasses and other mitigation structures in the region have been used by some wild animals, including tigers, leopards, gaur, sloth bears, civet cats, and langurs (Habib et al., 2020). While this is a promising start, long-term and multi-seasonal monitoring is essential to evaluate the effectiveness of such mitigation structures, especially with respect to the location of these structures as there are reports of roadkills in the areas where mitigation structures have not been constructed. Moreover, it is crucial that lessons from the monitoring exercises are used to inform future management decisions in the corridor area.

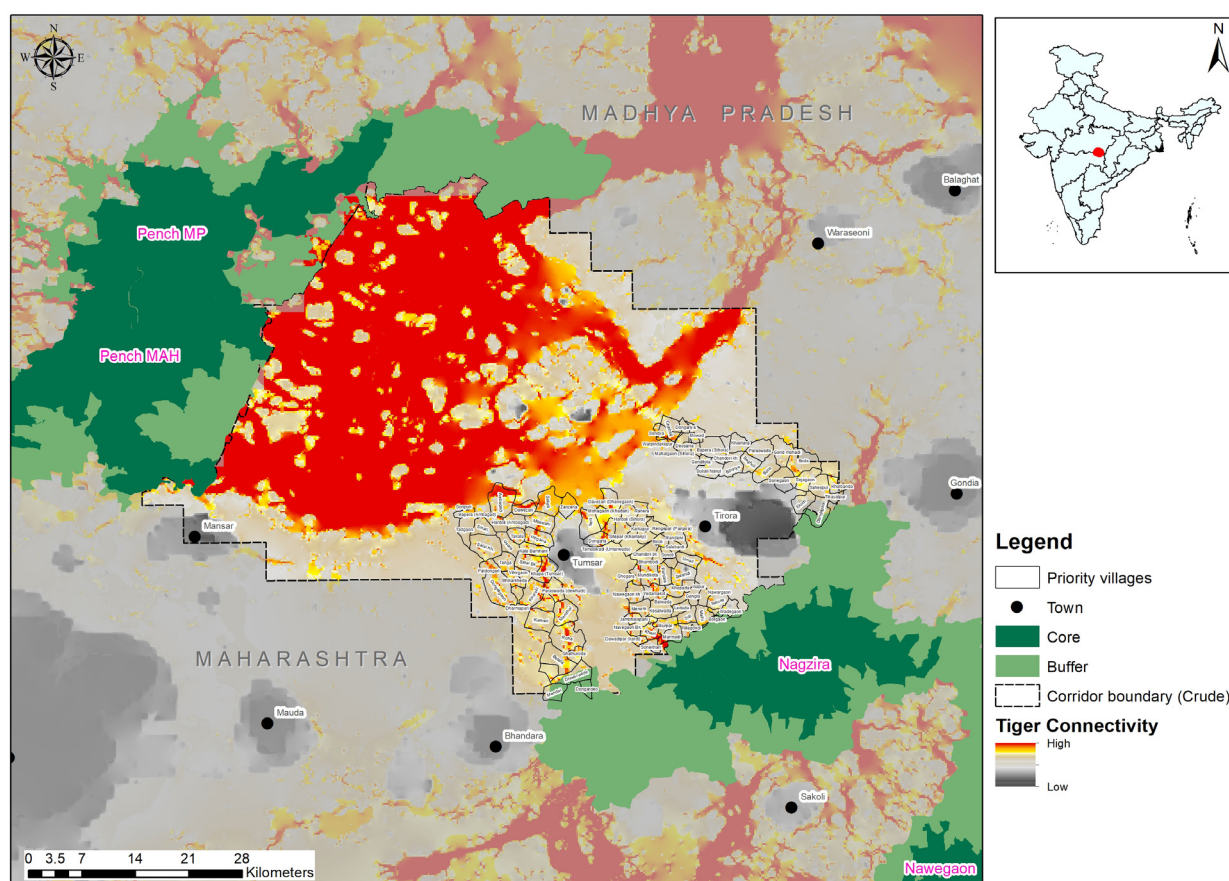


Figure 8. Map representing the priority villages in the Pench-Nagzira Corridor. The priority villages in the Critical Areas 1–3 are also listed in Table A1 (in the Appendix).

6 Recommendations & Opportunities

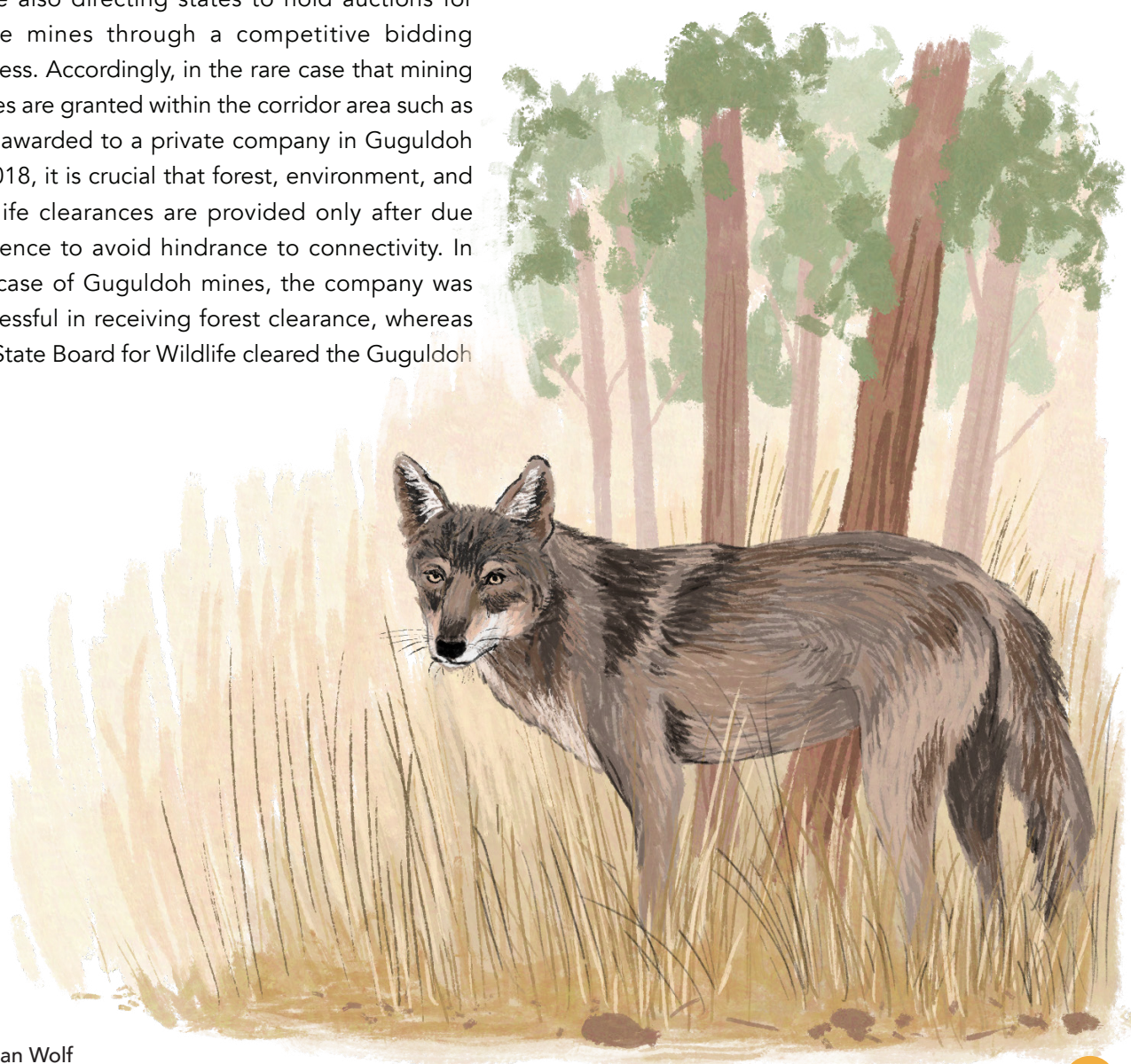
- 1. Integration of corridor conservation in the working plans of forest divisions:** As the forested areas of the Pench-Nawegaon Nagzira corridor—especially the Bawanthadi and Mogarkasa forest blocks—support breeding tiger populations, the forest management plans of the forest divisions should not solely be focused on forestry activities but must include specific wildlife management actions. Moreover, these action plans should be included in the working plans of territorial forest divisions overlapping with the corridor.

Maharajpur, Kharapada, Tumaditola, Cichada, and Salai ranges. Moreover, this can also help the local communities by incorporating them in the government schemes that are especially targeted at the villages surrounding the tiger reserves. Note that though the conservation reserve has been officially declared, its notification is pending, and it is imperative that the notification process be expedited. Several villages in this region are have shown willingness in being part of the buffer zone of PTR-MH.
- 2. Better coordination between tiger reserves:** National Tiger Conservation Authority (NTCA) guidelines require that tiger reserves prepare Tiger Conservation Plans (TCPs) with a corridor section that suggests the formulation of a Corridor Coordination Committee. The Pench-Nawegaon Nagzira Corridor will be included in the TCPs of PTR-MH, PTR-MP, and NNTR and coordination between these tiger reserves is crucial for effective management and efficient use of resources. Incorporation of corridor-related activities from the TCPs into working plans is important for effective implementation of the corridor sections of the TCPs.
- 3. Expansion of PTR-MH buffer to provide structural connectivity with Mogarkasa Conservation Reserve:** In 2022, the government declared an area of 104 km² in the corridor as Mogarkasa Conservation Reserve, which spreads across the Paoni Range (Ramtek Taluka) of the Nagpur Forest Division (Territorial and FDCM) and Lendezari and Jamkandri ranges of the Bhandara Forest Division. The expansion of the buffer zone of the PTR-MH to the east of NH-44 to the Mogarkasa Conservation Reserve can help maintain structural connectivity between the tiger reserve and the newly-declared conservation reserve, thereby providing better protection of the forest area. The expansion of the buffer would overlap with the Sawangi,
- 4. Identification of animal crossing sites:** Multiple linear infrastructures, including highways, railways, and canals intersect the critical areas of the corridor, as shown in Critical Area 4. These infrastructures are vulnerable to further expansion and upgradation. Hence, a comprehensive study is warranted to identify appropriate animal crossing sites where ecologically meaningful mitigation measures can be incorporated to facilitate animal movement.
- 5. Adoption of bamboo-based agroforestry:** The non-forested region between Bawanthadi Forest Block and NNTR in the corridor area is dominated by agriculture. Though dispersing tigers can move through the agricultural patches, transformation of farmlands to built-up areas, industries, or factories can hinder their movement in the future. Moreover, habitat connectivity must also be maintained in this region for facilitating the movement of other species and reducing human-carnivore interactions. The villages that overlap with this region (as shown in Critical Areas 1, 2, and 3 in Figure 7 and listed in Appendix 1) can be prioritised under the State Bamboo Mission of Maharashtra as the adoption of bamboo-based agroforestry will not only help maintain connectivity in this region but also supplement farm income for residents and provide resilience against climate change-related stressors. However, as cultivated lands and wetlands are important for Sarus cranes,

caution must be exercised and agroforestry systems should not be indiscriminately adopted in the selected villages where these cranes are found.

6. Ensuring stricter criteria for mining lease clearances and extensions: Given that mining leads to land-use change and an increase in built-up areas around mines that can affect the present connectivity, it is crucial that mining leases are not allocated arbitrarily in the manganese-rich areas of the corridor. This is particularly important as the Government of India amended the Mines and Minerals (Development and Regulation) Act in 2015 in order to expedite environmental clearances and issuance of licences. This amendment eased regulations, enabling mining in notified areas, while also directing states to hold auctions for these mines through a competitive bidding process. Accordingly, in the rare case that mining leases are granted within the corridor area such as that awarded to a private company in Guguldoh in 2018, it is crucial that forest, environment, and wildlife clearances are provided only after due diligence to avoid hindrance to connectivity. In the case of Guguldoh mines, the company was successful in receiving forest clearance, whereas the State Board for Wildlife cleared the Guguldoh

mining proposal without discussion during its 20th meeting that lasted only 15 minutes (The Times of India, 2023). Notably, the environmental impact assessment report obtained by the mining company suggested the absence of Schedule-I fauna from the proposed Guguldoh mining site, despite several reports and evidence suggesting otherwise (Pollution & Ecology Control Services, n.d.). As of September 2023, this mining project has become the subject of several controversies, including opposition from the local communities and a request from honorary wildlife wardens to NTCA to review the project (The Hitavada, 2023). It is important that any decision on the clearance of this project is taken only after weighing its pros and cons.



Indian Wolf
(*Canis lupus pallipes*)

7 Current Conservation Activities

- 1. Maharashtra Forest Department:** The forest department has actively undertaken protection measures, such as anti snare and anti electrocution drives in divisions overlapping with the corridor area, including Bhandara and Gondia divisions. Additionally, eco-development activities have been facilitated under the Shama Prasad Murkharji Jan Van Vikas Yojana, focusing on employment generation, habitat development, and human-wildlife conflict mitigation. Initiatives like supplying solar lights and installing walls or railings around open wells have been carried out, particularly in areas prone to human-wildlife conflict. Low-cost solar fences are provided to individual farmers at a subsidy of 75%. Villagers are engaged in forest protection and other activities outlined in the working plan. Protection and Rescue Teams, composed of local youths, are established in conflict-prone areas. At the division level, Rapid Response Teams are formed to aid in rescue operations.
- 2. Wildlife Conservation Trust (WCT):** WCT has been actively engaged in research and conservation activities in and around the Pench-Nawegaon Nagzira corridor area. Under its large carnivore monitoring programme, WCT has conducted systematic camera trapping surveys to monitor wildlife populations and their distributions in the forested areas of the Pench-Nagzira Corridor. It also has a dedicated programme focused on capacity building of the frontline forest staff in carrying out camera trap-based monitoring of tigers outside PAs, as well as law enforcement to help mitigate wildlife crime. Further, WCT also has a programme to facilitate wildlife connectivity and mitigate the negative impacts of linear infrastructure on corridors and wildlife by focusing on the upcoming and existing linear infrastructure in the corridor. WCT also maps wildlife crossing sites along these infrastructure projects to identify ecologically meaningful and effective mitigation measures, thereby promoting safe passage for wildlife.
- 3. Save Ecosystem and Tiger (SEAT):** SEAT is a non-governmental organisation (NGO) based out of Bhandara in Maharashtra. Its work focuses on mitigating human-wildlife conflict, raising community awareness, conducting research, and fostering alternative livelihoods in the Bhandara and Nagpur forest divisions. Notable initiatives of the NGO include camera trapping exercises in the Bhandara forest division to study wildlife presence in 2014–15, 2017, and 2021–22. SEAT is actively involved in safeguarding Sarus crane populations in Bhandara district by collaborating with the district collector to identify Sarus breeding and visit sites (including local water bodies and rice fields), appointing volunteers as ‘Sarus Mitra’ (Sarus Friends), and conducting awareness campaigns in villages.
- 4. Sarus Conservation Committee:** In January 2022, the Bombay High Court took suo moto cognizance and directed the Maharashtra government to set up district-level Sarus Conservation Committee for Gondia, Bhandara, and Chandrapur districts, the only three districts in Maharashtra that have some habitat areas to support Sarus cranes. The High Court also directed the state government to draft a joint action plan with the Centre and Madhya Pradesh government for the conservation of Sarus cranes in Maharashtra.

8 Supplementary Information

Delineation of the crude corridor boundary:

Circuit theory-based modelling approach was used to identify the corridor based on resistance surface generated using genetic data (Thatte et al., 2018 and Pariwakam et al., 2018). The cumulative current output values were classified into 10 quantiles and top four quantiles were chosen. A 5 km × 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 1).

Estimation of principal indicators:

Seven principal indicators, namely area of natural habitat, area under forest department, threatened species richness, average human population, human modification index, landscape complexity index, and natural habitat fragmentation index, were calculated to provide the overall status of the corridor. The method of estimating the value of each indicator is available online at <http://corridorcoalition.org/CWC/about.html>



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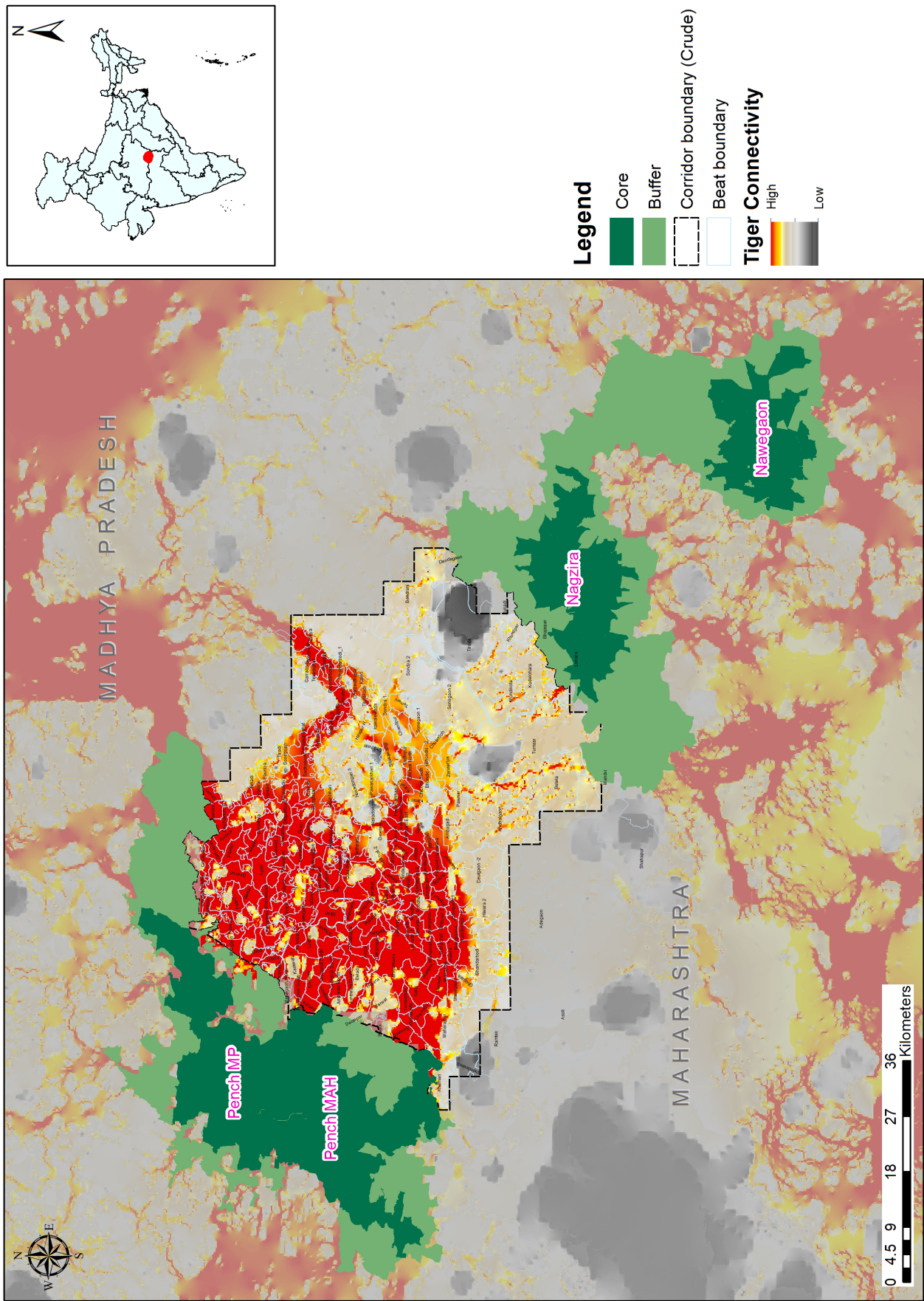


Figure A1. Map showing the beat boundaries across the Pench-Nawegaon Nagzira Corridor.

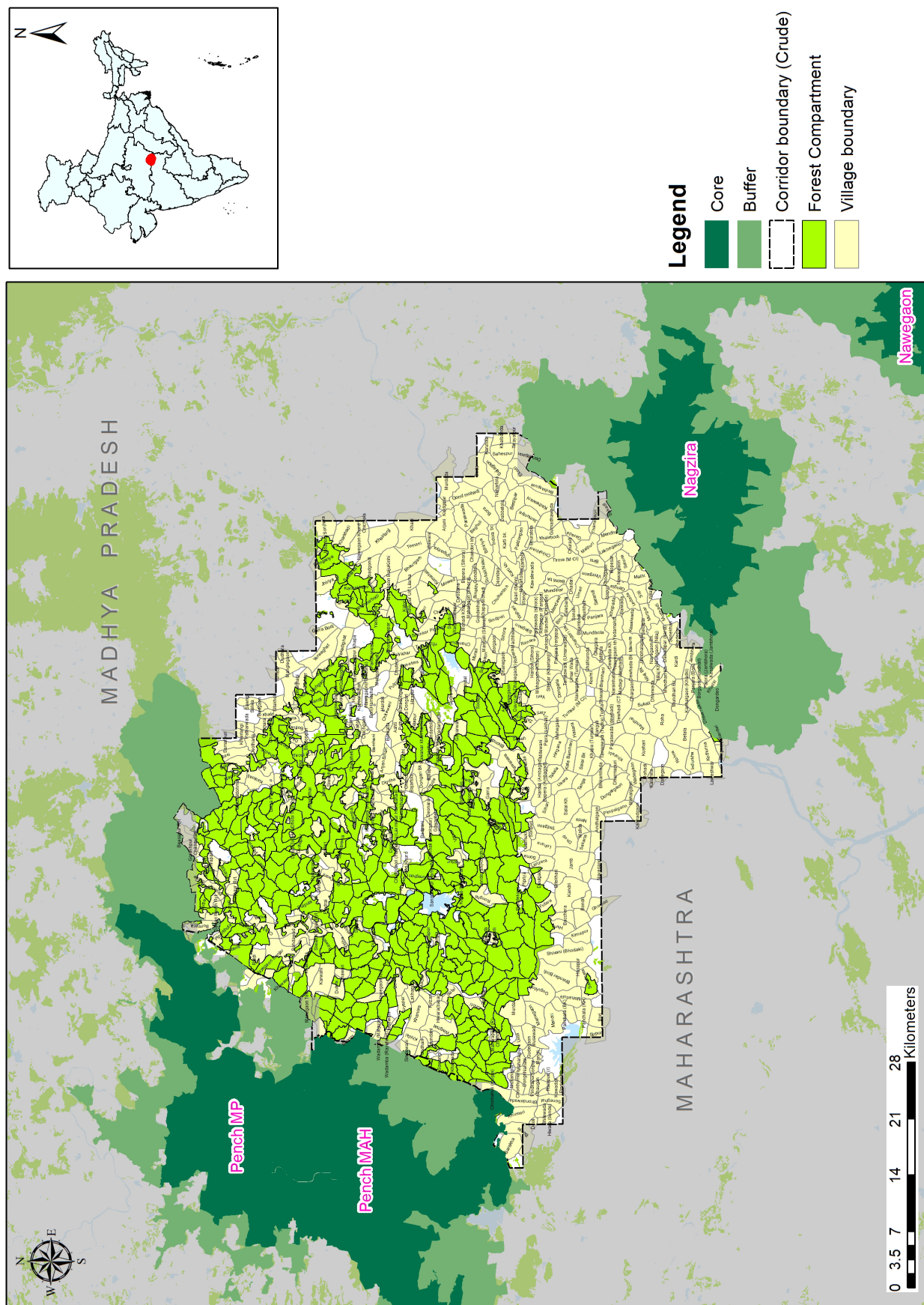


Figure A2. Map showing the forest compartment and village boundaries for the Pench-Nawegaon Nagzira Corridor area

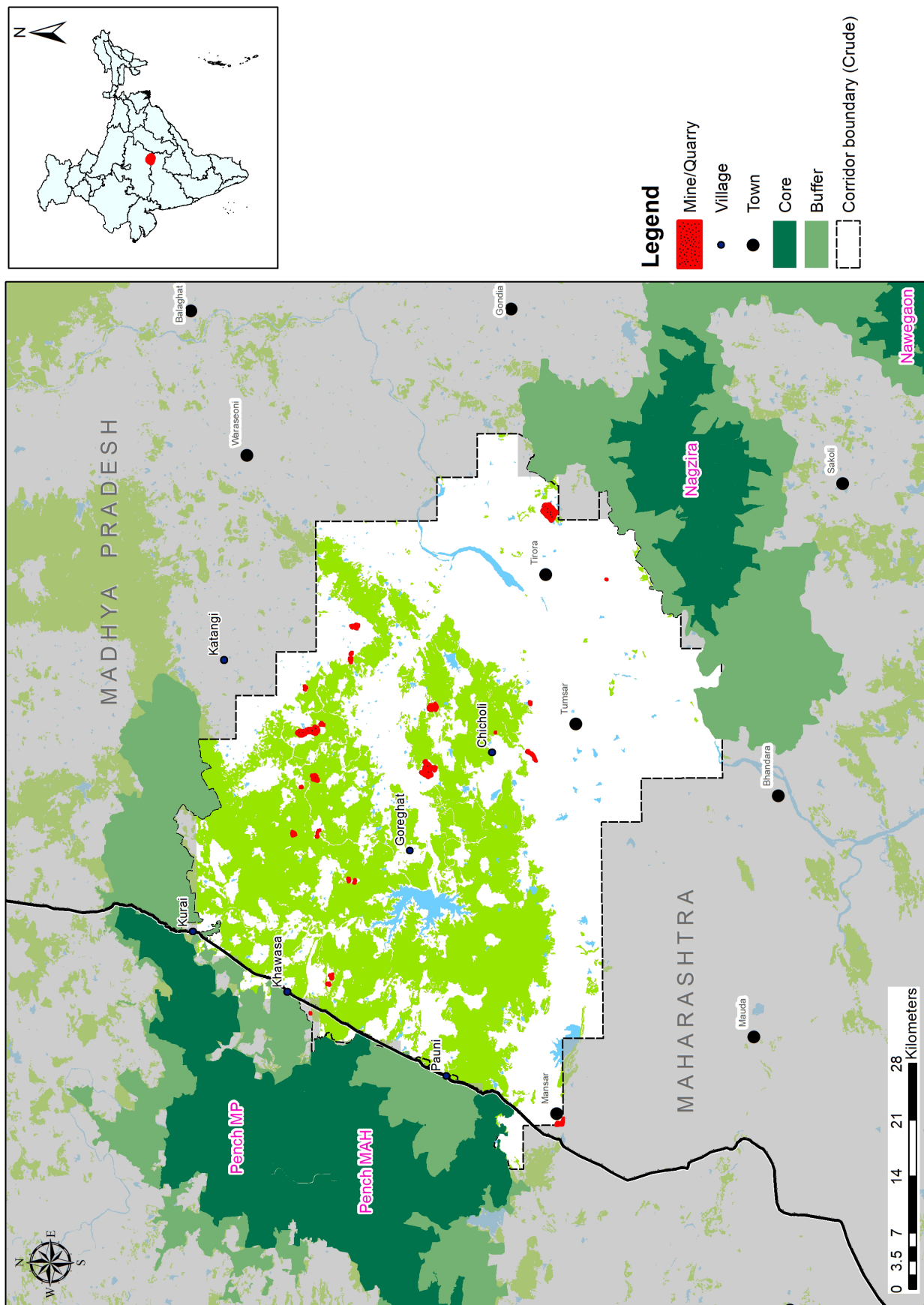


Figure A3. The location of mines or quarry within the Pench-Nawegaon Nagzira corridor area

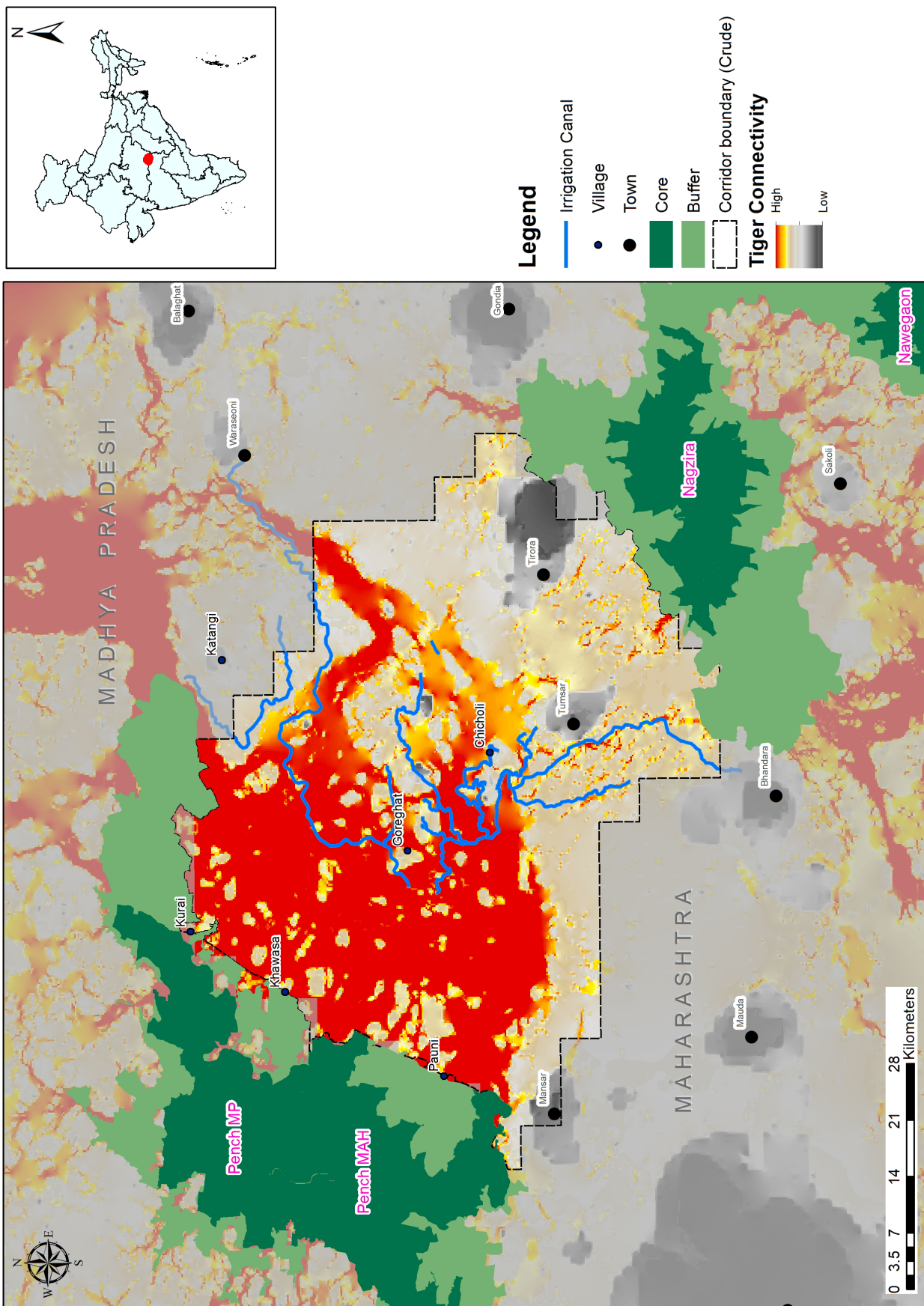


Figure A4. Several canals criss-cross through the Pench-Nawegaon Nagzira Corridor area.

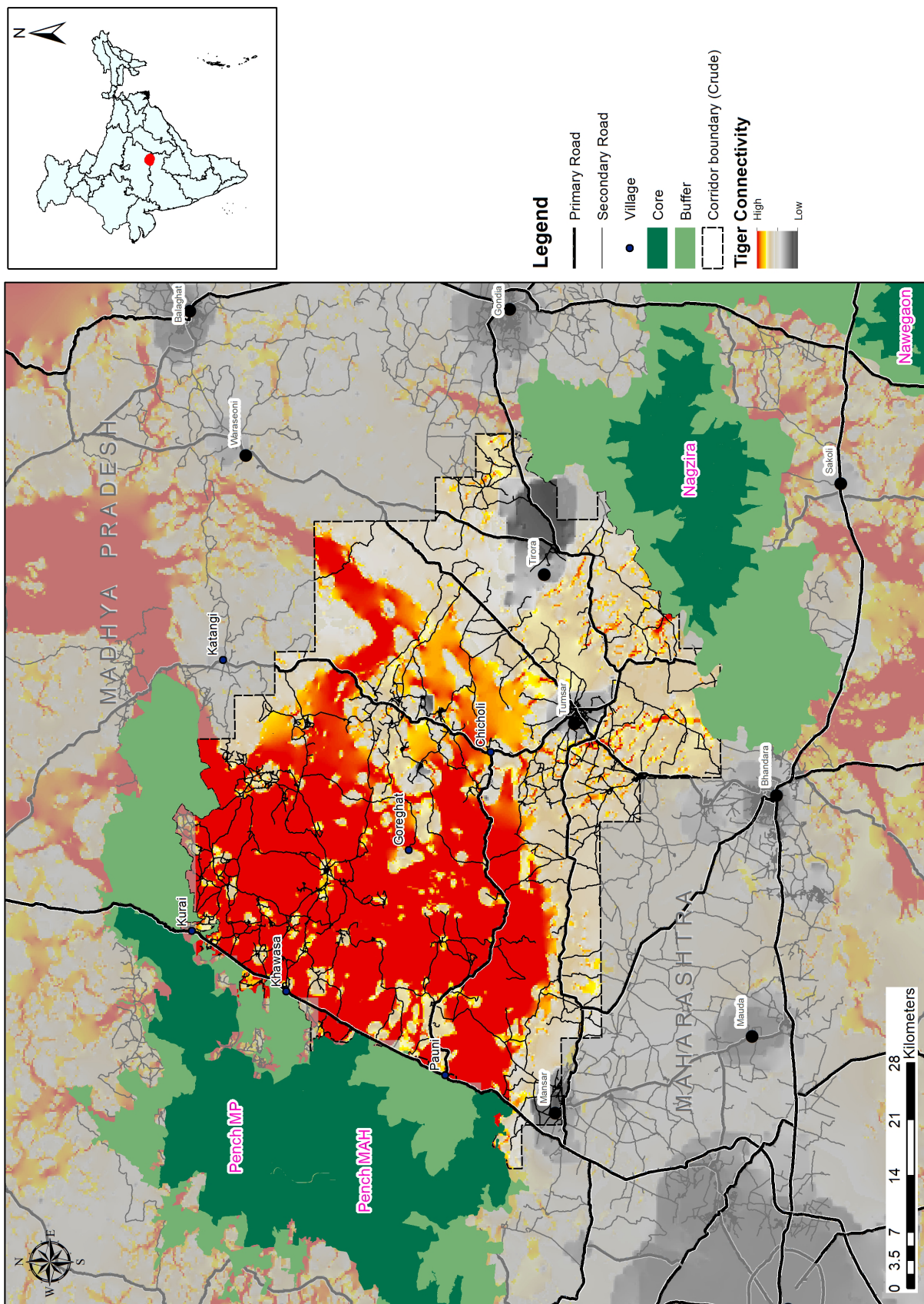


Figure A5: Primary and secondary roads in the Pench-Nawegaon Nagzira Corridor area.

Table A1. List of priority villages within the PENCH-Nawegaon Nagzira Corridor

Sr. No.	Village	Tehsil
1	Khairi	Bhandara
2	Mandwi	Bhandara
3	Dandegaon	Gondia
4	Ekodi	Gondia
5	Khalbanda	Gondia
6	Sahespur	Gondia
7	Tikayatpur	Gondia
8	Betala	Mohari
9	Bhikarkheda	Mohari
10	Dawadipar (kardi)	Mohari
11	Dharmapuri	Mohari
12	Dhiwarwada	Mohari
13	Dongardeo	Mohari
14	Dongargaon	Mohari
15	Ghatkuroda	Mohari
16	Jambhalapani	Mohari
17	Kushari	Mohari
18	Navegaon Bk.	Mohari
19	Paldongari	Mohari
20	Roha	Mohari
21	Salai Bk	Mohari
22	Salai Kh.	Mohari
23	Sihari	Mohari
24	Tadgaon	Mohari

Sr. No.	Village	Tehsil
25	Tanga	Mohari
26	Usara	Mohari
27	Vihirgaon	Mohari
28	Bagholi	Tirora
29	Baiwada	Tirora
30	Bhambodi	Tirora
31	Bihiriya	Tirora
32	Biroli	Tirora
33	Boda	Tirora
34	Bora	Tirora
35	Borgaon	Tirora
36	Chandori bk	Tirora
37	Chandori kh.	Tirora
38	Gangla	Tirora
39	Ghogara	Tirora
40	Gond mohadi	Tirora
41	Isapur	Tirora
42	Kesalwada	Tirora
43	Khairi	Tirora
44	Khairlanji	Tirora
45	Khopada	Tirora
46	Khurkhuli	Tirora
47	Ledada	Tirora
48	Malhi	Tirora

Sr. No.	Village	Tehsil
49	Mandawi	Tirora
50	Manora	Tirora
51	Mundikota	Tirora
52	Murmadi	Tirora
53	Murpar	Tirora
54	Nawargaon	Tirora
55	Nawegaon kh	Tirora
56	Nilagondi	Tirora
57	Panjara	Tirora
58	Paraswada	Tirora
59	Salebardi	Tirora
60	Sarandi	Tirora
61	Satona	Tirora
62	Sejagaon	Tirora
63	Selotpar	Tirora
64	Silli	Tirora
65	Sonegaon	Tirora
66	Sonekhari	Tirora
67	Sonoli	Tirora
68	Umari	Tirora
69	Wadegaon	Tirora
70	Yedamakot	Tirora
71	Ambagad	Tirora
72	Bapera (Ambagad)	Tumsar

Sr. No.	Village	Tehsil
73	Bapera (Sihora)	Tumsar
74	Davezari (Dhanegaon)	Tumsar
75	Dawezari	Tumsar
76	Deosarra	Tumsar
77	Dongarla	Tumsar
78	Gonditola	Tumsar
79	Hardoli (Ambagad)	Tumsar
80	Hardoli (Sihora)	Tumsar
81	Hingana	Tumsar
82	Karkapur	Tumsar
83	Kate Bamhani	Tumsar
84	Khairlanji (Dongarla)	Tumsar
85	Khapa (Tumsar)	Tumsar
86	Kharabi	Tumsar
87	Mahalgaon (Sihora)	Tumsar
88	Mandhal	Tumsar
89	Mitewani	Tumsar
90	Mohagaon (Khadan)	Tumsar
91	Panjara	Tumsar
92	Panjara (renjepar)	Tumsar
93	Paraswada (dewhadi)	Tumsar
94	Ranera	Tumsar
95	Rengepar (Panjara)	Tumsar
96	Sakali	Tumsar

Sr. No.	Village	Tehsil
97	Sitepar (Khairlanji)	Tumsar
98	Sondya	Tumsar
99	Sonpuri	Tumsar
100	Sukali Nakul	Tumsar
101	Takala	Tumsar
102	Tamaswadi (Umarwada)	Tumsar
103	Warpindakepar	Tumsar
104	Yerli	Tumsar
105	Zanzeria	Tumsar
106	Chicholi	Waraseoni
107	Dongariya	Waraseoni
108	Mowad	Waraseoni







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

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