STATUS OF LARGE CARNIVORES AND WILD UNGULATES

IN NORTH AND SOUTH BALAGHAT FOREST DIVISIONS

Report by
World Wide Fund for Nature - India (WWF-India)
and Madhya Pradesh Forest Department
North and South Balaghat Forest Divisions

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Foreword

The forests of Balaghat have, over the past decade, emerged as a remarkable example of how territorial forest divisions can evolve into important wildlife habitats through sustained protection, scientific management, and strong partnerships. Once known primarily as a corridor facilitating movement between Kanha and Pench Tiger Reserves, Balaghat has today thriving, breeding wildlife populations of species like Tigers, Leopards and Dholes.

Recognising this importance, Balaghat has been prioritised under the Tigers Outside Tiger Reserves (TOTR) initiative of the National Tiger Conservation Authority (NTCA)through whichadditional, dedicated funding is supporting the strengthening of protection infrastructure, monitoring systems and management interventions. The MP State Wildlife Board has also approved the Sonewani Conservation Reserve, covering 163.195 square kilometres in Balaghat districtestablishing it not just as an important connectivity area but also as a core habitat for species.

The Madhya Pradesh Forest Department has made consistent efforts in strengthening field protection, enhancing community engagement and intensifying protection measures across the Balaghat landscape. The region has also gained further ecological importance with the movement of wild elephants from Maharashtra's *Gadchiroli* region into the Kirnapur and Lanji ranges of Balaghat, highlighting the landscape's role as an emerging refuge and movement corridor for elephants as well.

The progress achieved in Balaghat has been supported by strong institutional partnerships with conservation NGOs. WWF-India's support over the past 10 years in the area,through initiatives likethe Interim Relief Scheme for livestock depredation, scientific data analysis, field logistics, and capacity building, has contributed to strengthening conservation efforts. Such long-term collaborations play an important role in achieving sustainable conservation outcomes.

This report, *Status of Large Carnivores and Wild Ungulates in North and South Balaghat Forest Divisions*, is not merely a documentation of numbers and distribution patterns, but a reflection of what sustained protection, scientific management, and community participation can achieve in territorial forest landscapes. The lessons emerging from Balaghat reinforce an important principle for the future of conservation in Madhya Pradesh and India—that the wildlife will not be secured within protected areas alone, but across entire forested landscapes. Balaghat today stands as a model and a reminder that with the right vision and commitment, the coexistence of people and wildlife is possible.

(**Subharanjan Sen**)
Principal Chief Conservator of
Forest & Head of Forest Force,
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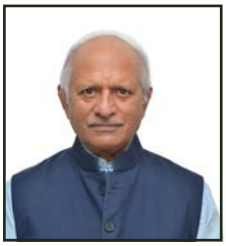
FOREWORD



Large carnivore conservation, particularly of tigers and leopards, has emerged as a critical conservation priority in India. While most conservation efforts have historically focused on protected areas, the role of unprotected forests and territorial landscapes in maintaining viable carnivore populations remains underexplored. These landscapes offer significant potential for species recovery and genetic connectivity, yet face mounting pressures from habitat loss, human-wildlife conflict, and unsustainable development. Realising this potential requires scientific monitoring, robust protection measures, and integrated landscape management that balances conservation with livelihood needs.

Balaghat, located in Madhya Pradesh, represented a unique conservation opportunity: the only non-protected area designated as a WWF's global TX2 site with a commitment to double its tiger numbers. Spanning approximately 4,900 sq km across four forest ranges (Balaghat and Logur in South Balaghat; South and North Lamta in North Balaghat), Balaghat has evolved from a wildlife connectivity area to an established recovery site and now a thriving habitat for tigers and leopards. This transformation, which has occurred over more than a decade of sustained engagement and hard work, underscores the potential of territorial forests when appropriately managed.

Since 2010, WWF-India has implemented the Interim Relief Scheme (IRS) and engaged communities through livelihood initiatives to sustain coexistence. The report *Status of Large Carnivores and Wild Ungulates in North and South Balaghat Forest Divisions,* presents a comprehensive assessment of large carnivore and prey populations and emerging conservation challenges from data collected in November 2021. The findings reveal a critical conservation paradox: while large carnivore populations demonstrate consistent recovery, the recovery of their prey base has lagged considerably, and therefore, livestock dependence has intensified. These observations reinforce findings and recommendations from our earlier report, *The Balaghat TX2 Recovery Site: Status of Tigers and Conservation Assessment (2014-2017)*, which emphasised that future conservation success will depend as much on large carnivore protection as on strengthening the prey base, managing grazing pressure, and proactively addressing human-wildlife conflict.

This report, validates that territorial forests can deliver conservation outcomes comparable to those of protected areas when appropriately managed, and reinforces the necessity of complementary socio-economic measures to sustain this integrated approach.

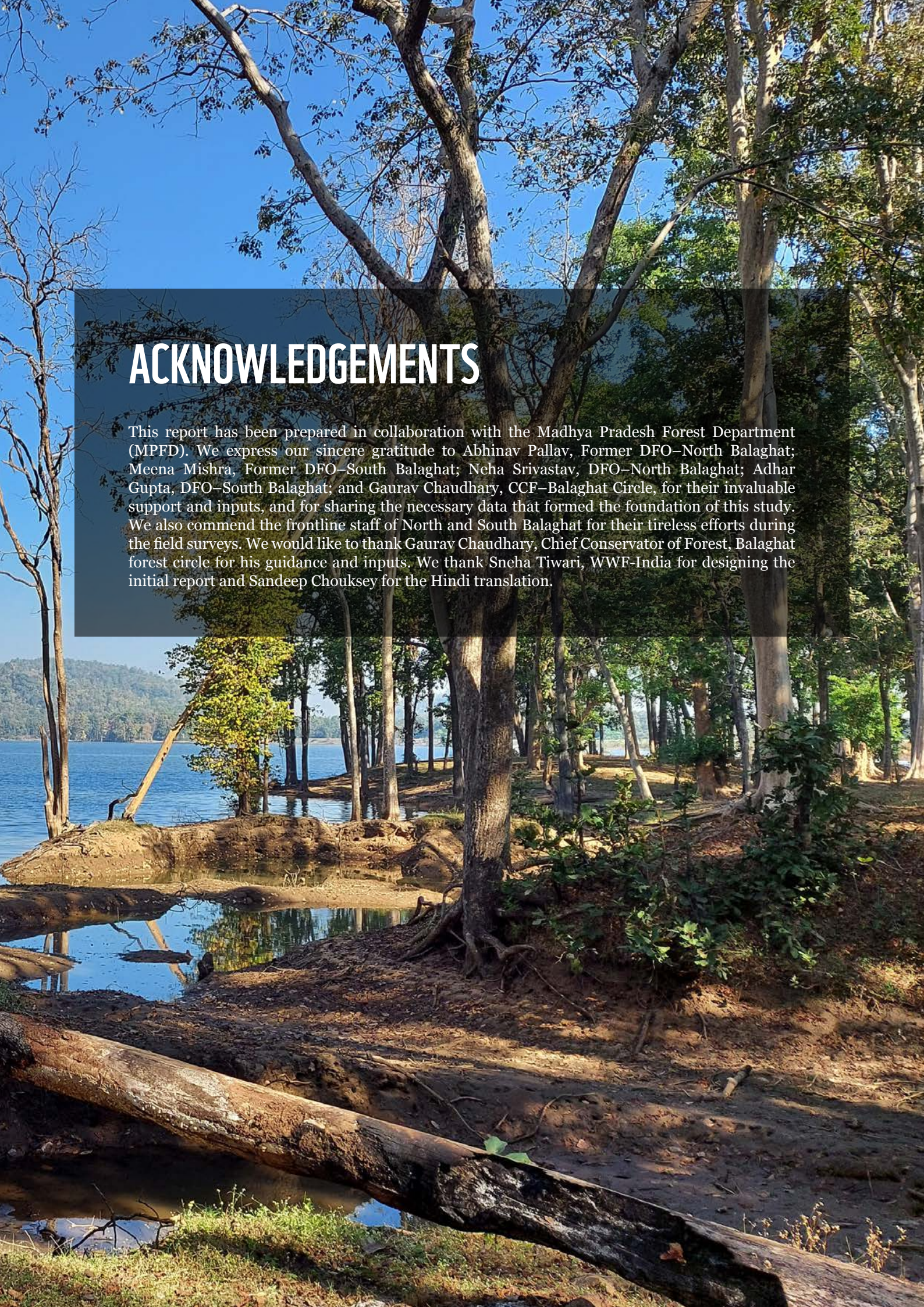
The report also highlights the escalating threats from linear infrastructure development and mining that compromise connectivity and makes a compelling case for prioritising Balaghat under landscape-level conservation initiatives, such as Tigers Outside Tiger Reserves (ToTR).

Balaghat stands as a testament to what can be achieved when sustained scientific engagement, integrated landscape management, and strong community partnerships converge towards a shared conservation vision. These outcomes reflect the unwavering dedication and collaborative efforts of the WWF-India field teams, researchers, and partners who have worked persistently across the landscape over the years.

WWF-India sincerely acknowledges and thanks the Madhya Pradesh Forest Department for its continued support, guidance, and constructive engagement, which have been central to shaping and strengthening conservation interventions in Balaghat.

WWF-India remains committed to further strengthening conservation outcomes in Balaghat and similar landscapes, where the potential for large carnivore recovery outside protected areas offers a transformative and scalable model for India's wildlife conservation agenda. Looking inwards, beyond conventional conservation boundaries, we continue to discover a new universe of ecologically rich landscapes. Balaghat stands out as one such landscape in India, revealing how resilience, coexistence, and long term stewardship can redefine the future of wildlife conservation.

Ravi Singh
Secretary General & CEO, WWF-India



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EXECUTIVE SUMMARY

The Balaghat forest circle, comprising the North and South Balaghat Forest Divisions in Madhya Pradesh, forms a vital component of the Central India Landscape. Strategically positioned between the Kanha and Pench Tiger Reserves, the region serves as a critical corridor for tiger (*Panthera tigris*) dispersal and long term genetic connectivity and therefore contributes significantly to the stability of tiger population across central India. Balaghat represents a mosaic of deciduous forests and agriculture. Its ecological richness is underscored by the presence of diverse flora and fauna, including apex predators such as tigers, leopards (*P. pardus*), and dholes (*Cuon alpinus*), as well as several ungulate species. This report aims to provide the density estimates of large carnivores in the South Balaghat division and prey density estimates in the Balaghat circle, along with the status of wildlife. This report also offers management oriented recommendations to support landscape level conservation planning in the region.

To assess the large carnivore density and status of wildlife, 71 camera traps were deployed in November 2021 across the Lalbarra and Katangi ranges of South Balaghat, covering an area of 215km^2 for a period of 25 days. Individual tigers and leopards were identified, and population density was estimated using Spatially Explicit Capture-Recapture (SECR) model in R. Relative Abundance Index (RAI) maps were generated to understand the presence of other wildlife. Additionally, line transect surveys were undertaken in both North and South Balaghat divisions in December 2021 as part of the All-India Tiger Estimation (AITE) 2022 monitoring. A total of 394 transects (788km) in North Balaghat and 517 transects (1,034km) in South Balaghat were surveyed using the distance sampling method to estimate herbivore densities.

There were 18 individual tigers and 27 individual leopards photo captured during the survey, with estimated densities of 3.72 ± 1.01 individuals/100km^2 for tigers and 6.67 ± 2.04 individuals/100km^2 for leopards. Twenty four mammalian species were photo captured, highlighting Balaghat's rich biodiversity. Herbivore density analysis indicated higher prey abundance in South Balaghat (125.16 ± 7.79 individuals/km^2) compared to North Balaghat (59.06 ± 3.3 individuals/km^2). Among ungulates, *Axis axis* (chital) was the most abundant species, followed by *Sus scrofa* (wild pig), while *Rusa unicolor* (sambar) and *Bos gaurus* (gaur) were recorded at lower densities.

The findings reinforce Balaghat's ecological significance as a functioning tiger habitat and a crucial connectivity link between major protected areas. The area supports substantial mammalian diversity and serves as a stronghold for large carnivores, in spite of being a territorial forest. However, the report also highlights key conservation challenges, including habitat fragmentation from infrastructure development, expansion of mining operations, habitat degradation, and potential human-wildlife conflicts, which needs to be addressed.

कार्यकारी सारांश

मध्य प्रदेश का बालाघाट वनवृत जिसमें उत्तर एवं दक्षिण बालाघाट वनमंडल शामिल हैं, मध्यभारत (सेंट्रल इंडिया लैंडस्केप) का एक अत्यंत महत्त्वपूर्ण भाग है। कान्हा और पेंच टाइगर रिज़र्व के मध्य स्थित इस वनक्षेत्र का, बाघों (*Panthera tigris*) के इन दोनों टाइगर रिज़र्व के मध्य वितरण एवं उनकी आनुवांशिक संयोजकता (Genetic Connectivity) को बनाये रखने, एवं बाघों की स्थायी एवं स्वस्थ आबादी को संरक्षित करने में विशेष योगदान है। बालाघाट का भू-परिदृश्य मुख्य रूप से पर्णपाती वनों एवं कृषि भूमि का समावेश है एवं परिस्थिक रूप से विभिन्न्न प्रकार की वनस्पतियों एवं जीव-जंतुओं से समृद्ध है। यहाँ मुख्यतः, बाघ, तेंदुआ (*Panthera pardus*) तथा ढोल या सोनकुत्ता (*Cuon alpinus*) जैसे शीर्ष मांसाहारी वन्यप्राणी एवं चीतल, सांबर, गौर जैसे शाकाहारी वन्यप्राणी बड़ी संख्या में पाए जाते हैं।

इस प्रतिवेदन का उद्देश्य दक्षिण बालाघाट वनमंडल में बड़े मांसाहारी वन्यप्राणियों की घनत्व का आंकलन, बालाघाट वनवृत में शाकाहारी वन्यप्राणियों की संख्या-घनत्व का मूल्यांकन, एवं इस क्षेत्र में वन्यप्राणियों की वर्तमान स्थिति का अवलोकन करना है। साथ ही, यह प्रतिवेदन भू-दृश्य संरक्षण के लिए एक प्रभावी प्रबंधन योजना बनाने के सुझाव भी प्रस्तुत करता है, ताकि इस महत्वपूर्ण पारिस्थितिक क्षेत्र की जैव-विविधता को भविष्य हेतु संरक्षित किया जा सके।

दक्षिण बालाघाट के लालबर्रा और कटंगी वनपरिक्षेत्रों में वन्यप्राणियों की स्थिति तथा बड़े मांसाहारी प्राणियों की घनत्व का आकलन करने हेतु नवंबर 2021, 215 वर्ग किलोमीटर क्षेत्र में कुल 71 ट्रैप कैमरे 25 दिनों की अवधि के लिए लगाए गए थे। कैमरा ट्रैप में प्राप्त चित्रों (Photo) के माध्यम से अलग- अलग बाघों और तेंदुओं पहचान की गयी, तथा Spatially Explicit Capture-Recapture (SECR) मॉडल के माध्यम से, R सॉफ़्टवेयर में आंकड़ों का विश्लेषण कर उनकी संख्या घनत्व का आंकलन किया गया। दूसरे अन्य वन्यप्राणियों की उपस्थिति को समझने हेतु Relative Abundance Index (RAI) आधारित मानचित्र तैयार किए गए। इसके अतिरिक्त, अखिल भारतीय बाघ आकलन (AITE) 2022 के अंतर्गत शाकाहारी वन्यप्राणियों की स्थिति एवं उनके घनत्व के आंकलन हेतु, उत्तर एवं दक्षिण बालाघाट वनमंडलों में लाइन ट्रांसेक्ट सर्वेक्षण भी किए गए। उत्तर बालाघाट में 394 ट्रांसेक्ट (कुल 788 किमी) तथा दक्षिण बालाघाट में 517 ट्रांसेक्ट (कुल 1,034 किमी) पर सर्वेक्षण कार्य किया गया। शाकाहारी वन्यजीवों की घनत्व के आंकलन हेतु डिस्टेंस सैम्पलिंग आधारित विधि का उपयोग किया गया।

कैमरा ट्रैप सर्वेक्षण में प्राप्त फोटों के माध्यम से अलग-अलग,18 बाघों एवं 27 तेंदुओं की पहचान की गयी, एवं इनका संख्या घनत्व क्रमशः 3.72 ± 1.01 प्रति 100 वर्ग किलोमीटर तथा 6.67± 2.04 प्रति 100 वर्ग किलोमीटर पाया गया। इसके अतिरिक्त कैमरा ट्रैप में 24 दूसरे स्तनधारी वन्यजीव प्रजातियाँ भी दर्ज हुईं, जो बालाघाट की समृद्ध जैव विविधता को दर्शाता हैं। लाइन ट्रांसेक्ट के आंकड़ों के विश्लेषण से यह ज्ञात हुआ की उत्तर बालाघाट वनमंडल (59.06 ± 3.3 जीव/वर्ग किमी) की तुलना में दक्षिण बालाघाट (125.16 ± 7.79 जीव/वर्ग किमी) वनमंडल के वनक्षेत्र में शाकाहारी वन्यप्राणियों की प्रचुर उपलब्धता है। शाकाहारी वन्यप्राणियों में सर्वाधिक घनत्व, चीतल (*Axis axis*) एवं इसके बाद जंगली सूअर (*Sus scrofa*), जबकि सांभर (*Rusa unicolor*) और भारतीय गौर (*Bos gaurus*) का घनत्व अपेक्षाकृत कम पाया गया।

प्रतिवेदन के परिणामों से स्पष्ट हैं की बालाघाट पारिस्थितिक दृष्टि से अत्यंत महत्त्वपूर्ण क्षेत्र है एवं बाघों तथा अन्य वन्यप्राणियों को एक सक्रीय आवास प्रदाय करता है। साथ ही कान्हा और पेंच जैसे संरक्षित क्षेत्रों के मध्य एक महत्वपूर्ण जैव गलियारे के रूप में कार्य करता है। स्तनधारी वन्यजीवों कि बहुतायत इस बात का प्रमाण है, की राजस्व एवं सामान्य वनमंडल श्रेणी में होते हुए भी यह वनक्षेत्र बड़े मांसाहारी वन्यजीवों को एक स्थायी आवास प्रदान करता है।

हालाँकि, प्रतिवेदन में कुछ प्रमुख संरक्षण चुनौतियों का भी उल्लेख किया गया है, जिनमें अधोसंरचना विकास के कारण प्राकृतिक पर्यावास की क्षति, खनन गतिविधियों का विस्तार, पर्यावास विनाश तथा मानव–वन्यजीव संघर्ष की संभावनाएँ भी शामिल हैं, जिनका प्रभावी संरक्षण नीतियों के माध्यम से निराकरण किया जाना आवश्यक है।


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1. INTRODUCTION

The Balaghat circle, comprising North and South Forest Divisions (FD), holds some of the most pristine and contiguous forest patches in central India. It is contiguous with two tiger source populations in Madhya Pradesh; the Kanha Tiger Reserve (KTR) to the north east, and the Pench Tiger Reserve (PTR) to the south west, forming the Kanha-Pench wildlife corridor (Figure 1a), and plays a vital role in facilitating tiger dispersal to the low tiger density areas such as the Navegaon-Nagzira Tiger Reserve (NNTR) in Maharashtra (Qureshi et al., 2023). The area plays a crucial role in facilitating functional and genetic connectivity of tigers and ensuring viability and long term persistence of the population (Jhala et al., 2025). The forests of Balaghat were identified as a critical tiger recovery TX2 site (Harihar et al., 2018) owing to their crucial importance in terms of landscape level conservation.

Current population assessments indicate that the Balaghat circle (including the North and South Balaghat divisions) supports a minimum of 49 tigers (>1 year of age) at a density of 1.77 (0.25) tigers/100km^2 and has a sex ratio of two females per male (Qureshi et al., 2023). The Madhya Pradesh State Wildlife Board has recently sanctioned 163.195km^2 of forest area of the South Balaghat division as the Sonewani Conservation Reserve to secure tiger movement and prey habitat, while recognising local community use of the forest. However, changing land use patterns, expanding human settlements, and linear infrastructure are progressively fragmenting this vital habitat. While conservation has been prioritised in the region's protected areas, which are known for dynamic and pioneering management interventions, the territorial forest divisions have received far less attention and investment. These are often deficient in terms of resources for protection, law enforcement, and evidence based wildlife management, even though these areas are critically important to maintain ecological integrity and achieve landscape level conservation goals. Balaghat forest circle is one such area with immense ecological value, and this report presents an analysis of recent wildlife data to provide some insights and recommendations for management.

1.1 Description of the Geographic Area

Balaghat district has the Maikal range to the north east, the Satpura range to the west and the Wainganga plains to the south. The district extends from 21°N, 79°E to 22°N, 81°E. North and South Balaghat cover a total area of 9,232km^2. The neighbouring districts are Mandla and Dindori to the northwest and Seoni to the west of the state of Madhya Pradesh, Rajnandgaon district of the state of Chhattisgarh to the east, and Gondia and Bhandara districts of the state of Maharashtra to the south. The two main indigenous communities are Baiga and Gond of the Baihar, Birsa, Paraswada, Lanji, Kirnapur, Katangi, Balaghat, Waraseoni and Lalbarra tehsils of Balaghat district. These tribes hold enormous traditional knowledge about various forest based resources, including the medicinal properties of native plant species. Nearly half of the area is under forest cover and contains a mosaic landscape of agriculture and settlements (Figure 1b). The main crop in the Balaghat district is paddy.

The hilly area of north Balaghat is roughly separated from the Wainganga plains of south Balaghat by the Chiroli hills. The area is represented by the gneissic complex of the Precambrian formation which constitutes minerals such as potash, feldspar, quartz, micas, and large deposits of granite (Gaussen et al., 1974). The eastern boundary of the Balaghat district is represented by quartzites and schists of the same formation. The area represents a rich diversity of soil, probably due to the various watersheds and hills surrounding this region. The soil can be placed into three major categories: black alluvial soil, tropical red ferruginous soil, and vertic brown soil. The average maximum and minimum temperatures are 40°C and 25°C, respectively. The average rainfall is between 1,000–1,400mm with 185–200 biological dry days annually. The area supports three vegetation types as per Gaussen et al. (1974): *Terminalia-Anogeissus-Cleistanthus* series in the middle parts of Balaghat, *Shorea-Bhuchanania-Cleistanthus* series in the southern region and *Shorea-Terminalia-Adina* series in the northern region. These vegetation types were classified by Champion and Seth (1968) as Southern Tropical Dry Mixed Deciduous Forest (5A/C3), and transition between Northern Tropical Moist Deciduous Sal Forest 3C/C2e and Moist Peninsular Sal, respectively. The *Tectona grandis* found here were mostly planted for harvesting purposes. The key tree species are *Shorea robusta, Madhuca indica, Terminalia elliptica, T. chebula, T. bellirica, T. arjuna, Diospyros melanoxylon, Butea monosperma, Lagerstroemia parviflora, Anogeissus latifolia, Ficus benghalensis, Ougeinia oojeinensis, Phyllanthus emblica, Schleichera oleosa, Lannea coromandelica,* and *Syzygium cumini*. The understory is characterised by *Pogostemon benghalensis, Colebrookea oppositifolia, Crotalaria spectabilis, Phoenix acaulis*, and grasses such as *Aristida setacea, Heteropogon contortus, Thysanolaena latifolia, Saccharum spontaneum,* with vast expanses of bamboo groves of *Dendrocalamus strictus* and *Bambusa bambos*. Invasive species such as *Lantana camara, Parthenium hysterophorus,* and *Eupatorium perfoliatum* are common in highly degraded forest areas.

The area is known for its faunal diversity, hosting the following species: tiger (*Panthera tigris*), Indian leopard (*P. pardus*), sloth bear (*Melursus ursinus*), dhole (*Cuon alpinus*), gaur (*Bos gaurus*), sambar (*Rusa unicolor*), nilgai (*Boselaphus tragocamelus*), chital (*Axis axis*), barking deer (*Muntjac muntjac*), Hanuman langur (*Semnopithecus* sp.), wild pig (*Sus scrofa*), and chousingha (*Tetracerus quadricornis*). Balaghat district holds a significant diversity of birds with 364 species recorded from the area out of which 118 are migratory, 11 are threatened, 55 are high priority, 59 are schedule I and seven are endemic (SoIB, 2026). Balaghat has also been identified as an important area of conservation significance for avifauna in the State Action Plan for Madhya Pradesh (Jayapal et al., 2023) for the Indian vulture (IUCN status – CR), black-bellied tern (IUCN status – EN) and sarus crane (IUCN status – VU).

Balaghat has been studied for large carnivore population biology (Harihar et al., 2018; Jhala et al., 2020; Talegaonkar et al., 2020). Reported (minimum) numbers from the All India Tiger Estimation (AITE) reports for tigers were 21 (Jhala et al., 2020) and 49 (Qureshi et al., 2023), and estimated population sizes for leopards were 81 and 134 in 2018 and 2022, respectively (Jhala et al., 2020, Qureshi et al., 2024). However, the extent of area surveyed increased between 2018 and 2021, so these estimates are not directly comparable. Other assessments include an analysis of temporal activity patterns of sympatric carnivores and human-wildlife interaction (Talegaonkar et al., 2020 & Borah et al., 2016) that found that the key determinants of tiger occupancy are the absence of human disturbance and prey presence. Nayak et al. (2013) studied the habitat overlap between cattle and wild ungulates and found a high dietary overlap between the domestic and wild ungulates. Similarly, a recent study conducted by WWF-India in the Kanha-Pench Corridor, which overlaps an approximately 2,700km^2 area of Balaghat FD, found that 50% of the tigers' diet comprised livestock (unpublished data). While carnivore populations have been the focus of most previous surveys in Balaghat FD, there are still significant knowledge gaps about the status and abundance of wild ungulates. The threefold objectives of this report are to: (i) provide estimates of large carnivore density in areas of the Balaghat forest circle surveyed in 2021; (b) provide estimates of wild ungulate densities; and (c) based on these estimates, provide recommendations and insights for possible management actions.

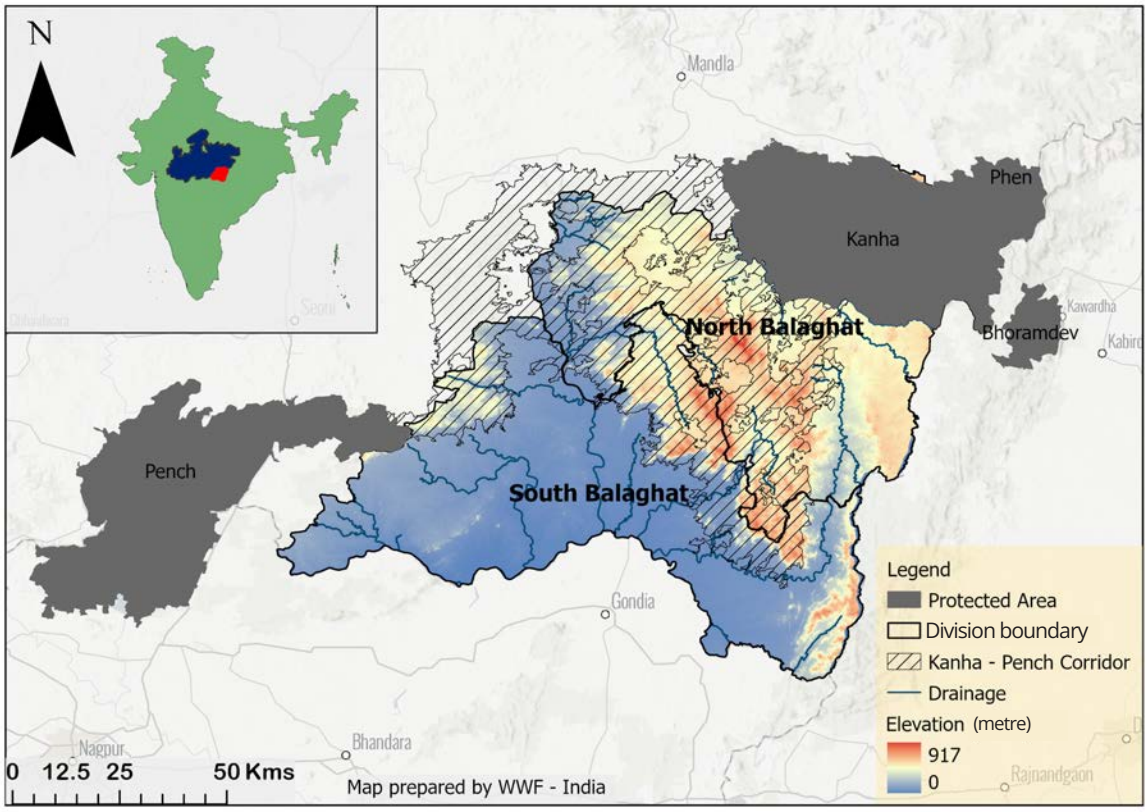

Figure 1a: Administrative boundaries map of Balaghat forest divisions

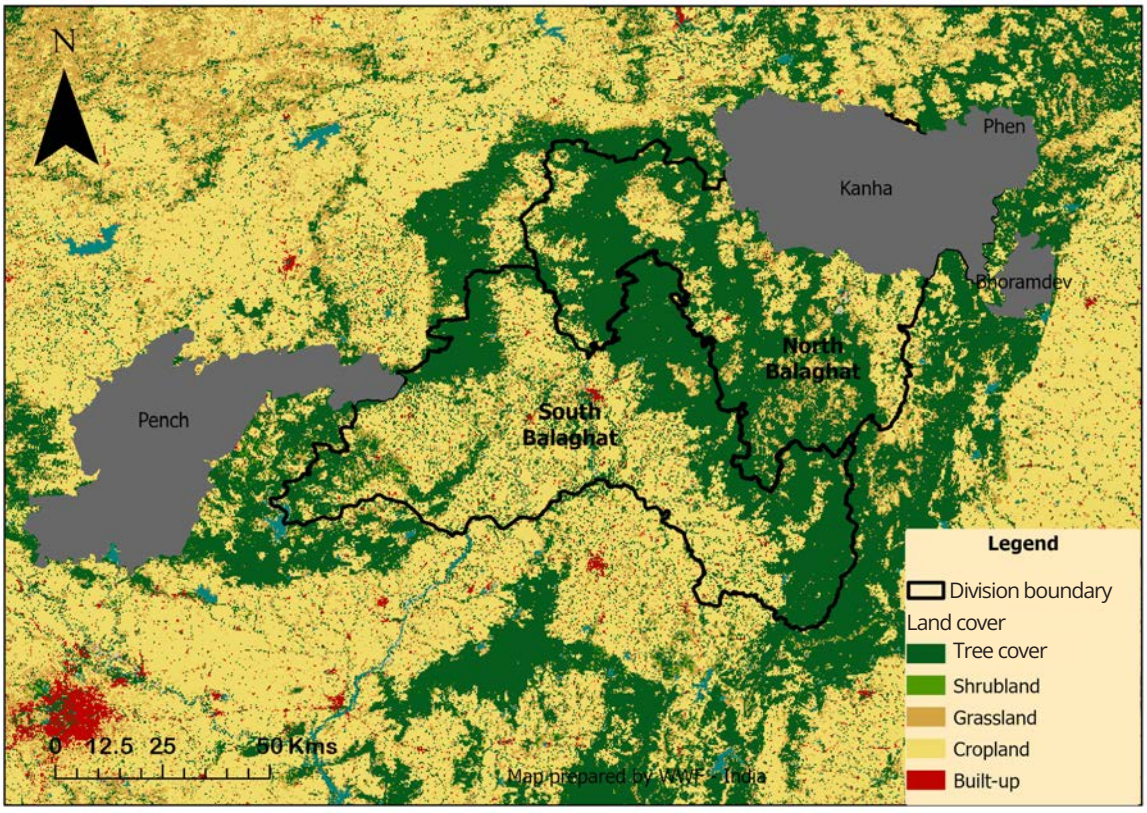

Figure 1b: Land use land cover of the Balaghat forest divisions (European Space Agency World Cover 2021)

2. METHODOLOGY

2.1. Camera Trap Survey

Camera traps were deployed by trained forest department personnel at strategic locations along the forest trails and waterbodies where the movement of large carnivores and other terrestrial mammals was more likely. Camera traps were deployed at 71 locations covering a 215km² area (Figure 2a) in November 2021. Each camera was functional for a period of 25 days in two ranges of South Balaghat division; Lalbarra and Katangi (Figure 2a). Data were then collected and segregated species wise using AI-based image classification, followed by manual screening to address misclassification errors. Unique tiger and leopard individuals were identified based on the left and right flanks, and individual profiles were prepared (Annexure 1). Tiger and leopard density (for adults and post dispersal animals; two years and older in age) was estimated using maximum likelihood based Spatially Explicit Capture-Recapture analysis (Efford & Fewster, 2013) in R (R core team, 2024) using 'secr' package (Efford, 2025). The buffer was estimated separately for the tiger and leopard using *suggest.buffer* function of 'secr' package, and a habitat mask was prepared, excluding non habitat from the suggested buffer around the camera traps. The buffer of 8km and 10km for leopard and tiger, respectively, was taken around the camera traps. We fit a null model with detection parameter g0 (baseline encounter probability) and σ (scale parameter that describes movement around an individual's home range centre). Movement around the (latent) home range centres was described by a half-normal detection function. The abundance was then estimated using the null model, and pixel density was generated to understand their spatial distribution.

For co-predators and herbivores, the Relative Abundance Index (RAI) was calculated. For that, a matrix was prepared with location, date, and time for each species. Independent photo captures were defined for each species based on the time and location of the photo. Two consecutive photos were considered independent if the time interval was >15 minutes for one species at one location. This matrix was used to calculate RAI as follows:

Relative Abundance Index (RAI) = 100 X (A/N) where A is the number of independent photo captures, and N is the number of trap nights.

This is defined as the number of photo captures per 100 trap nights. The RAI maps were generated using the Inverse Distance Weighted (IDW) technique by interpolating the RAI values using ArcGIS Pro 3.5.

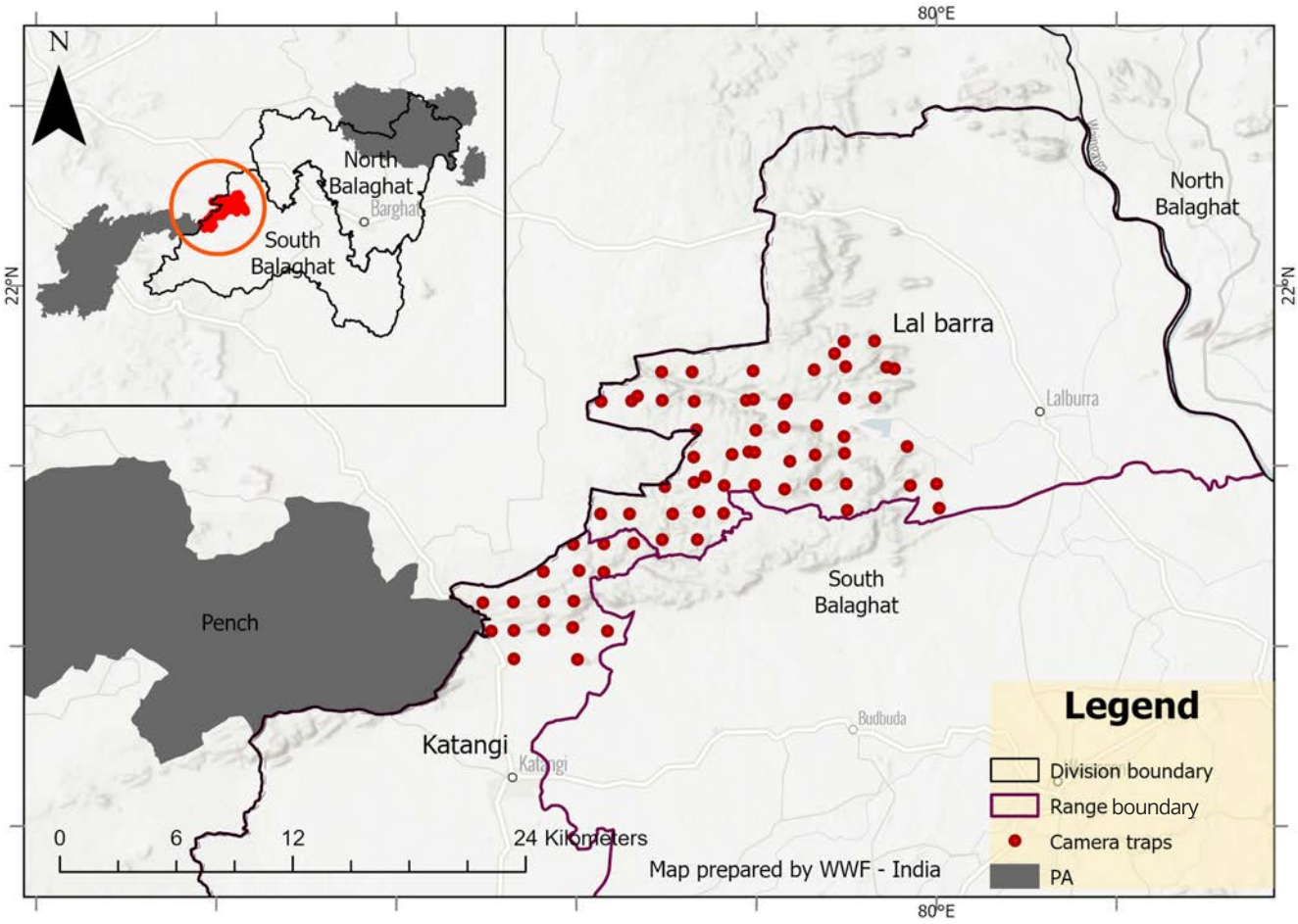

Figure 2a: Camera trap locations in forest ranges; Katangi and Lalbarra of South Balaghat forest division

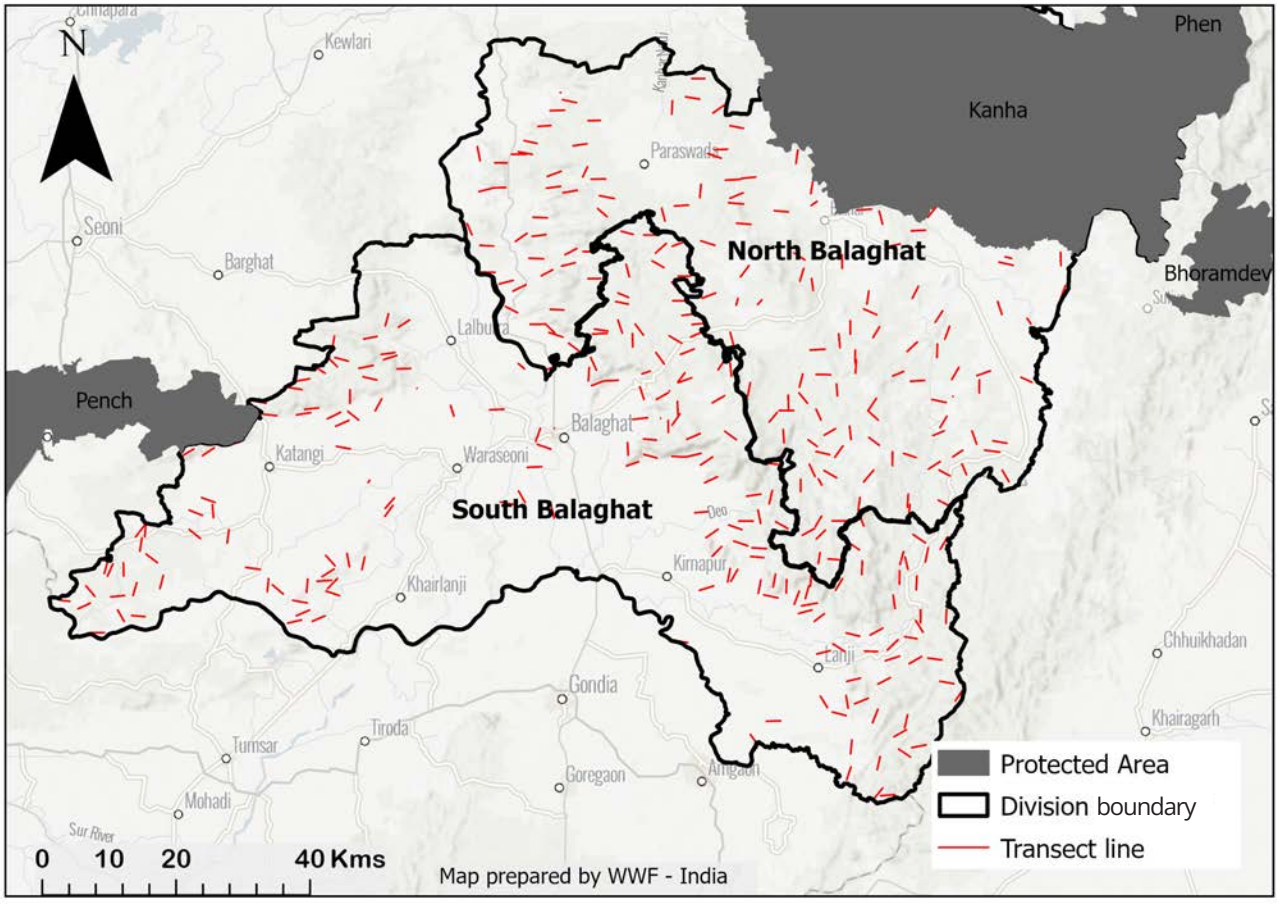

Figure 2b: Line transect sampling in North and South Balaghat divisions

2.2. Line Transect Survey

A total of 160 and 199 line transects (spatial replicates only; figure 2b) were surveyed in North and South Balaghat, respectively, during winter 2021, as part of the Phase III monitoring exercise of the AITE 2022 in all ranges of North and South Balaghat by the divisional ground staff of the forest department. One line transect was walked in each beat, the smallest administrative unit, with three temporal replicates. The transects were walked during the peak activity hours. The division, range, and species wise observations of all herbivores are compiled in Table 1. On sighting of a herbivore, species ID, cluster size, radial distance, angle, GPS coordinates, and forest types were recorded. Wild ungulates detected on transect lines include gaur, sambar, nilgai, barking deer, chital, chinkara (*Gazella bennettii*), and wild pig (Table 1). The sightings with above mentioned parameters were recorded in the MSTrIPES Ecological Module mobile app.

The line transect data were analysed using conventional distance sampling (CDS) in the programme, distance 8.0, to estimate species wise densities (Thomas et al. 2010). Three key detection functions, half normal, hazard rate, and uniform, were fitted to the data along with three adjustment terms: cosine, simple polynomial and hermite polynomial. All combinations of these detection functions and adjustment terms were run. Data were truncated for the farthest observations based on the visual inspection model histograms. Data were also checked for heaping, responsive movement, over-dispersion, and other observer biases, and then corrected using appropriate data filters. The best fit model was selected based on the AIC and goodness-of-fit test.

Table 1: Overview of 2022 line transect data: The highest sightings of prey were Balaghat range followed by Katangi range of South Balaghat Division while the highest encountered prey was Hanuman langur in both forest divisions.

Division	Range	Number of observations
South Balaghat	Balaghat	369
	Hatta	93
	Katangi	339
	Khairlanji	88
	Kirnapur	199
	Lalbarra	120
	Lanji East	264
	Lanji West	225
	Lougur	331
	Waraseoni	151
North Balaghat	Birsa Damoh	127
	East Baihar	109
	North Lamta	130
	North Ukwa	95
	South Lamta	119
	South Ukwa	112
	West Baihar	168

Species	South Balaghat	North Balaghat
Barking deer	146	96
Chinkara	5	0
Chital	327	72
Gaur	19	3
Grey junglefowl	2	5
Hanuman langur	821	355
Hare	172	62
Nilgai	65	26
Peafowl	50	11
Red junglefowl	68	27
Rhesus macaque	318	127
Sambar	60	28
Wild pig	124	48
Total	2177	860


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3. RESULTS

3.1. Large Carnivore Densities

There were 262 tiger photo captures in the Lalbarra and Katangi ranges of South Balaghat. Eighteen individual tigers were identified, with both left and right flanks captured for 12 tigers. Twelve tigers were recaptured on one or more occasions. The tiger profiles based on the camera trap pictures are given in Annexure 1. Similarly, a total of 154 leopard photos were captured during the camera trapping session, and 27 individual leopards were identified. The estimated densities of tiger and leopard were 3.72 ± 1.01 and 6.67 ± 2.04, respectively. Estimates of associated detection parameters are provided in Table 2. The estimated abundance for the tiger and the leopard was 31.03 ± 8.42 and 40.73 ± 12.47, respectively. The pixel density maps of tiger and leopard, representing spatial density gradient, are shown in Figure 3a and 3b.

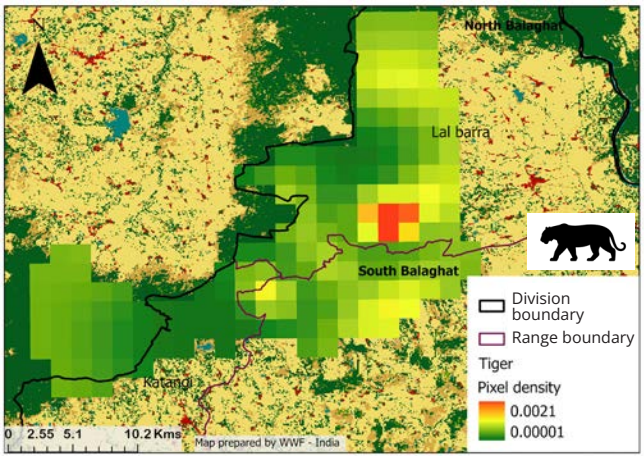


Figure 3a: Pixel density surface for tiger. The red colour shows a higher density of large carnivore.

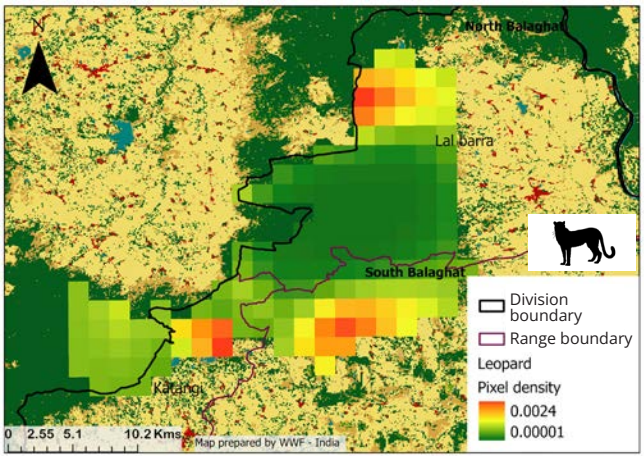


Figure 3b: Pixel density surface for leopard. The red colour shows a higher density of large carnivore.

3.2. Wildlife Presence in Balaghat

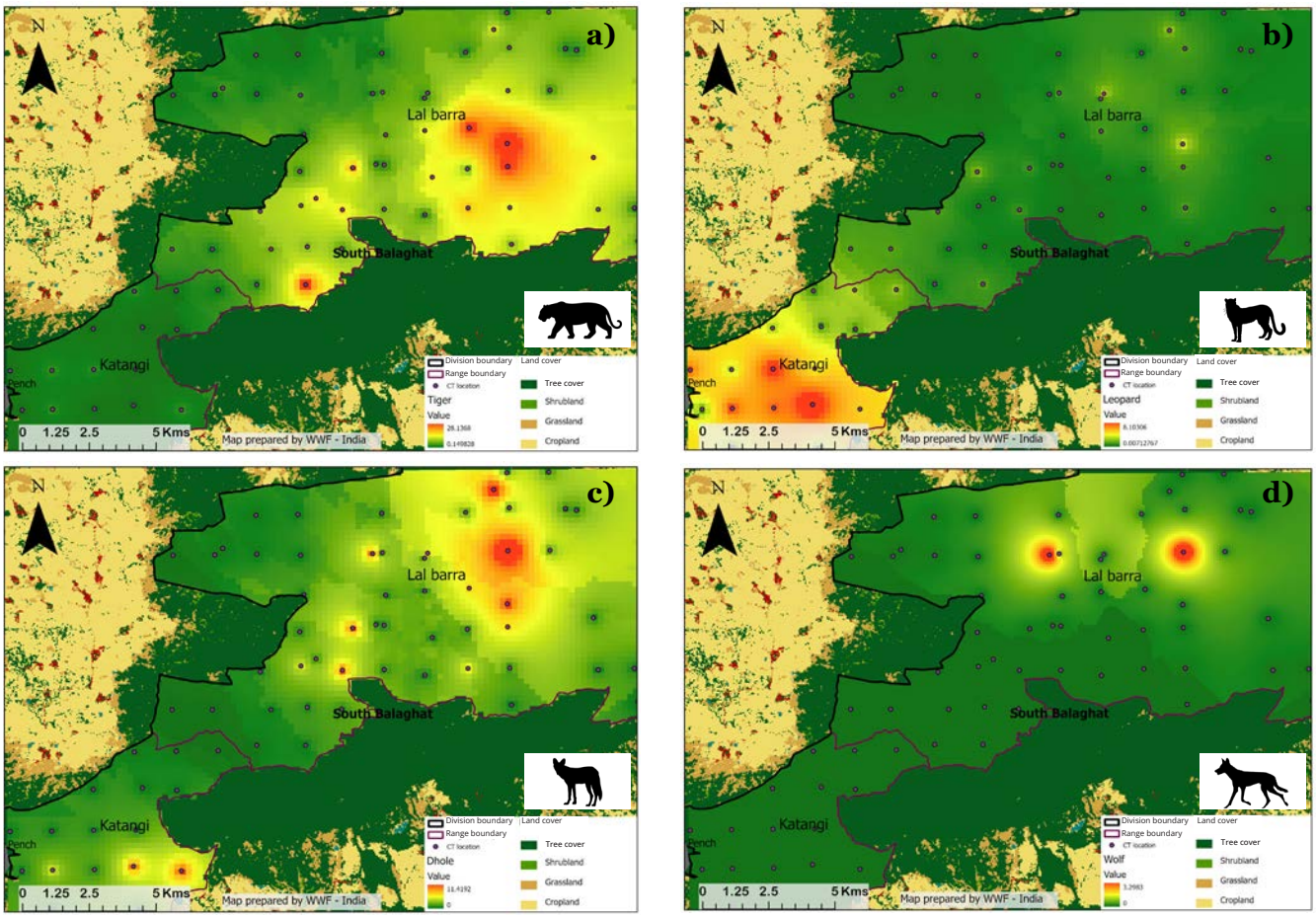
There were a total of 24 mammal species photo captured in two ranges of South Balaghat division that included large carnivores: tiger and leopard; meso-carnivores: dhole, wolf, jackal; small carnivores: jungle cat (*Felis chaus*), Indian fox (*Vulpes bengalensis*), common palm civet (*Paradoxurus hermaphroditus*), small Indian civet (*Viverricula indica*), honey badger (*Mellivora capensis*), Indian grey mongoose (*Herpestes edwardsii*), and ruddy mongoose (*H. smithii*). Omnivores comprised: sloth bear and wild pig; herbivores: gaur, sambar, chital, nilgai, barking deer, chousingha, Rhesus macaque, Hanuman langur, Indian hare (*Lepus nigricollis*) and porcupine (*Hystrix indica*).

Table 2: Tiger and leopard density (individual/100km²) in South Balaghat division; g0 here represents the detection probability and σ (sigma) represents the spatial scale parameter which is defined as average distance moved from the activity centre.

Species	Unique individual captured	Model	Density ± SE (individual/ 100km²)	g0	σ ± SE (km)	Abundance ± SE
Tiger	18	g0(.)σ(.)	3.72 ± 1.01	0.02	3.73 ± 0.40	31.03 ± 8.42
Leopard	27	g0(.)σ(.)	6.67 ± 2.04	0.02	3.24 + 0.60	40.73 ± 12.47

3.3. Spatial Occurrence of Predator, Co-Predator and Prey Species: South Balaghat Division

Based on RAI, tiger movement/usage was found to be more frequent in the Lalbarra range compared to the Katangi range of South Balaghat division (Figure 4a), while leopard movement was found to be more frequent in the Katangi range. Moreover, dhole was also recorded more frequently in Lalbarra (Figure 4c), indicating a potential overlap with the tiger home range. The wolf and jackal had incidental occurrences (Figure 4d and 4e). Among herbivores, the spatial distribution of gaur, sambar, chital and barking deer (Figure 4g, 4h, 4i, 4j) overlapped with both tiger and dhole. On the other hand, leopards (Figure 3b) showed complete spatial avoidance of the tiger range. While tiger activity was more prominent in the Lalbarra range, leopards were more active in the Katangi range. Interestingly, we captured three male leopards at the same location in the Katangi range, showing tightly overlapping territories of the species. The jackal was the only species among captured carnivores that shared the area with the leopard. Among herbivores, wild pig and nilgai were frequently detected in the same area (more abundant in the Katangi than the Lalbarra) as the leopard.



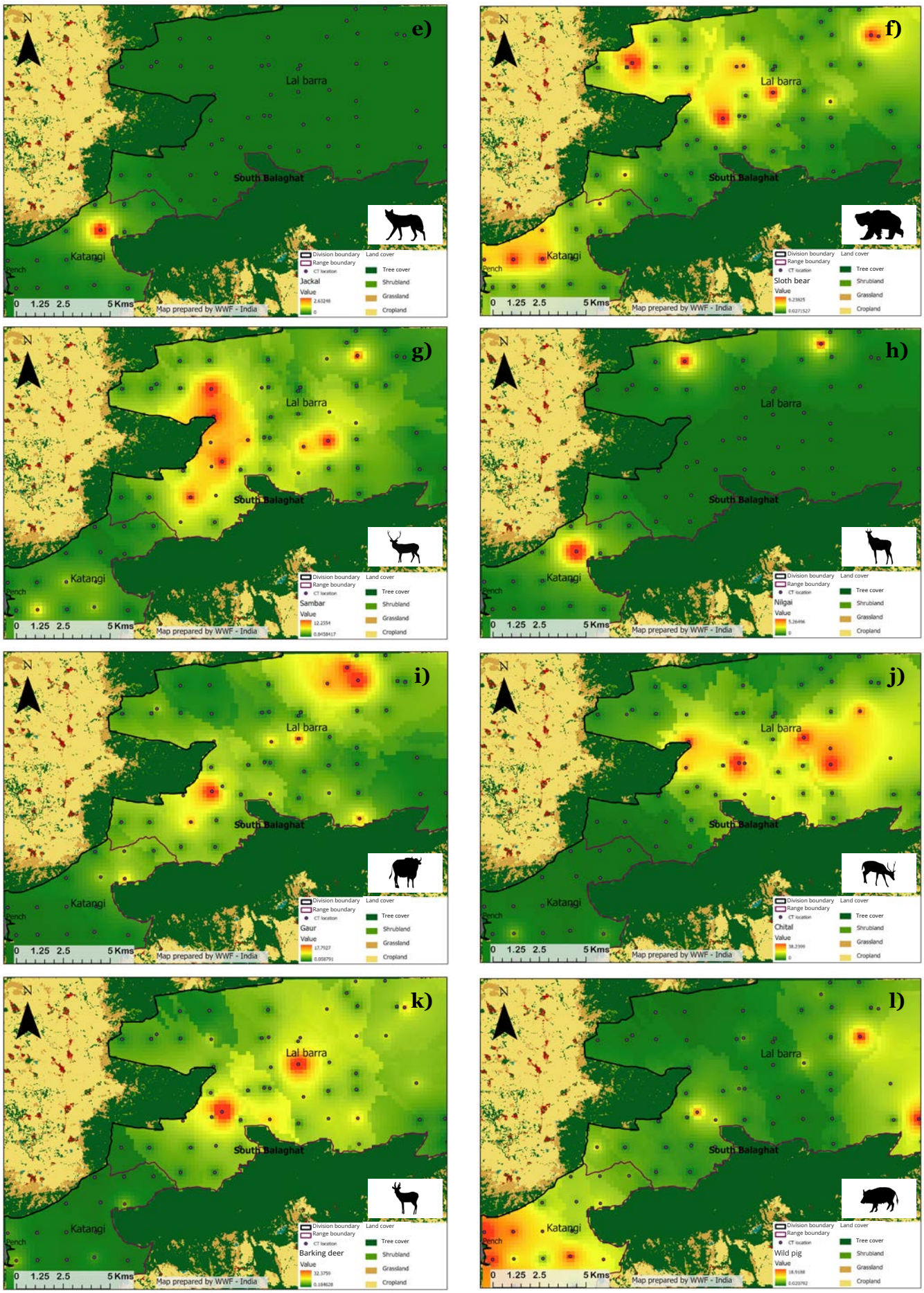


Figure 4: Relative Abundance Index maps of a) Tiger, b) Leopard, c) Dhole, d) Wolf, e) Jackal f) Sloth bear, g) Sambar, h) Nilgai, i) Gaur, j) Chital, k) Barking deer, l) Wild pig in Lalbarra and Katangi ranges of South Balaghat division. Refer figure 2a for the sampling coverage.

3.4. Status of Herbivore Species

A total of 394 and 517 line transects (including spatial and temporal replicates) were walked in North and South Balaghat forest divisions, respectively, covering a total distance of 788km in North Balaghat and 1,034km in South Balaghat. The total effort includes spatial and temporal replicates. There was a total of 838 sightings recorded of the prey species mentioned in Table 1 in North Balaghat, while 2,124 sightings were recorded in South Balaghat. Of these, 269 sightings in North Balaghat and 726 sightings in South Balaghat were of the seven wild ungulates mentioned in Section 2.2. The prey (species mentioned in Table 1) density was estimated to be 59.06 ± 3.3 individuals/km^2 in North Balaghat and 125.16 ± 7.79 individuals/km^2 in South Balaghat (Table 3) while the wild ungulate density (for seven species) was estimated to be 8.66 ± 0.77 individuals/km^2 in North Balaghat and 25.71 ± 1.7 individuals/km^2 in South Balaghat. Species wise density estimates revealed that the Hanuman langur is the most abundant prey species present in North Balaghat, followed by the Rhesus macaque (Table 4). Among the wild ungulates, chital was the most abundant species, followed by wild pig. Other wild ungulates; sambar, nilgai and gaur were present at relatively low densities (<3 animals/km^2). A similar pattern was reflected in the South Balaghat division (Table 5), with the same four species dominating the herbivore guild. However, the overall prey densities were higher in the South Balaghat division than that recorded in North Balaghat.

Table 3: Herbivore density estimates in South Balaghat and North Balaghat

Division	Species	Density +/- SE	CV	Detection probability	Encounter rate	Number of line transects	Efforts	Observations
South Balaghat	Wild ungulates	8.66 ± 0.77	0.09	0.51	0.34	394	788	269
	All prey	59.06 ± 3.3	0.05	0.64 ± 0.01	1.06			838
North Balaghat	Wild ungulates	25.71 ± 1.7	0.06	0.45	0.7	517	1034	726
	All prey	125.16 ± 7.79	0.06	0.51	2.05			2124

Table 4: Herbivore density estimation of all species in North Balaghat

Species	Individual density/ km²	CV	Cluster density/ km²	Group size/km²	Detection probability	Encounter rate (individuals/ km)
Barking deer (n=96)	1.49 ± 0.19	0.13	1.26 ± 0.16	1.18 ± 0.03	0.64	0.12
Chital (n=69)	3.94 ± 0.63	0.16	0.82 ± 0.10	4.76 ± 0.44	0.70	0.08
Hanuman langur (n=346)	34.18 ± 2.61	0.07	4.92 ± 0.31	6.94 ± 0.28	0.63	0.43
Hare (n=62)	1.62 ± 0.24	0.14	1.45 ± 0.21	1.12 ± 0.03	0.41	0.07
Rhesus macaque (n=123)	15.88 ± 2.38	0.15	2.02 ± 0.25	7.84 ± 0.66	0.55	0.15
Wild pig (n=48)	2.31 ± 0.56	0.24	0.63 ± 0.12	3.63 ± 0.47	0.68	0.06

Table 5: Herbivore density estimation of all species in South Balaghat

Species	Individual density/ km²	CV	Cluster density/ km²	Group size/km²	Detection probability	Encounter rate (individuals/ km)
Barking deer (n=146)	2.08 ± 0.27	0.13	1.66 ± 0.21	1.25 ± 0.04	0.44	0.13
Chital (n=327)	14.91 ± 1.41	0.09	3.38 ± 0.29	4.41 ± 0.17	0.48	0.31
Hanuman langur (n=821)	63.2 ± 4.1	0.06	9.51 ± 0.55	6.64 ± 0.19	0.43	0.78
Hare (n=172)	2.91 ± 0.36	0.12	2.66 ± 0.33	1.09 ± 0.01	0.46	0.16
Nilgai (n=65)	1.02 ± 0.23	0.22	0.52 ± 0.10	1.95 ± 0.18	0.63	0.05
Rhesus macaque (n=318)	33.29 ± 4.48	0.13	4.15 ± 0.52	8.00 ± 0.38	0.37	0.29
Sambar (n=60)	1.28 ± 0.29	0.22	0.63 ± 0.13	2.01 ± 0.12	0.51	0.05
Wild pig (n=124)	7.84 ± 1.41	0.18	1.58 ± 0.22	4.95 ± 0.53	0.42	0.11

4. DISCUSSION

The results provide valuable insights into the spatial distribution of tiger, co-predators and prey in two ranges of South Balaghat forest division and density of wild herbivores in Balaghat forest circle. The results highlight the ecological significance of Balaghat forest divisions as a key landscape supporting large carnivores and other mammalian diversity with 18 tiger individuals recorded in the Lalbarra and the Katangi ranges of South Balaghat. Twelve out of 18 tigers were recaptured, with breeding signs recorded at two locations suggesting territory establishment by tigers. Similarly, 27 individual leopards were captured in South Balaghat, with records of breeding pairs reinforcing Balaghat's role as a functioning tiger and leopard habitat rather than merely a habitat corridor.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The tiger and leopard density maps (Figure 3a and 3b) show an inverse relationship between areas with high leopard and high tiger densities. This may be indicative of leopards avoiding high tiger density areas, but this inference will need further investigation. The competitive exclusion of leopards by tigers has also been reported in previous studies (Harihar et al., 2011; Karanth & Sunquist, 2000). While, Talegaonkar et al., (2020) reported a temporal overlap between the two species.

The results show that the South Balaghat division supports a relatively larger herbivore population compared to the North Balaghat. This could be due to the differences in the availability of suitable habitats in these divisions. However, a specific study could provide clear reasons for these differences. Further, the overall herbivore densities in both divisions remain lower than the densities reported from KTR and PTR (Table 6) (Jhala et al., 2020). The density of key tiger prey species, sambar and chital, remains low across both divisions, raising concerns about wild prey sufficiency in sustaining the current predator population. However, South Balaghat supports relatively high densities of wild pigs and barking deer, in some cases exceeding estimates from KTR and PTR. This may partially offset the scarcity of preferred prey but also indicates a shift in wild-prey composition available to large carnivores. A recent study (WWF-India, unpublished data) suggests that over 50% of the diet of tigers in the Kanha-Pench Corridor, which overlaps significantly with the Balaghat divisions, comprises livestock. This heavy dependency on livestock poses both conservation and conflict risks, as it increases the potential for human-wildlife interactions and retaliatory killings.

Balaghat supports substantial biodiversity, with 24 mammal species photo-captured in South Balaghat, indicating good habitat conditions, protection and management.

Table 6: Species wise comparison with Kanha and Pench Tiger Reserves (Qureshi et al., 2025)

Density (Individual/km²) (SE)				
Species	**Kanha TR**	**Pench TR**	**North Balaghat**	**South Balaghat**
Chital	40.29 (1.85)	53.97 (2.55)	3.94 (0.63)	14.91 (1.41)
Sambar	8.21 (0.54)	9.18 (0.73)		1.28 (0.29)
Wild pig	11.19 (0.88)	12.47 (1.74)	2.31 (0.56)	7.84 (1.41)
Gaur	6.42 (0.58)	3.4 (0.59)		
Barking deer	3.75 (0.33)	NA	1.49 (0.19)	2.08 (0.27)
Nilgai	NA	15.2 (1.41)		

5. INSIGHTS AND RECOMMENDATIONS

Balaghat is a critical stronghold for large carnivores, particularly tigers and leopards, and while wild herbivore numbers are relatively low, densities of chital and sambar are still comparable or higher than numbers in some of the protected areas in central India, such as Sanjay-Dubri Tiger Reserve, Veerangna Durgawati Tiger Reserve and Guru Ghasidas National Park. Therefore, Balaghat should primarily be seen as a habitat and should be accorded as much conservation attention as any protected area.

The Madhya Pradesh State Wildlife Board has recently approved the proposal for Sonewani Conservation Reserve in one of the most important sites in the South Balaghat Division. This is an important opportunity to develop a unique model for a protected area in Madhya Pradesh. The management plan should be developed and implemented jointly with the participation of communities. The plan should aim to achieve a dual objective of wildlife conservation and sustained community benefits. The Sonewani Conservation Reserve can become a model that can be replicated across the state for important wildlife habitats and connective areas outside protected areas.

Similarly, for the rest of the Balaghat territorial divisions, the wildlife component of the working plan needs to be strengthened. To achieve this, some of the subsequent recommendations presented in this report should be incorporated into the working plan(s).

5.1. Wildlife Monitoring and Protection

Given the ecological importance of the area and good mammalian diversity, ecological monitoring is essential. Long term research and regular monitoring are key to effective management. The area surveyed using the camera traps in 2022 was limited to only two ranges of South Balaghat. Such monitoring should be extended to all the ranges and standardised for future surveys. The camera trap exercise can be done annually for 25 days along with the line transect exercise for ungulate density estimations. The number of transects in the South Balaghat division should be increased to fill the large sampling gaps in spatial coverage.

The current status of Balaghat as territorial forests limits the financial resources that are needed to manage and monitor these populations and their habitat. The dedicated allocation of funds for strengthening forest infrastructure (forest camps, anti-poaching camps) and staff capacity should be ensured for better conservation planning. Balaghat should be taken up as a priority region for conservation support by the Madhya Pradesh Forest Department under the "Tigers Outside Tiger Reserves" project of NTCA.

5.2. Conflict Management

Since the area is a mosaic of forest and agricultural lands, human-wildlife interaction is expected. A rapid-response mechanism needs to be established for compensation of crop depredation (as the livestock-kill compensation mechanism is already in place) to prevent retaliation and improve relationships with the communities. As part of the process of compensation for livestock depredation, regular monitoring of livestock kills should be undertaken. The data collected would not only provide insights into the movement and protection of predators in the division but also help in understanding and addressing the conflict animals and conflict hotspots over the years.

5.3. Habitat Management

Habitat management should focus on three key aspects: invasive species management, wetland conservation, and fire management.

(i) Balaghat has been reported to have a high cover of invasive species according to the AITE report (Quereshi et. al., 2023). The district is also reported to have high environmental suitability for several invasive plants of great concern, including *Ageratina adenophora*, *Ageratum conyzoides*, *Mesosphaerum suaveolens*, *Lantana camara*, *Parthenium hysterophorus*, and

Senna tora. Human modification of natural areas, such as linear infrastructure, agriculture, and extractive activities including tree felling, livestock grazing, and mining, has emerged as a major driver of these invasions. Both forest divisions (North & South) should therefore be prioritised for early removal of invasive species before they spread over larger areas. However, *Lantana camara* is known to adapt to changing ecological conditions (Mungi et al., 2020) and therefore requires ecosystem-specific management experiments to evaluate the effectiveness of different interventions. Invasive species eradication is often ineffective because areas are frequently reinvaded (Bhagwat et al., 2012), and therefore removal efforts should be considered a step within a broader habitat restoration process rather than a standalone solution.

(ii) Balaghat has a large number of wetlands (Figure 5). According to the National Wetland Atlas, the district has a total wetland area of about 24,610 ha, including 3,496 small wetlands (<2.25 ha). Rivers and streams account for 49.87% of the wetland area, followed by tanks and ponds (20.58%). Reservoirs and barrages form another major wetland type, accounting for about 15.15%. These wetlands face several threats, including discharge of untreated waste and effluents from industries and settlements, encroachment, and solid waste dumping. Recognising the importance of conserving inland wetlands, India has established initiatives such as the National Wetlands Conservation Programme under the National Lake Conservation Plan and the Wetlands (Conservation and Management) Rules, 2017. Management efforts should include regular monitoring of water quality (physical, chemical, and microbiological parameters), periodic assessment of pesticide and heavy metal contamination in fish and other aquatic components, and implementation of wetland management practices that combine legal protection, integrated planning, ecosystem restoration, and community participation.

(iii) Balaghat district is highly vulnerable to forest fire as per the FSI report on vulnerability of India's forests to fires (Figure 6). Fire management should focus on prevention and early response. Fire hotspot mapping and fire vulnerability grading of different areas should be carried out using geospatial tools to identify high-risk locations. Madhya Pradesh already has a well-established fire alert system with beat-level alerts and one of the highest numbers of subscribers to the Forest Fire Alert System (FSI, 2023); these alerts should be regularly monitored and used for timely field response. An assessment of staff availability, equipment, and infrastructure for firefighting should also be undertaken. Site-specific measures such as creation and maintenance of fire lines and controlled burning in high fuel load areas may be implemented where required. Engaging local communities, including forest fringe villages and Joint Forest Management Committees, can help in early reporting of fires and support prevention efforts through awareness and local participation.

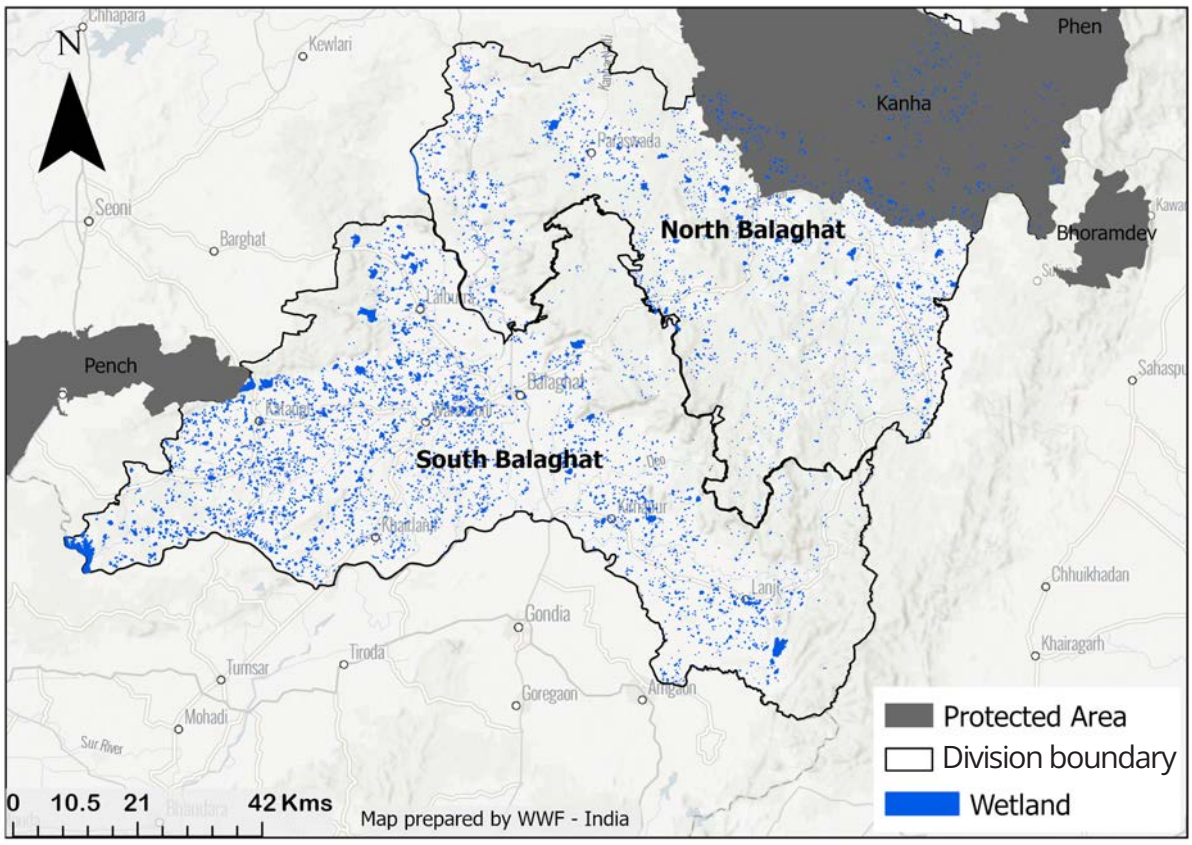


Figure 5: Wetlands in Balaghat divisions, source: WRIS, India

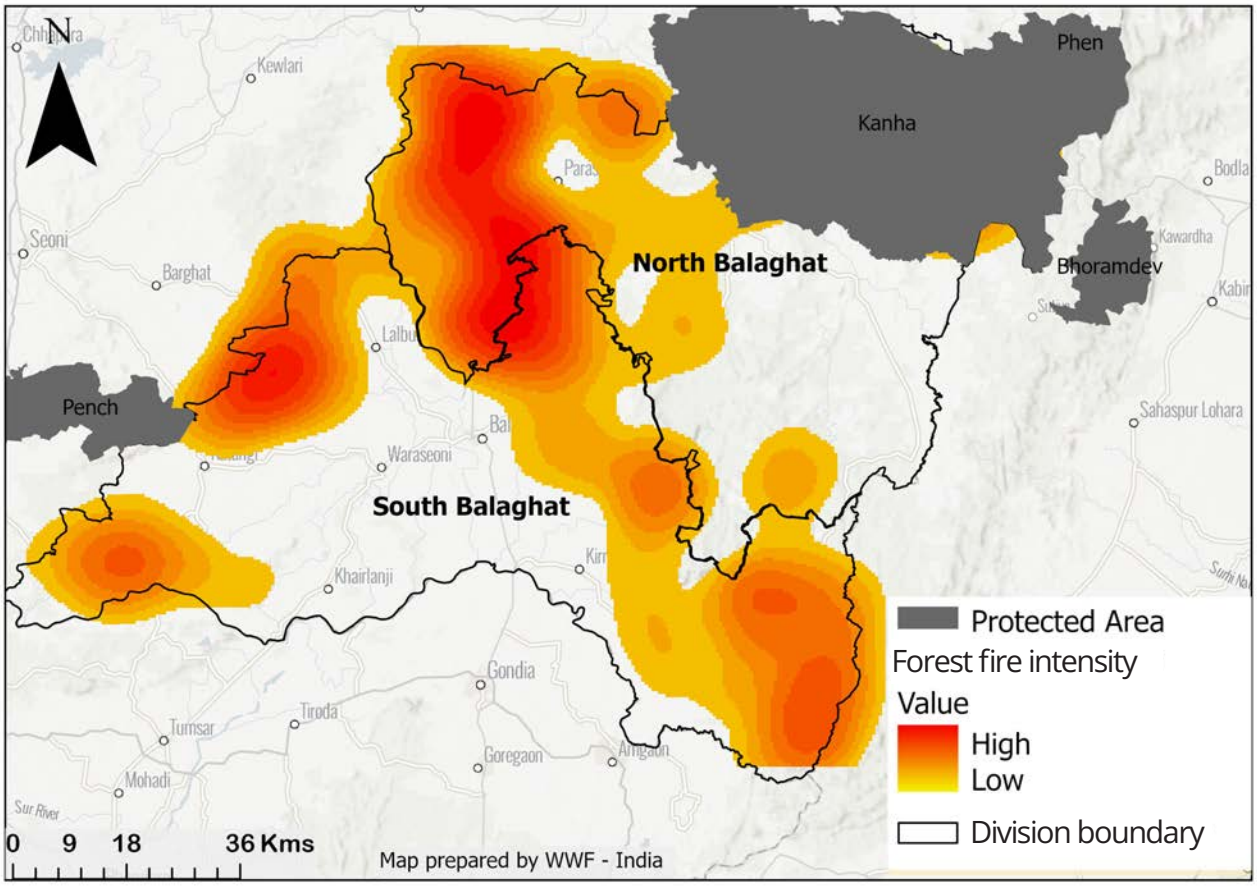


Figure 6: Fire intensity in Balaghat divisions; source: NASA FIRMS

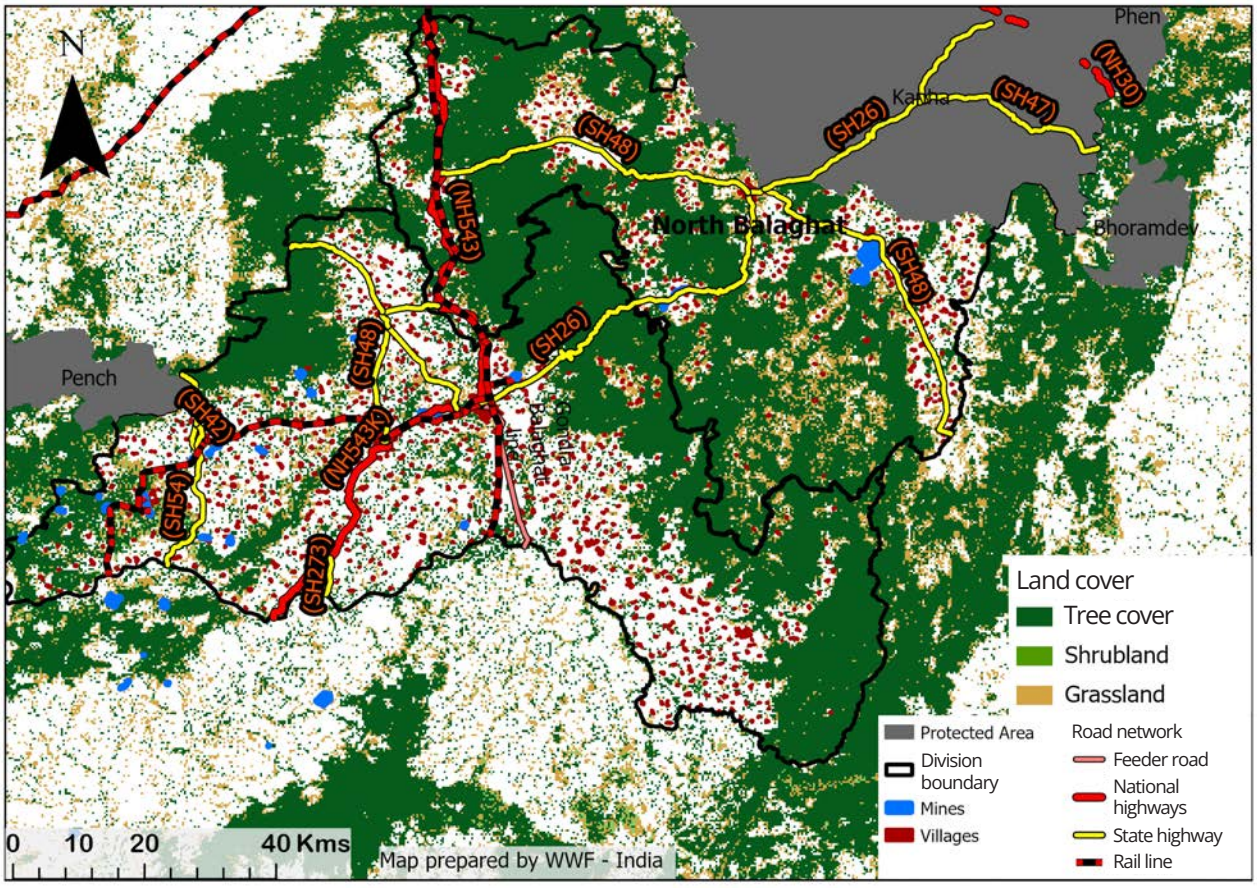


Figure 7: Major roads and mines in the North and South Balaghat forest division.

5.4. Community Engagement

The Balaghat district consists of 10 administrative blocks (Figure 7); Balaghat, Baihar, Birsa, Katangi, Khairlanji, Kirnapur, Lalbarra, Lanji, Paraswada, and Waraseoni. These blocks include 1,385 villages and 692 Gram Panchayats. According to the 2011 Census, the district has a population of approximately 1.7 million, of which 22.5% belong to Adivasi communities, mainly Gond and Baiga. Agriculture and livestock rearing are the primary sources of livelihood, while many households also collect Non-Timber Forest Produce (NTFP) such as mahua, tendu leaves, harra, bahera, aonla, sal seeds, and honey.

Engaging local communities through their involvement and active participation in planning and management can substantially benefit conservation, including the safe dispersal of tigers. Multiple avenues exist, including engagement in ecotourism, value chain, and market development for local products like millet, vegetables, NTFP, and fire management.

The forest department currently engages local communities through Joint Forest Management Committees (JFMCs) and Van Samiti. Strengthening these committees and enhancing community role as decision makers in their governance would be critical for their effective functioning. These committees should have adequate representation and participation in accordance with the working plan guidelines. Further, Community Rights (CRF and CFRR) holders under the FRA, 2006, should be encouraged to undertake community-led conservation. Conservation NGOs should be roped in to play a facilitatory role in the development and implementation of the CFR Management plans.

5.5. Mitigation of Linear Infrastructure Impacts

Balaghat is highly vulnerable to the upcoming linear infrastructure development due to its importance as an important wildlife habitat and key connectivity corridor. There are nearly 77km of National Highway (NH 543), along with several State Highways (SH 26–Seoni–Balaghat–Baihar; SH 48–Lamta–Baihar; SH 54–Seoni–Bhandara), that bisect the forest habitat of Balaghat (Patil et al., 2023). Additionally, the railway line that connects Jabalpur to Balaghat and Gondia through Nainpur also poses challenges for wildlife movement (Patil et al., 2023). The increasing traffic on these roads and the increasing frequency and speeds of trains is a risk to wildlife movement (Patil et al., 2023). Therefore, any linear infra upgradation should have a site-specific mitigation strategy as per the NTCA and WII guidelines (WII 2016).

NGOs (WCT and WWF) have undertaken studies and developed recommendations for mitigation measures for several upcoming infra projects in the Balaghat division. These recommendations should be incorporated whenever these projects come up for Forest Clearance. Further, regular maintenance of the existing mitigation structures is also highly recommended.

5.6. Mitigating Impacts of Mining

Balaghat is a well known source of copper and manganese and has some of the largest deposits in India (Patil et al., 2023). The Malanjkhand copper mine, the largest single copper deposit in India and the Bharveli manganese mine, the largest underground manganese mine in Asia, are located adjacent to the Balaghat forest. Apart from the direct land use change and degradation, associated activities of such mines, like construction of roads, traffic, production of wastewater and sediments, and human settlement, can lead to habitat destruction and fragmentation and can cause significant disturbances to wildlife.

To reduce these impacts, the following actions are recommended:

1. Allocation of new mining blocks should be avoided, especially in the areas that are critical habitats or wildlife movement areas.
2. Other off-site infrastructures like townships and washeries should be located outside the forest and away from significant wildlife movement areas.
3. Transportation of Ore or Overburden (OB) should be banned between sunset and sunrise.
4. The exhausted/closed opencast mines should be systematically restored as a priority.

6. अंतर्दृष्टि एवं अनुसंशायें

बड़े मांसाहारी वन्यप्राणियों, विशेष रूप से बाघ और तेंदुए, के लिए बालाघाट एक महत्वपूर्ण क्षेत्र है, हालांकि यहाँ शाकाहारी वन्यप्राणियों की कुल संख्या अपेक्षाकृत कम है, लेकिन कुछ क्षेत्रों में चीतल और सांभर का घनत्व संजय–दुबरी टाइगर रिज़र्व, वीरांगना दुर्गावती टाइगर रिज़र्व और गुरु घासीदास नेशनल पार्क जैसे संरक्षित क्षेत्रों के सामान या उससे अधिक है।

इसलिए बालाघाट वन्याप्रणियों के लिए एक महत्वपूर्ण आवास क्षेत्र है। जिसे अन्य संरक्षित क्षेत्रों के समान संरक्षण महत्व दिया जाना आवश्यक है।

अभी हाल ही में मध्य प्रदेश राज्य वन्यजीव बोर्ड ने दक्षिण बालाघाट वनमंडल के लालबर्रा परिक्षेत्र के एक महत्वपूर्ण क्षेत्र सोनेवानी को कंज़र्वेशन रिज़र्व बनाने के प्रस्ताव को मंज़ूरी दी है। यह राज्य में संरक्षित क्षेत्र के एक नए प्रतिरूप (मॉडल) को विकसित करने का अवसर है। इस कंज़र्वेशन रिज़र्व की प्रबंधन योजना को स्थानीय समुदायों की भागीदारी के साथ तैयार एवं लागू किया जाना चाहिए, जिसका उद्देश्य वन्यप्राणियों के संरक्षण के साथ-साथ समुदायों के दीर्घकालिक लाभ सुनिश्चित करना होना चाहिए। ताकि भविष्य में यह प्रदेश के अन्य महत्वपूर्ण वन्यप्राणी क्षेत्रों और संरक्षित क्षेत्रों के बाहर स्थित कनेक्टिविटी क्षेत्रों के लिए एक प्रतिरूप (मॉडल) बन सके।

इसी तरह, बालाघाट के शेष वन क्षेत्रों के लिए तैयार किए जाने वाली कार्ययोजना में वन्यजीव योजना को और सुदृण करने की आवश्यकता है। जो की इस प्रतिवेदन में सुझाये गयीं अनुसंशाओं को भी शामिल कर किया जा सकता है।

6.1. वन्यप्राणी अनुश्रवण एवं सुरक्षा

क्षेत्र के पारिस्थितिक महत्व और स्तनधारी प्रजातियों की विविधता को देखते हुए यहां नियमित निगरानी की आवश्यकता है। दीर्घकालिक शोध और सतत निगरानी प्रभावी वन्यप्राणी प्रबंधन का आधार होते हैं।

वर्ष 2022 में किया गया कैमरा ट्रैप सर्वेक्षण का कार्य केवल दक्षिण बालाघाट की दो रेंजों तक सीमित था। इस प्रकार का कार्य सभी रेंजों में किया जाना चाहिए एवं भविष्य के लिए अनिवार्य किया जाना चाहिए। शाकाहारी वन्यप्राणियों की संख्या का अनुमान लगाने के लिए लाइन ट्रांसेक्ट सर्वेक्षण को भी कैमरा ट्रैप सर्वेक्षण के साथ किया जा सकता है। दक्षिण बालाघाट वनमंडल में वर्तमान में ट्रांसेक्ट की संख्या कम है, इन्हें बढ़ाया जाना चाहिए ताकि वर्तमान में जो आंकड़ों की कमी है उसे पूरा किया जा सके।

वर्तमान में बालाघाट क्षेत्रीय वन (Territorial Forest) के अंतर्गत आता है, जिसके कारण यहां संरक्षण और निगरानी के लिए उपलब्ध वित्तीय संसाधन सीमित हैं। फॉरेस्ट कैंप, एंटी-पोचिंग कैंप और कर्मचारियों की क्षमता विकास जैसी बुनियादी सुविधाओं के लिए अतिरिक्त बजट की आवश्यकता है। मध्य प्रदेश वन विभाग को बालाघाट वनमंडल को प्राथमिकता देते हुए NTCA के "Tigers Outside Tiger Reserves" कार्यक्रम के अंतर्गत शामिल करना चाहिए।

6.2. मानव–वन्यप्राणी संघर्ष प्रबंधन

यह क्षेत्र जंगल और कृषि भूमि का मिश्रण होने के कारण यहाँ मानव और वन्यप्राणियों के बीच संपर्क होना स्वाभाविक है। शाकाहारी वन्यप्राणियों के द्वारा फसलों को होने वाले नुकसान के लिए भी एक त्वरित और प्रभावी मुआवज़ा प्रणाली विकसित की जानी चाहिए, क्योंकि मांसाहारी वन्यप्राणियों के द्वारा पालतू पशु के मारे जाने पर मुआवज़ा व्यवस्था पहले से मौजूद है। यह लोगों में उत्पन्न होने वाले त्वरित रोष और वन्यप्राणियों के प्रति प्रतिशोध की भावना को कम करने में सहायता करेगा तथा समुदायों के साथ विश्वास को मजबूत करेगा।

इसके साथ ही पशुहानि होने पर कैमरा ट्रैप के माध्यम से सतत निगरानी की जानी चाहिए। जिससे प्राप्त जानकारी शिकारी प्रजातियों की गतिविधियों को समझने में उपयोगी सिद्ध होगी, और संघर्ष के प्रमुख क्षेत्रों की पहचान करने और बेहतर संरक्षण योजना बनाने में उपयोगी होगी।

6.3. पर्यावास प्रबंधन (habitat management):

पर्यावास प्रबंधन तीन प्रमुख बिंदुओं पर केंद्रित किया जाना चाहिए– आक्रामक या खरपतवार वनस्पति प्रजातियों का प्रबंधन, आर्द्रभूमियों (वेटलैंड्स) का संरक्षण एवं पुनर्स्थापन, तथा अग्नि प्रबंधन।

(i) आक्रामक या खरपतवार वनस्पति प्रजातियों का प्रबंधन:

AITE रिपोर्ट (Qureshi et al., 2022) के अनुसार बालाघाट में आक्रामक प्रजातियों का काफी फैलाव है। इसके साथ ही, यह क्षेत्र कई प्रमुख आक्रामक वनस्पतियों जैसे *Ageratina adenophora, Ageratum conyzoides, Mesosphaerum suaveolens, Lantana camara, Parthenium hysterophorus* तथा *Senna tora*, के लिए अत्यधिक अनुकूल पाया गया है। इनके फैलाव के पीछे मुख्य कारण मानवीय गतिविधियाँ हैं, जैसे सड़क एवं अन्य निर्माण कार्य, कृषि विस्तार, पेड़ों की कटाई, चराई और खनन। इस स्थिति को देखते हुए उत्तर एवं दक्षिण दोनों वन मंडलों में प्रारंभिक स्तर पर ही इन प्रजातियों को हटाने और नियंत्रित करने पर जोर दिया जाना चाहिए। हालांकि, *Lantana camara* जैसी प्रजातियाँ प्रतिकूल पारिस्थितिक परिस्थितियों में भी स्वयं को ढाल लेती हैं (Mungi et al., 2020), इसलिए इसके प्रभावी प्रबंधन के लिए क्षेत्र-विशिष्ट (ecosystem-specific) प्रयोगों एवं उपायों की आवश्यकता है, ताकि अलग-अलग उपायों की उपयोगिता का आंकलन किया जा सके। यह भी देखा गया है कि आक्रामक प्रजातियों का पूर्ण उन्मूलन अक्सर प्रभावी नहीं होता, क्योंकि प्रभावित क्षेत्रों में इनका पुनः

प्रसार हो जाता है (Bhagwat et al., 2012)। इसलिए, इन प्रजातियों को हटाने की प्रक्रिया को व्यापक आवास सुधार (habitat restoration) के रूप में अपनाया जाना चाहिए।

(ii) आर्द्रभूमि (वेटलैंड) संरक्षण एवं प्रबंधन:
बालाघाट जिले में आर्द्रभूमियों काफी संख्या में हैं। राष्ट्रीय आर्द्रभूमि एटलस के अनुसार, जिले में लगभग 24,610 हेक्टेयर क्षेत्र आर्द्रभूमियों के अंतर्गत आता है, जिसमें 3,496 लघु आर्द्रभूमियाँ (<2.25 हेक्टेयर) शामिल हैं। कुल आर्द्रभूमि क्षेत्र में 49.87% नदियां एवं धारा और 20.58% छोटे-बड़े तालाब शामिल हैं। लगभग 15.15% जलाशय एवं बैराज हैं, जो की काफी महत्वपूर्ण हैं। ये आर्द्रभूमियों कई प्रकार के खतरे जैसे बिना उपचारित अपशिष्ट जल एवं औद्योगिक/घरेलू उत्सर्जन, अतिक्रमण, तथा कचरा फेंकने जैसी समस्याओं का सामना कर रही है। आर्द्रभूमियों के संरक्षण के महत्व को ध्यान में रखते हुए भारत में राष्ट्रीय झील संरक्षण योजना के अंतर्गत, राष्ट्रीय आर्द्रभूमि संरक्षण कार्यक्रम तथा आर्द्रभूमि (संरक्षण एवं प्रबंधन) नियम, 2017 लागू किए गए हैं। इनके संरक्षण के लिए जल की गुणवत्ता की नियमित जांच, जलीय जीवों में कीटनाशक तथा भारी धातुओं के प्रदूषण का आंकलन तथा ऐसे प्रबंधन उपायों को शामिल किया जाना चाहिए, जो इन्हे कानूनी संरक्षण प्रदान कर सकें, साथ ही पारिस्थितिकी तंत्र के पुनर्स्थापन और स्थानीय समुदाय की भागीदारी सुनिश्चित हो सके।

(iii) वनों की अग्नि का प्रबंधन:
FSI की रिपोर्ट के अनुसार बालाघाट जिले के वन क्षेत्र अग्नि के प्रति काफी सवेदनशील हैं। अतः वनों की आग की रोकथाम के लिए त्वरित कार्रवाई एवं प्रबंधन पर विशेष ध्यान देना आवश्यक है। आधुनिक तकनीकों जैसे जियोस्पेशियल उपकरणों का उपयोग करते हुए अत्यधिक सवेंदनशील क्षेत्रों की पहचान किया जाना चाहिए। मध्य प्रदेश में पहले से ही बीट स्तर तक सुचना प्रदान करने वाली सुदृढ़ वन अग्नि चेतावनी प्रणाली उपलब्ध है, तथा मध्य प्रदेश इस प्रणाली के उपयोगकर्ताओं की संख्या के मामले में अग्रणी राज्य है (FSI, 2023)। इन सूचनाओं की नियमित निगरानी कर त्वरित मैदानी कार्रवाई सुनिश्चित की जानी चाहिए। साथ ही, आग की रोकथाम के लिए उपलब्ध स्टाफ, उपकरण और संसाधनों की समीक्षा भी आवश्यक है। जहां आवश्यक हो, वहां स्थल-विशिष्ट उपाय जैसे फायर लाइन का निर्माण एवं रखरखाव और अधिक ज्वलनशील क्षेत्रों में नियंत्रित आग का उपयोग जैसे उपाय किए जा सकते हैं। स्थानीय समुदायों, विशेषकर वन परिक्षेत्र के गांवों एवं संयुक्त वन प्रबंधन समितियों की भागीदारी से आग फैलने की सूचना, जागरूकता और रोकथाम के प्रयासों को और भी मजबूत किया जा सकता है।

6.4. समुदायों की भागीदारी

बालाघाट ज़िले में कुल 10 प्रशासनिक ब्लॉक हैं—बालाघाट, बैहर, बिरसा, कटंगी, खैरलांजी, किरनापुर, लालबर्रा, लांजी, परसवाड़ा और वारासिवनी। इन ब्लॉकों में 1,385 गांव और 692 ग्राम पंचायतें शामिल हैं। 2011 की जनगणना के अनुसार जिले की जनसंख्या लगभग 17 लाख है, जिसमें लगभग 22.5 प्रतिशत आदिवासी समुदायों (मुख्यतः गोंड और बैगा) से संबंधित हैं।

यहां लोगों की आजीविका का मुख्य आधार कृषि और पशुपालन है। इसके अलावा कई परिवार गैर-काष्ठ वन उत्पाद जैसे महुआ, तेंदूपत्ता, हर्रा, बहेरा, आंवला, साल बीज और शहद का संग्रह भी करते हैं।

यदि स्थानीय समुदायों को संरक्षण और प्रबंधन की प्रक्रिया में सक्रिय रूप से शामिल किया जाए, तो इससे वन्यजीव संरक्षण और बाघों के सुरक्षित विस्तार—दोनों को लाभ मिल सकता है। ईकोटूरिज़्म, स्थानीय उत्पादों की मूल्य श्रृंखला और कृषि उत्पादों (जैसे मिलेट और सब्ज़ियां) को बाजार से जोड़ना, गैर-काष्ठ वन उत्पाद तथा आग प्रबंधन जैसे क्षेत्रों में कई संभावनाएँ मौजूद हैं।

वन विभाग वर्तमान में संयुक्त वन प्रबंधन समितियों (JFMCs) और वन समितियों के माध्यम से समुदायों को शामिल करता है। इन समितियों को और मज़बूत करने, तथा कार्ययोजना के दिशा-निर्देशों के अनुसार इनका उचित प्रतिनिधित्व सुनिश्चित करने की आवश्यकता है। FRA 2006 के अंतर्गत CFR और CFRR अधिकार धारकों को समुदाय-नेतृत्व वाले संरक्षण प्रयासों के लिए प्रोत्साहित किया जाना चाहिए। संरक्षण से जुड़े गैर-सरकारी संगठनों को CFR प्रबंधन योजनाओं के विकास और उनके क्रियान्वयन में सहयोगी भूमिका निभानी चाहिए।

6.5. रेखीय अवसंरचना के प्रभावों को कम करना

बालाघाट का वनक्षेत्र एक महत्वपूर्ण वन्यप्राणी आवास और कनेक्टिविटी कॉरिडोर है, इसलिए यहाँ प्रस्तावित और मौजूदा रेखीय अवसंरचना परियोजनाओं से वन्यजीवों पर गंभीर प्रभाव पड़ सकता है। जिले में लगभग 77 किलोमीटर राष्ट्रीय राजमार्ग और कई राजकीय मार्ग वनक्षेत्रों को काटते हुए गुजरते हैं। इसके अलावा जबलपुर–बालाघाट–गोंदिया रेलवे लाइन भी वन्यजीवों की आवाजाही में बाधा उत्पन्न करती है। बढ़ता यातायात और तेज़ गति से चलने वाली ट्रेनें वन्यजीवों के लिए जोखिम बढ़ाती हैं।

इसलिए किसी भी सड़क या रेलवे परियोजना के उन्नयन के दौरान NTCA और WII की गाइडलाइनों के अनुसार स्थान-विशेष शमन उपायों को लागू किए जाना चाहिए (WII, 2016)।

कई आगामी परियोजनाओं के लिए WWF-India and WCT जैसे गैर सरकारी संगठनों के द्वारा पहले ही अध्धयन कर शमन उपायों के सुझाव विकसित किए जा चुके हैं। जब ये परियोजनाएँ वन स्वीकृति के लिए प्रस्तुत हों, तो इन सुझावों को अनिवार्य रूप से शामिल किया जाना चाहिए। साथ ही मौजूदा शमन संरचनाओं का नियमित रखरखाव भी अत्यंत आवश्यक है।

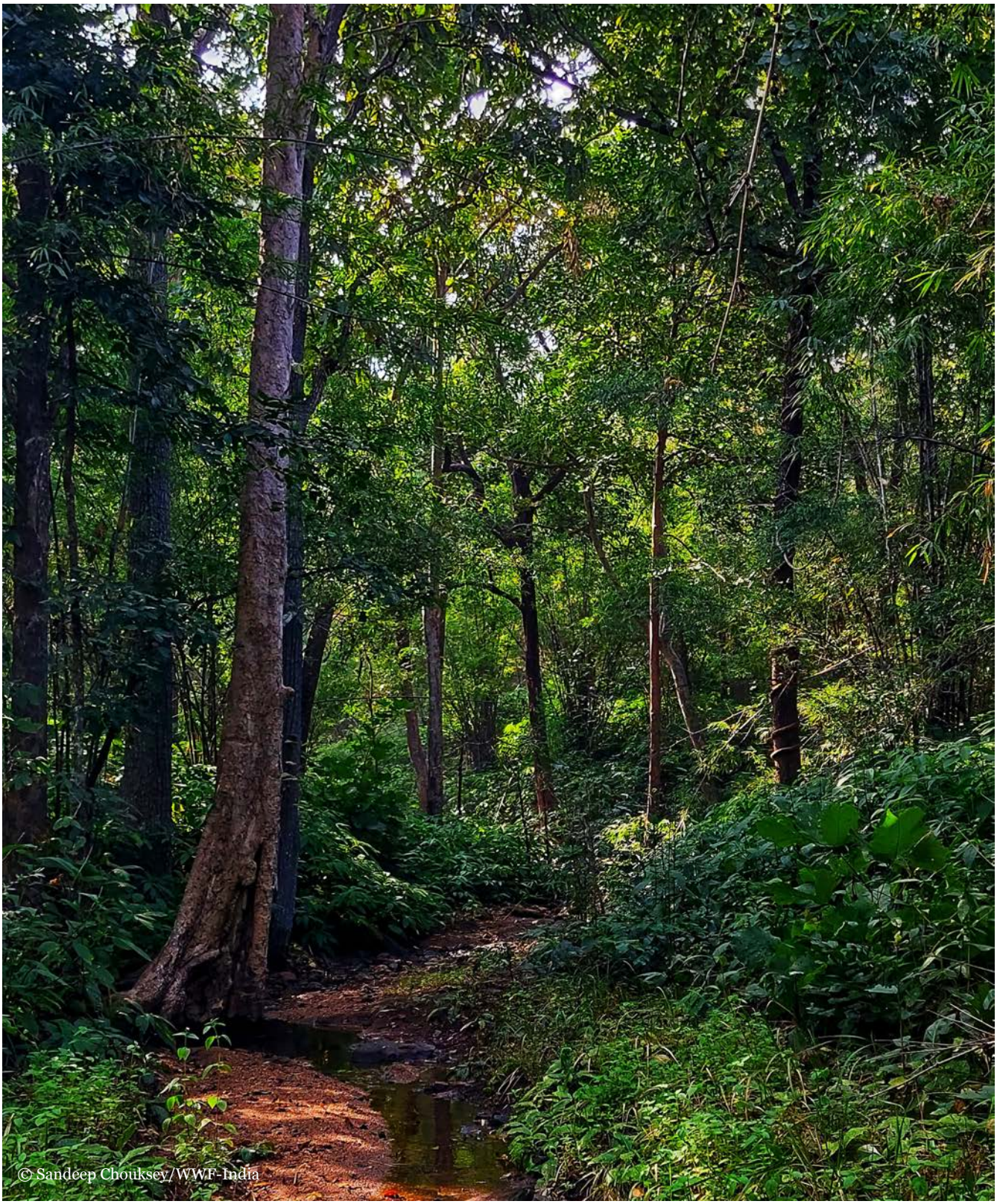
6.6. खनन गतिविधियों के प्रभावों को कम करना

बालाघाट, तांबा और मैंगनीज़ जैसे खनिजों का एक प्रमुख क्षेत्र है और देश के महत्वपूर्ण खनिज भंडारों में से एक है। मलाजखंड की ताम्बे की खदान और भारवेली की मैंगनीज़ खदान जैसे बड़े खनन क्षेत्र वन क्षेत्रों के निकट स्थित हैं।

खनन गतविधियिों से न केवल भूमि के उपयोग में बदलाव और भूमि क्षरण होता है, बल्कि इससे जुड़ी सड़कों, भारी वाहनों की आवाजाही, अपशिष्ट

जल और अवसाद के कारण वन आवास समाप्त और क्षतग्रिस्त हो सकते हैं। इससे वन्यजीवों की आवाजाही में बाधाएं उत्पन्न होती हैं।

इन प्रभावों को कम करने के लिए निम्नलिखित कदम सुझाए जाते हैं:
a. नए खनन खण्डों का आवंटन नहीं किया जाना चाहिए, विशेष रूप से उन क्षेत्रों में जो महत्वपूर्ण वन्यजीव आवास या आवागमन मार्ग हैं।
b.आवासीय क्षेत्र और शोधन संयंत्र जैसी सहायक अवसंरचनाओं को जंगल के बाहर और वन्यजीवों की आवाजाही वाले क्षेत्रों से दूर स्थापित किया जाना चाहिए।
c. खनिज और ओवरबर्डन का परिवहन सूर्यास्त से सूर्योदय के बीच प्रतिबंधित किया जाना चाहिए, ताकि रात्रिचर और शाम के समय में सक्रिय रहने वाले वन्यप्राणियों पर इसका असर न पड़े।
d. बंद या समाप्त हो चुकी खुली खानों का वैज्ञानिक और व्यवस्थित तरीके से पुनर्स्थापन किया जाना चाहिए और इसे प्राथमिकता दी जानी चाहिए।



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ANNEXURES

Annexure 1: Tiger Profile – South Balaghat Division

Tiger 1

Tiger 2

Tiger 3

Tiger 4

Tiger 5

Tiger 6

Tiger 7

Tiger 8

Tiger 9

Tiger 10

Tiger 11

Tiger 12

Tiger 13

Tiger 14

Tiger 15

Tiger 16

Tiger 17

Tiger 18

Annexure 2: Wildlife Photo Captured in the Camera Traps in South Balaghat

Leopard (*Panthera pardus*)

Dhole (*Cuon alpinus)*

Indian wolf (*Canis lupus*)

Jackal (*Canis aureus*)

Jungle cat (*Felis chaus*)

Indian fox (*Vulpes bengalensis*)

Common palm civet (*Paradoxurus hermaphroditus)*

Small Indian civet (*Viverricula indica*)

Honey badger (*Mellivora capensis*)

Indian grey mongoose (*Herpestes edwardsii*)

Ruddy mongoose (*Herpestes smithii*)

Sloth bear (*Melursus ursinus*)

Wild pig (*Sus scrofa*)

Gaur (*Bos gaurus*)

Sambar (*Rusa unicolor*)

Chital (*Axis axis*)

Nilgai (*Boselaphus tragocamelus*)

Barking deer (*Muntiacus muntjak*)

Chousingha (*Tetracerus quadricornis*)

Rhesus macaque (*Macaca mulatta*)

Hanuman langur (*Semnopithecus entellus*)

Indian hare (*Lepus nigricollis*)

Porcupine (*Hystrix indica*)

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