REVIVAL OF THE GAUR

IN SANJAY TIGER RESERVE MADHYA PRADESH

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

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Foreword

Principal Chief Conservator of Forest
& Head of Forest Force,
Government of Madhya Pradesh

प्रधान मुख्य वन संरक्षक
एवं वन बल प्रमुख,
मध्य प्रदेश सरकार

Wildlife conservation poses a formidable challenge for a developing nation like India. In the face of modern complexities such as uncontrolled urbanization, natural calamities, climate change, and burgeoning tourism, the impact on biodiversity must be carefully assessed and mitigated. Safeguarding forests and their inhabitants while enhancing habitats and preserving corridors is an arduous task for forest authorities. The loss of a species from its native habitat, or local extinction, inflicts a profound blow to the ecosystem, with recovery often taking an extensive period.

Translocating species that have become locally extinct offers a direct means of addressing such losses, albeit entailing a complex process for long-term protection. Following the successful translocation of tigers in Sariska, Rajasthan, in 2008 and Panna, Madhya Pradesh, in 2009 and witnessing the well-known successful example of gaur reintroduction in Bandhavgarh Tiger Reserve in 2011, it became evident that translocation could play a crucial role in species conservation in our country.

Another successful gaur translocation program in Sanjay-Dubri Tiger Reserve in 2023-24 underscored the effectiveness of a "species recovery program" and showcased the strength of the Madhya Pradesh Forest Department (MPFD) and the Wildlife Institute of India in turning back the wheels of local extinction of gaur. This pioneering initiative marked the country's second largest mass translocation of a mammalian species. The program has served as a valuable learning and has been instrumental in showcasing the results of efficient planning, better preparedness, coordination along with effective use of modern drugs, equipment, vehicles and trained human resources. The additional knowledge gained by managers, scientists, veterinarians, researchers, and ground staff during the translocation program was unparalleled. Furthermore, it has empowered the Madhya Pradesh Forest Department to actively pursue further translocation endeavours in protected areas across the state.

This prologue celebrates not only the accomplishments of the Gaur translocation program but also the collaborative spirit and dedication of all those involved in safeguarding India's rich biodiversity. It serves as a testament to the potential of translocation initiatives to contribute significantly to our nation's conservation landscape.

I compliment the team for their efforts in creating this document and hope it will be useful to others in initiating similar conservation programs.

Aseem Shrivastav, IFS

Foreword

Principal Chief Conservator of Forest (WL)
& Chief Wildlife Warden,
Government of Madhya Pradesh

प्रधान मुख्य वन संरक्षक (वन्यजीव)
एवं मुख्य वन्यजीव प्रतिपालक,
मध्य प्रदेश सरकार

The history of gaur presence in the Sanjay-Dubri Tiger Reserve (SDTR) is a poignant reminder of the delicate balance between wildlife and their habitats, and the consequences of that balance being disrupted. According to the management plan records until 1998, documented by Sh. A.S Alawa, gaur populations were once an integral part of SDTR's rich biodiversity. The area historically supported a viable population of gaur, which unfortunately faced a decline and ultimately became locally extinct over time.

Before this local extinction, a small population of gaur was observed in specific areas within the Mohan range of SDTR, notably Machmahua, Kharsoti, Baigwana, Runda, and Bhadora. These observations were primarily made during the open season. However, there was a significant gap in definitive information regarding their presence and movements during the rainy season. It was widely believed that during the monsoon, these animals migrated to neighbouring regions such as Chhattisgarh and Jharkhand, seeking refuge and resources. This historical context underscores the importance of understanding and preserving the intricate patterns of wildlife movement and habitat use. The disappearance of gaur from SDTR not only marked a loss of a species but also a disruption in the ecological fabric of the region. It highlights the critical need for effective conservation strategies and the importance of continual monitoring and management efforts to protect and restore wildlife populations.

The efforts to reintroduce gaur into SDTR represent a significant step towards rectifying this loss and restoring the ecological balance. By revisiting the history and learning from past experiences, we aim to ensure a future where gaur and other wildlife can thrive once more in the SDTR. This reintroduction program is not just about bringing back a species; it is about reinstating a vital component of the ecosystem that supports a myriad of life forms, ensuring the health and resilience of SDTR for generations to come. As we embark on this journey of reintroduction and conservation, it is crucial to remember the lessons from our past and to approach this task with a commitment to scientific rigor, ecological sensitivity, and collaborative effort. The following pages delve into the details of this ambitious project, outlining the methodologies, challenges, and hopeful outcomes of reintroducing gaur to their ancestral home.

I wholeheartedly congratulate the contributors for this excellent contribution that elaborates on a multitude of approaches for initiating and managing a species recovery program.

Atul Kumar Srivastava, PhD, IFS

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

Foreword

Director
Wildlife Institute of India
(An Autonomous Institution of the Ministry of Environment, Forest and Climate Change, Government of India)

निदेशक
भारतीय वन्यजीव संस्थान
(पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार का एक स्वायत्त संस्थान)

Wildlife conservation in developing countries is difficult owing to rapidly shrinking habitats, rampant poaching, and multiple anthropogenic pressures. These complex issues require innovative management interventions to preserve wildlife and prevent local extinctions, especially in Protected Areas. Local extinction of large herbivores had rarely been a focus for forest managers until the recent extinction of the gaur, or Indian bison, in Sanjay-Dubri Tiger Reserve (SDTR), Madhya Pradesh. In response to this critical management challenge, the Madhya Pradesh Forest Department took active management initiatives to reintroduce gaur into the tiger reserve. The translocation of 50 gaur individuals from Kanha Tiger Reserve and Satpura Tiger Reserve to SDTR, conducted in collaboration with the Wildlife Institute of India, Dehradun, marked a significant milestone in Indian wildlife conservation.

For several reasons, the gaur reintroduction program in SDTR is a landmark initiative. It stands out as one of a valuable example of a species recovery program. It represents this species' second-largest mass translocation within its entire distribution range, from India to Southeast Asia. The scientific information in the technical report “Revival of the Gaur in Sanjay Tiger Reserve, Madhya Pradesh” provides valuable information for field professionals. This study offers crucial insights for scientists, park managers, researchers, and veterinary officers regarding translocation protocols for megaherbivores, the use of modern drugs for animal capture, and valuable information on the ecology of gaur, including ranging patterns, habitat use, food habits, group size, health conditions, and management recommendations. The report highlights the importance of an intensive management approach and effective long-term conservation measures for gaur.

The successful gaur translocation in SDTR exemplifies the potential for further translocations of large mammals in India. This pioneering effort demonstrates that we can address the critical challenges of wildlife conservation in India with a proactive approach to species recovery and management. I am confident that we can continue to make significant strides in preserving our nation's wildlife heritage by utilising such active strategies.

I congratulate the contributors for their steadfast efforts and contributions. I am hopeful that this document would provide valuable information on species recovery for professionals working on similar initiatives.

Virendra R. Tiwari, IFS

Foreword

Former Principal Chief Conservator of Forest
Government of Madhya Pradesh

प्रधान मुख्य वन संरक्षक (सेवानिवृत्त)
मध्य प्रदेश सरकार

Madhya Pradesh has been at the forefront of active wildlife management, undertaking numerous initiatives to recover and conserve various species. The state's commitment is evident through several noteworthy projects. For instance, providing inviolate space to wildlife populations by amicably relocating villages from the core areas, managing habitat judiciously and establishing of a reintroduced population of Hard-ground Barasingha in both Van Vihar National Park and Satpura Tiger Reserve and now in Bandhavgarh Tiger Reserve, the reintroduction and supplementation of tigers in Panna Tiger Reserve and Nauradehi WLS, reintroduction of gaur in Bandhavgarh Tiger Reserve highlight the state's dedication and commitment in maintaining biodiversity. The translocation of Chital to various parks such as Van Vihar, Sanjay Tiger Reserve, and Kuno Palpur National Park using non-invasive techniques showcases innovative approaches in wildlife management. Additionally, the ambitious project of establishing a Cheetah population in Kuno National Park underscores Madhya Pradesh's pioneering role in species recovery efforts.

Despite these successes, the importance of science-based management interventions cannot be overstated. These interventions are crucial for making informed decisions that strengthen wildlife management practices. The collaboration between the Madhya Pradesh Forest Department and the Wildlife Institute of India on the prestigious project of reintroducing gaur in the Sanjay Tiger Reserve is a testament to the significance of such scientific approaches. Reintroducing gaur, a mega-herbivore, is no small feat. It requires meticulous planning, comprehensive training, and precise execution. I am pleased to note that this collective effort has resulted in the successful reintroduction of 50 individuals from the Kanha and Satpura Tiger Reserves to the Sanjay Tiger Reserve. This achievement is a significant milestone in wildlife conservation and showcases the power of collaborative efforts.

I commend the team for producing a comprehensive document that details the ecology of gaur and the efforts towards their recovery, including the assessments and planning prior to reintroduction, the specifics of field capture and translocation, and the monitoring of the reintroduced population post-release. This document adds to the existing knowledge on reintroductions of mega-herbivores and provides valuable insights that can be applied to similar initiatives in the future. I wholeheartedly congratulate the Forest Department of Madhya Pradesh and the Wildlife Institute of India for this significant contribution and extend my appreciation to the park managers, veterinarians, biologists, frontline staff, mahouts, and the captive elephants of Kanha, Satpura, and Sanjay Tiger Reserves for their dedicated efforts towards the successful reintroduction of gaur.

I am confident this initiative will yield excellent results, leading to the successful re-establishment of gaur in Sanjay Tiger Reserve.

Jasbir Singh Chauhan, IFS (Retd.)

भारतीय वन्यजीव संस्थान
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वैज्ञानिक–जी एवं विभागाध्यक्ष
वन्यजीव स्वास्थ्य एवं प्रबंधन विभाग
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Animal reintroduction is increasingly used as a conservation tool worldwide. However, documented examples explaining the nuances of translocating large mammals in the Asian context remain limited and, thus, hinder adaptive learning. This document provides a detailed account of the reintroduction of the endangered wild cattle, the Indian gaur (*Bos gaurus*), in one of its important historical ranges. The main objective of the reintroduction was to establish a viable meta-population in the Sanjay Dubri Tiger Reserve of Madhya Pradesh in central India as part of the landscape-level species recovery and biodiversity conservation program.

Conservation through intervention is now common, but with increasing evidence and appreciations of the risk. It needs to be justified, with development of clear objectives, identification and assessment of risk, and with measures of performance.

-IUCN /SSC. 2013

Large mammal reintroductions are inherently challenging and require close consideration of several technical and administrative concerns. This document attempts to elucidate the overall approach involved in the planning phase of gaur reintroduction by elaborating on (i) the planning process in every stage of the program, (ii) the synthesis of available information on past and present approaches followed in reintroduction (iii) the comprehensive literature review and (iv) amalgamation of expert opinion through structured discussions with national and international experts to draw on the learnings from the past similar experiences.

Additionally, the document elaborates on the range of field activities involved in capturing and translocating animals in a concise and easily accessible format for the benefit of field practitioners. The document also provides a detailed account of scientific approaches involved in habitat assessment, demographic and behavioural evaluation, and aspects of population genetics, which guided the gaur reintroduction program in the Sanjay Dubri Tiger Reserve during all its stages.

The document is primarily intended for wildlife managers, veterinary professionals, field biologists, and field officials who will collectively steer and implement similar large mammal reintroduction programs in the future.

It is hoped that the importance of expertise, meticulous planning, foolproof logistics arrangements, and detailed scientific assessments required in field execution, as emphasised in the document, would inspire and guide similar future endeavours.

Parag Nigam, MVSc, PhD

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Executive Summary

Reintroductions/ conservation translocations of animals have increasingly been recognised as a strategy to conserve threatened species and restore ecosystem functions. Madhya Pradesh Forest department (MPFD) together with the Wildlife Institute of India (WII) initiated the project on Gaur Reintroduction titled "Establishment of Gaur (Bos gaurus gaurus) in Sanjay Tiger Reserve, Madhya Pradesh" for a period of five years (2023-2028). This initiative is aimed at conserving this threatened species and restoring biodiversity in the landscape. Emphasizing a comprehensive and multidisciplinary approach, this reintroduction program involved collaboration between various stakeholders and institutions aimed at ensuring a scientifically sound and logistically feasible program.

An action plan for reintroduction of Gaur in Sanjay-Dubri Tiger Reserve (SDTR) was jointly developed by the MPFD and WII and formed the basis for field capture and translocation under the project. The program was meticulously divided into pre-translocation, translocation and post-translocation phases.

During the pre-translocation phase, detailed habitat assessments were conducted to identify gaur suitable areas within the SDTR. Pondi and Mohan ranges were identified as suitable for reintroduction of gaur based on favourable vegetation and water resources. Additionally, a 30-hectare soft release enclosure with a 2-hectare sub-enclosure was also built at Domarpat beat of the Pondi range to hold the animal for the initial period after release in SDTR.

The source population was identified from two different reserves namely Kanha Tiger Reserve (KTR) and Satpura Tiger reserve (STR) that had a considerable population of gaur. Efforts were made to carry out health assessments of individuals and herds identified for translocation prior to their capture. Additionally, this phase also included habituating the captive elephants to approach gaur herd (to facilitate close distance darting), training of field staff in various procedures involved in capture (lifting, carrying and weighing), conducting mock drills (darting, animal lifting and weighing, loading-unloading etc.), carrying out reconnaissance surveys of the route for journeys, arranging drugs and medicaments, equipment and collars.

The field captures were executed during June 2023 with the capture of 28 animals from KTR between 1st to 7th June and 16 animals from STR between 26th to 29th June 2023. During the Phase II executed in April 2024, a total of 06 animals were captured and

translocated from KTR between 8th to 9th April 2024 making a total of 50 animals reintroduced in SDTR.

Out of the 50 reintroduced gaur, 12 animals were fitted with Very High Frequency (VHF) radio collars (Telonics USA), six fitted with Satellite-GPS collars (VERTEX GPS Plus collars, Vectronic Aerospace, Germany), and 22 individuals were fitted with color-coded neck bands (locally fabricated). Detailed account of the field capture and translocation operation and finer aspects of planning, pre-capture processes, capture operations and post release etc. are discussed in detail in the section on translocation phase.

The post-translocation phase involved intensive monitoring of gaur at SDTR. Initially, the gaurs were housed in a small 2-hectare soft-release enclosure, facilitating closer monitoring. This enclosure also served as a transitional space where the gaur could adjust behaviourally and acclimatize to the new environment.

After this initial phase, the gaurs were allowed to move to a larger 30-hectare enclosure. This larger space continued to offer opportunities for intensive monitoring while providing a more expansive area for the gaur to adapt further. Here, the animals could continue their behavioural adjustments and develop natural social structures in a controlled but more naturalistic setting. It also facilitated the development of cohesiveness and herd formation, provided protection from immediate predation, and allowed the animals to recover from the effects of tranquilizers and potential homing instincts.

Subsequently, the animals were released into the open forest. Post-release monitoring was a critical component of the reintroduction program. This monitoring was conducted intensively and collaboratively by the WII research team and the field staff of SDTR. Both collared and non-collared gaur (identified based on color-coded neck bands) were monitored closely. The teams studied their movements, behaviour, diet, health, and interactions in detail.

The reintroduction of gaur in SDTR has been a significant success, setting a precedent for future translocations of large mammals in India. The program has demonstrated the effectiveness of well-planned and scientifically grounded conservation strategies. The detailed monitoring and adaptive management practices have provided valuable insights into the species' adaptation processes, ensuring their long-term viability in the reserve. This success highlights the importance of meticulous planning, collaboration, and ongoing research in wildlife conservation efforts.

1. Introduction

Habitat destruction, fragmentation, and loss, besides poaching, consumptive exploitation, invasive ingress, diseases, and negative interactions, have disrupted the delicate balance of natural ecosystems, resulting in a decline of numerous wild populations. It calls for appropriate interventions that support species conservation. Thus, conservation strategies that involve introducing, reintroducing, relocating, and translating species or populations within their range or to parts of their former range have become an important tool in wildlife management. (Griffith *et al.,* 1989; Kleiman, 1989; Stanley Price, 1991; Wolf *et al.,* 1996).

Such efforts have the laudable goal of reducing the probability of extinction by increasing the number of viable populations in an area or increasing the number of individuals in small populations, thereby supporting the restoration of biodiversity. These efforts, however, have been possible due to careful understanding and assessment of the species' ecological requirements, identification of suitable release sites, and implementation of comprehensive management.

There are well-known success stories globally involving such initiatives viz., mammals: Oryx (*Oryx leucoryx*) (Stanley, 1989), Gazelles (*Gazella sp.)* (Dunham et al., 1997; Haque & Smith, 1996; Wacher & Kitchenside, 1998), Przewalski's wild horse (*Equus przewalski*) (Van Dierendonck & Wallis de Vries, 1996), Pere David's deer (*Elaphurus davidianus*) (Kock & Woodford, 1988), Europeon bison (*Bison bonasus*) (Kuemmerle et. al., 2011; Perzanowski & Marszaáek 2012), Plain bison (*Bison bison bison*) (Gates et al., 2010), Grey Wolf (*Canis lupus*) (Smith & Bangs, 2009), Musk ox (*Ovibos moschatus*) (Jingfors, 1980) and Golden lion tamarin (*Leontopithicus rosalia*) (Kleiman & Rylands, 2002); birds: Californian condor (*Gymnogyps californianus*) (Toone & Wallace, 1994), Whooping crane (*Grus americana*) (Archibald, 2000) and Red kite (*Milvus milvus*) (Carter, 2001); reptiles: Galapagos land iguana (*Conolophis subcristatus*) and Galapagos tortoise (*Geochelone elephantophus*) (Cayot et al., 1994); amphibians: Great crested newt (*Triturus cristatus*) and Common newt (*Triturus vulgaris*) (Kinne, 2006); and insects: Karner blue butterfly (*Lycaeides melissa samuelis*) (Martin & Brown, 1995).

During the last few decades, India has witnessed quite a few successful reintroductions, including but not limited to One-horned rhinoceros (*Rhinoceros unicornis*) in Dudhwa Tiger Reserve (Sinha et al., 2005) and Manas Tiger Reserve (Talukdar et al., 2013; Bonal et al., 2009); tiger (*Panthera tigris*) reintroduction in Sariska Tiger Reserve (Sankar et al., 2010) and Panna Tiger Reserve (Ramesh et al., 2018); Pygmy Hog (*Porcula salvania*) in

Manas (Narayan et al., 2010) and Sonai Rupai Wildlife Sanctuary in Assam (Narayan et al., 2008); Indian Bison or Gaur (*Bos gaurus gaurus*) in Bandhavgarh Tiger Reserve (Pabla et al., 2011; Sankar et al., 2013; Nigam et al., 2014); and Gharial (*Gavialis gangeticus*) in River Ganga (Yadav et al., 2013) as part of population building initiative.

Additionally, a variety of wild animals have been captured and translocated to suitable habitats as part of conflict mitigation [Elephants (*Elephas maximus*) (Mukti et al., 2010), Blackbuck (*Antilope cervicapra*) (Bonal et al., 2002), Nilgai (*Boselaphus tragocamelus*) (Sale et al., 1988), Sloth bear (*Melursus ursinus*) (Arun et al., 2021), leopard (*Panthera pardus*) (Athreya et. al., 2010), tiger (*Panthera tigris*) (Dhungana et al., 2016)]; as part of developing meta-populations of small, vulnerable populations of Hard-ground Barasingha (*Rucervus duvaucelii*) (Shukla et al., 2015); or and as part of prey base building initiative Chital (*Axis axis*), Sambar (*Rucervus unicolor*), Nilgai (*Boselaphus tragocamelus*) etc. (Jhala et al., 2021).

1.1 Defining Re-introduction

Reintroduction is the intentional movement and release of an organism inside its indigenous range from which it has disappeared and is carried out to establish a viable, free-ranging population in the wild of a species, subspecies or race which has become globally or locally extinct, or extirpated, in the wild and needs to be carried out within the species' former natural habitat and range with long-term management (IUCN/SSC, 2013).

"Restore species to their natural habitats, revitalise ecosystems, and contribute to preserving Earth's biodiversity."

The objectives of a re-introduction include:

a) Enhancing a species' long-term survival; re-establishing a keystone species (in the ecological or cultural sense) in an ecosystem.
b) Maintaining and/or restoring natural biodiversity.
c) Providing long-term economic benefits to the local and/or national economy.
d) Promoting conservation awareness or a combination of these.

The reintroduction of species into the habitat from which they were extricated is being increasingly used for species recovery and to fulfil biodiversity or restoration objectives (Sarrazin & Barbault, 1996). It has become a popular and widely applied conservation tool (Armstrong & Seddon, 2008; Seddon *et al.,* 2012), often providing the last chance to restore locally extinct populations within limited timeframes (Sarrazin, 2007).

Reintroduction of wild animals create a safety-net population and supports restoration of habitats and recovery of the potential habitats to sustain historical faunal assemblages. The reintroduction of wildlife, however, is a complex and long-term process that requires appropriate knowledge, skills, and expertise of the personnel involved, appropriate assessments, appropriate logistics and infrastructure, scientific

expertise, interdisciplinary collaboration, and strong partnerships between different stakeholders.

Process of Reintroduction

The reintroduction process typically involves several key steps including proper assessment of the feasibility and suitability of re-introducing the target species; habitat restoration and management prior to reintroduction; selection of animals destined for reintroduction taking due account of health and genetic makeup; selection of release sites taking due account of habitat suitability, availability of food, water, and shelter, absence of potential threats, and connectivity with other habitats; monitoring and post-release management to track the progress and welfare of re-introduced populations besides community engagement and education and adaptive management approaches for long term survival of species in the new area.

1.2 Defining Supplementation / Re-enforcement/ Augmentation

Supplementation involves adding individuals to an existing population of conspecifics (IUCN/SSC, 2013), e.g., to correct skewed sex ratios and improve genetic status. Supplementation is usually undertaken either to increase the effective founder number in a re-introduced population when it is not possible to re-introduce all founders simultaneously or to introduce new blood as part of metapopulation genetic management occasionally.

Re-enforcement and augmentation are synonyms for supplementation in IUCN/SSC (2013) Guidelines for Reintroductions and Other Conservation Translocations.

1.3 Mega-herbivore re-introduction

The human activities, habitat loss and fragmentation, hunting, and competition with livestock, have led to global decline of Mega-herbivores. The re-introduction of mega-herbivores into the wild represents a conservation strategy aimed at restoring ecological balance through promoting biodiversity, re-establishing natural processes, improving ecosystem resilience, and providing numerous ecological, economic, and social benefits.

The objective is not only to save these species from extinction but also to reinstate their ecological functions and their complex interactions with other organisms.

By reintroducing these magnificent animals, we have an opportunity to rectify the damage caused by human activities and forge a more sustainable future for both wildlife and humanity.

Mega herbivores play crucial roles in shaping landscapes, maintaining vegetation dynamics, and influencing the abundance and distribution of other species thereby acting as ecosystem engineers shaping the landscape (through feeding and browsing activities). They help in controlling vegetation density and composition, promote habitat heterogeneity, and create microhabitats supporting various plant and animal species. They also play a crucial role in seed dispersal, aiding the regeneration and diversity of plant communities across landscapes. Their presence influences predator-prey relationships and provides resources for scavengers.

Successful re-introductions of mega herbivores have been witnessed in various parts of the world. The major examples include the restoration of American and European bison herds in North America (Gates et al., 2010) and Europe (Kuemmerle et. al., 2011; Perzanowski & Marszaáek, 2012), the successful reintroduction of elephants in select African and Asian habitats, and the revival of rhinoceros populations in Africa (Emslie et al., 2009) and India's Dudhwa Tiger Reserve (Sinha et al., 2005) and Manas Tiger Reserve (Talukdar et al., 2013; Bonal et al., 2009) and Gaur in Bandhavgarh Tiger Reserve (Sankar et al., 2013).

Such initiatives however require detailed study on habitat suitability, availability of food resources, understanding potential conflicts with human activities, and interactions with existing species. This would however require, proper involvement of scientists, managers, local communities, and policymakers to achieve long-term conservation goals.

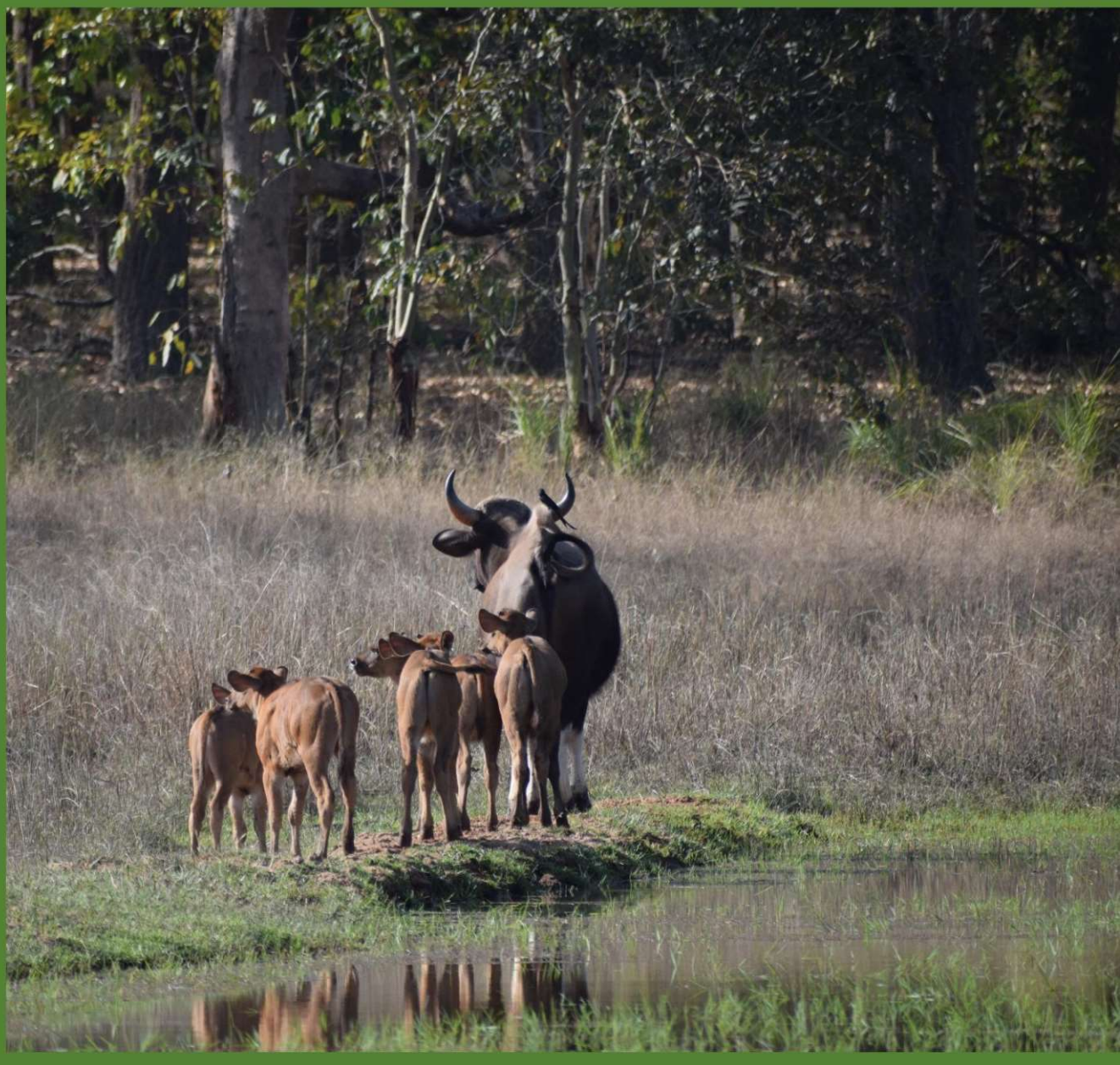
Until 1995, Bandhavgarh Tiger Reserve (BTR), situated in eastern Vidhyan hills, supported a small population of gaur (<40 individuals) that became locally extinct with the last documented reports in 1998. The reasons attributed for local extinction included possible disruption of the migratory corridor between the forests of Bandhavgarh and Ghunghuti and Amarkantak, major developmental activities hindering connectivity, predation, and possibly disease (Pabla et al., 2011). Even after the local extinction of the gaur, Bandhavgarh continued to be an excellent habitat for the gaur, and hence, it was decided to reintroduce the gaur in Bandhavgarh. The Madhya Pradesh Forest Department took major conservation efforts in collaboration with the Wildlife Institute

of India and &-Beyond (Previously CC Africa) to reintroduce gaur in BTR and build a viable self-sustaining population.

A total of fifty gaur (14 male and 36 female) were reintroduced in BTR from Kanha Tiger Reserve (KTR) in two phases i.e. phase-I during January 2011 (n=19) and phase-II, during March 2012 (n=31) (Sankar et al., 2015). The major findings are presented below.

1.4 Population recovery, Grouping and Sociality

Following initial reintroduction and subsequent supplementation, the gaur population explored the park and established into four distinct herds. A fairly high overlap (93.6%) was observed between herds, totalling n=60 individuals during 2012. Social bonding between these individuals was observed between the existing gaur herds and the supplemented stock of 2012. Over the next eight years, these herds showed fusion and fission dynamics and a total of seven distinct herds were reported by 2020, with the population growing to 168 individuals (Nigam et al., 2021). The gaur individual herd size varied from two to 31 individuals, though all the gaur herds had mixed-age class individuals (Nigam et al., 2022). The mean group size of gaur in BTR was estimated as 17.3 ± 2.2(SE) (Nigam et al., 2022). The bulls were found solitary across seasons (n=138) and joined the herd for a span of 10-20 days.



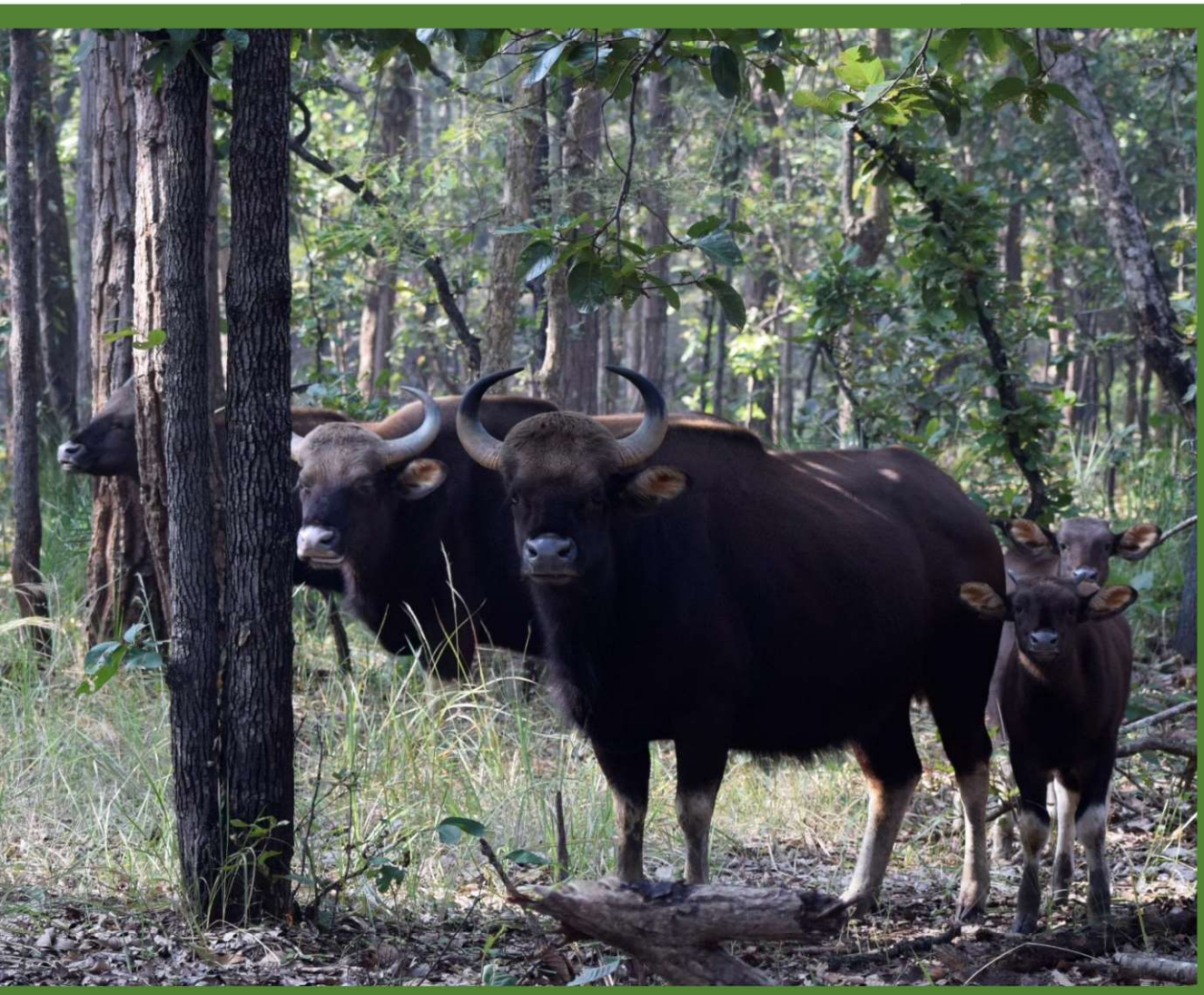
1.5 Home Range

The average home range of reintroduced gaur reached an asymptote after exploring a minimum of 154 km2 (71 km^2 - 279 km^2) within 143 days (range- 120 -163 days) of reintroduction. Locations of twenty-five radio-collared individuals were used to analyse the stabilisation of the home range. The gaur's estimated summer, monsoon and winter home ranges were 290 km2, 137.1 km^2 and 155 km^2, respectively (Nigam et al., 2018).

Table 1.1: Home range of reintroduced gaur in Bandhavgarh Tiger Reserve, Madhya Pradesh

Phase Year	100% Minimum Convex Polygon (km^2)	95% Fixed Kernel Density (km^2)
2011-15	405.2	146.9
2015-18	375.8	225.5
2018-22	466.9	209.69

*Adopted from (Sankar et al., 2015; Nigam et al., 2018; Nigam et al., 2022)



1.6 Feeding Pattern

During the study period, a total of 112 species of food plants belonging to 39 families were recorded. The food plants eaten by gaur comprised 42 tree species, 17 shrub species, 12 herb species, 35 grass species and six climber species (Nigam et al., 2022).

1.7 Habitat Use

Gaur predominantly used Open Mixed Forest, followed by Sal Forest and Bamboo Mixed Forest, whereas Grassland and Scrubland were used according to their availability within their entire used home range of different herds (Sankar et al., 2013). The overall habitat use of gaur in Bandhavgarh was observed in the following order: Sal Forest > Open Mixed Forest > Grassland > Bamboo Mixed Forest > Rocky Outcrop > Agriculture Land > Plantation > Scrubland > Habitation > Riverine Forest > Water Bodies (Nigam et al., 2022).

1.8 Summary

Gaur Reintroduction in BTR has been a successful conservation initiative of the mega-herbivore in the country. The study was instrumental in monitoring various ecological aspects of reintroduced gaur. The success of the gaur reintroduction program in BTR can be attributed in part to the meticulous planning and execution of project activities. From conducting thorough feasibility studies to implementing effective capture strategies and ensuring rigorous post-release monitoring, every stage of the reintroduction process was carefully regulated and managed. Additionally, ongoing habitat management initiatives within BTR have helped to create a conducive environment for the reintroduced gaur population, mitigating potential threats and enhancing their prospects for survival and proliferation.

The reintroduced gaur population in BTR in the Central Indian landscape has successfully overcome the challenges of local species extinction and is impending as a good example of the ecological restoration programme.

2. Species Overview

Indian Bison or Gaur
(*Bos gaurus gaurus*, Smith 1927)

2.1 Biological Attributes

The gaur (*Bos gaurus*) is the largest living bovid confined to the Oriental bio-geographic region and has been classified as follows:

Phylum	Class	Order	Family	Sub-Family	Genus	Species	Sub-species
Chordata	Mammalia	Artiodactyla	Bovidae	Bovinae	Bos	*B. gaurus*	*B. g. gaurus*

Based on morphological characteristics, the species is classified into three subspecies: *B. gaurus gaurus, B. gaurus readei* and *B. gaurus hubbacki* (Ahrestani, 2018). B. gaurus gaurus is mainly found in India, Nepal and Bangladesh; *B. gaurus readei* inhabits China and Myanmar; *B. gaurus hubbacki* is mainly found in Malaysia and occurs in two distinct forms, one with well-developed dewlap and one without (Hubback, 1937; Lydekker 1903, 1907, Srikosamatara & Suteethorn 1994). The morphological evidence for the existence of three subspecies is supported by phylogenetic analysis of mitogenomes (Kamalakkannan et al., 2020). The gaur and taurine cattle diverged ~ 4.5 million years before the present (Kumar et al., 2017), and the gaur is likely to be the wild progenitor of the domesticated *gayal* (Kamalakkannan et al., 2020; Wang et al., 2017; Mukherjee et al., 2019) also known as *mithan* or *Mithun*.

2.1.1 Conservation Status

The global population of gaurs is between 15,000 and 30,000 animals, with only 6000-21,000 being reproductively active (Duckworth et al., 2016). The population has decreased by at least 30% during the previous three generations (Duckworth et al., 2016). The gaur is included in the IUCN Red List of Threatened Species as Vulnerable (criteria A2cd+3cd+4cd ver. 3.1). (Duckworth et al., 2016).

It is included in Appendix-I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, 2022) and in Schedule-I of the Indian Wildlife (Protection) Act of 1972. (WPA,1972) as amended in 2023.

2.1.2 Life history traits and Reproduction

Biological Traits	Status
Age at sexual maturity	***Male:** 27 months ***Female:** 26 months
Mating season	November and March (in South India) (Morris, 1948, Ashokkumar et al., 2011) December to January (in Central India) (Brander, 1923; Sankar et al., 2015; Nigam et al., 2022) March to April (in Nepal and Northeastern India) (DNPWC, 2020) However, the occurrence of a few new-born animals throughout the year in Mudumalai Tiger Reserve indicated that some mating may occur all through the year (Ashokkumar et al., 2004)
Young per Birth	1, rarely 2 (Godfrey et al., 1991)
Weaning	*7-9 months (Ashokkumar et al., 2011)
Mean age at first conception	*37.6 months
Oestrous	typically spans 18-24 days. (This period includes a luteal phase lasting about 14-18 days and a follicular phase of 4-6 days.) (Godfrey et al., 1991; Ashokkumar et al., 2011)
Gestation period	~ 9.5 months (Hubback, 1937; Schaller, 1967).
Maximum longevity	*24 years (female) *23.6 years (male) (Crandall, 1964)
Oldest age at conception	*18 years

*Studied in captive population by Ahrestani et al. (2011)

Gaur is a sexually dimorphic with horns in both sexes. Males have more prominent horns, especially at the base, with a more outward sweep and minor curling at the points. Males have a prominent muscular crest between their shoulders, a colossal dewlap hanging between their forelegs, with a smaller one beneath their chin besides a grey boss between the horns and rusty-coloured hairs on the insides of the thighs and forelegs. Adult bulls have a lustrous black, short-haired pelage. Young bulls, like the cows, are dark brown in morph. The horns of young bulls are smooth, bright orange in colour, and black-tipped, but the horns of older bulls are corrugated, a drab olive hue, and occasionally frayed at the points (Schaller, 1967). Cows are much smaller than bulls, and their dorsal ridges and dewlaps are less developed. Cows have dark brown pelage and narrower horns, are more erect and have a greater inward curvature than bulls. Newborn gaur is

pale orange, brown, lacks white stockings and weighs around 40-45 kg. They develop a dark brown pelage at around three months of age (Grzimek et al., 2003).

2.1.3 Bodily Measurements of Gaur (Ahrestani and Prins, 2011)

Features	Males	Females
Shoulder height	1.7 – 2.0 m	1.5-2.0 m
Body length	2.5 – 3.0 m	2.5-3.0 m
Tail length	0.7 – 1.0 m	0.6-0.8 m
Body weight	600 – 1000 kg	450 – 800 kg
Pelage	Dark brown to Black	Light brown to Dark brown

2.1.4 Distribution

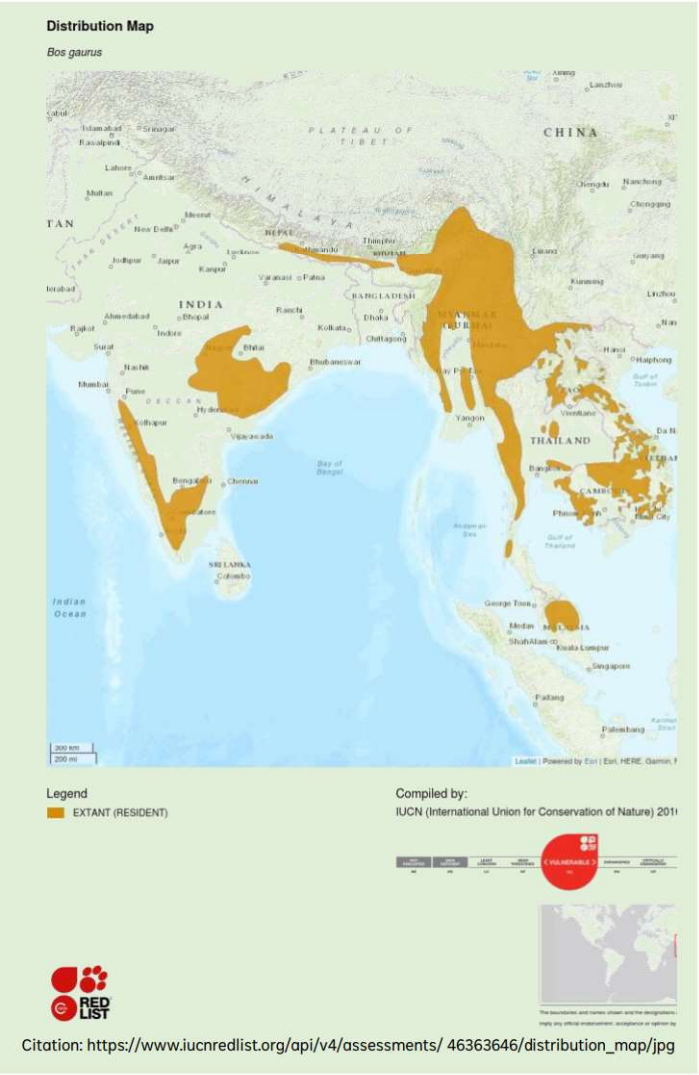
Once distributed throughout South and Southeast Asia, gaur currently occur in fragmented populations of the original distributional range in India, Nepal, Bhutan, Cambodia, China, Lao PDR, Malaysia (Peninsular Malaysia), Myanmar, Thailand, and Vietnam (Corbet and Hill 1992). The present and the past distribution of gaur suggests that B. gaurus is an animal of the Indo-Malayan region. It would have traversed into the Indian sub-continent through the Northeastern region downwards to the eastern peninsula and then west to the Central Indian highlands and the Western Ghats southwards (Sankar et al., 2004). Karanth et al. (2010) estimated an approximately 60% range reduction of the species in the past 50 years. Nonetheless, India is the stronghold of the gaur population, distributed in four major regions such as the Western Ghats, Eastern Ghats, Central India and northeast India (Choudhury, 2002).

Gaur is found in 124 protected areas in India, which cover 26% of its actual distribution area (Ashokkumar et al., 2011). The major populations are found in the protected areas of Kerala, Tamil Nadu, and Karnataka up to Bhagwan Mahaveer National Park in Goa and Radhanagari Wildlife Sanctuary in Maharashtra (Karanth and Kumar, 2015; Ahrestani and Karanth 2014).

Figure 2.1 Different age classes in gaurs

In India, the gaur population is separated into three distinct regions: North-Eastern, South-Western (Choudhury, 1999; Mukherjee, 1982) and Central Indian landscape (Choudhury, 1999; Mukherjee, 1982; Davidar, 1986; Krishnan, 1972; Saharia, 1982; Shukla & Khare, 1998).

In northern India, the gaurs are distributed over the Himalayan foothills from the Narayani River to the Siang River in north Bengal, as well as the Mishmi Hills, Dapha Bum Range, Patkai Range, Naga Hills, Barail Range, Mizo Hills, hill areas of Chittagong, Tripura, and Manipur, and the Meghalaya Plateau. The habitat in the northeast overlaps with that in Bhutan, Bangladesh, Myanmar, and, to a lesser extent, Nepal. The distribution is discontinuous and extensively fractured, as it is in the other regions, with at least 20 populations already split within the 54000 km^2 of accessible gaur habitat (Duckworth et al., 2016).



Citation: https://www.iucnredlist.org/api/v4/assessments/ 46363646/distribution_map/jpg

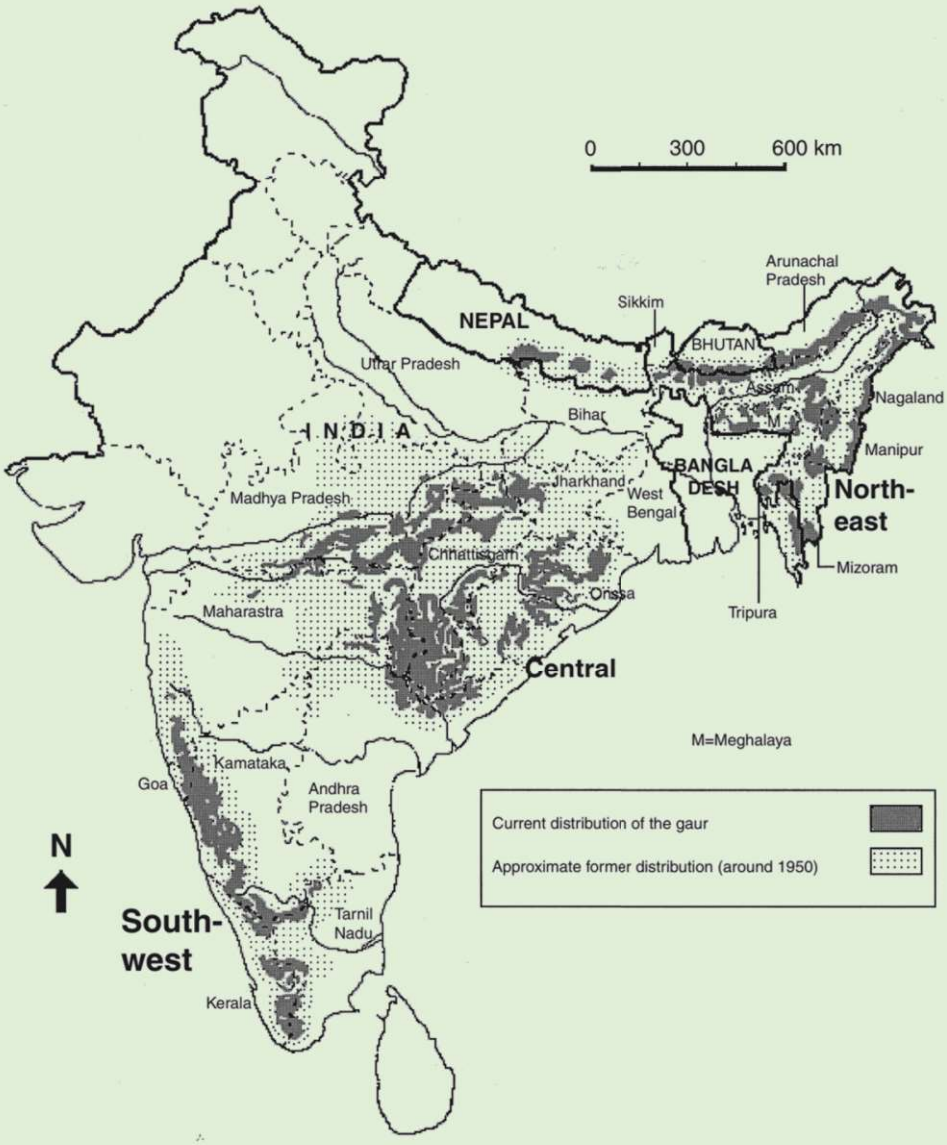
In Southern India, they are found in the southern hills, the Nilgiris, the Anamalais, the Cardamom Hills, and surrounding plains in the Western Ghats (Shukla & Khare, 1998) and distributed over the Palani and Dindugal hills, the Shandamangalam ranges, the Shervaroys and sections of the mountain range near Vellore and the Karnataka border on the peninsula's eastern side. The species spans Southwestern Maharashtra through Goa, Karnataka, Tamil Nadu, and Kerala (Choudhury, 1999). The important gaur areas are Mudumalai and Anamalai in Tamilnadu, Wayand, Periyar and Parambikulam in Kerala, Bandipur, Nagarhole and Bhadra in Karnataka, Molem in Goa and Radhanagari in Maharashtra (Davidar, 1986). These region's habitat types range from tropical wet evergreen forests to scrub forests.

Central India has the most extensive gaur habitat, spread over 83,000 km^2 is home to approximately one-fourth of the country's gaur population (Sankar et al., 2001). In the Central Indian landscape, the gaur ranges from the middle Satpura Range to the Chotanagpur Plateau and then to the northern slopes of the Eastern Ghats in central India. Its range includes parts of the Deccan Plateau between the Gawilgarh Hills and the Northeastern Ghats. It is found in Maharashtra (northern and eastern sections), Andhra Pradesh (northern areas, Papikonda NP), Telangana (Kawal), Madhya Pradesh (mainly eastern and the southern regions), Chhattisgarh, Jharkhand, Bihar (southern corner), Uttar Pradesh (only in extreme south-eastern portions), and Odhisha (Choudhury · 2002; Ashokkumar et al., 2011).

The gaur in protected areas of central India resides in Kanha National Park (3.87 per Km^2), Pench Tiger Reserve, Madhya Pradesh (4.35 per km^2), Satpura Tiger Reserve (6.84 per km^2) , Tadoba-Andhari Tiger Reserve (3.18 per km^2), Melghat Tiger Reserve (2.03 per km^2) , Nawegaon Nagzira Tiger Reserve (7.47 per km^2) and Sahyadri Tiger Reserve (8.07 per km^2) (Jhala et al., 2020) and Bandhavgarh Tiger Reserve (re-introduced population of 168 individuals) (Nigam et al., 2021).

Historical account of Gaur in Madhya Pradesh

In the early 20th century, Dunbar Brander (1923), documented the widespread presence of gaur in the Betul and Khandwa districts of Madhya Pradesh. The fragmented gaur populations were reported in Balaghat, Mandla, Dindori, Anuppur, Sidhi, Seoni, Chhindwara, and Hoshangabad districts. There are unconfirmed reports of its existence in Katni and a small area called Kali Bhit at the junction of Betul, Harda and Khandwa districts (Pabla et al., 2011).



Map 2.1 Current distribution of gaur in India (Choudhury, 2002)

2.2 Ecological attributes

2.2.1 Group structure & dynamics

Gaurs are gregarious in nature with matrilineal societies (Ashokkumar et al., 2010). Adult females usually lead the herds. The group structure is fluid and dynamic, and the observed social associations are solitary males, bull groups and mixed herds (Areendran, 2000; Ashokkumar et al., 2010). The group size of mixed herds ranges from 1 to 20 animals (Brander, 1923; Schaller, 1967) and occasionally ranges up to 47-54 individuals (Ashokkumar et al., 2004; Nigam et al., 2022). Gaur herds consist of both sexes and various age classes. Males can be seen as rover individuals or in small all-male groups. They frequently compete, especially during the mating season (Ahrestani & Karanth, 2014).

A key characteristic of the gaur social structure is the fusion-fission dynamic (Nigam et al., 2022) with the herd size being influenced by factors such as the availability of resources, seasonal changes, and reproductive cycles (Nigam et al., 2022). Fusion-fission dynamics are not just a response to environmental conditions but also play a crucial role in the social cohesion of the species. These interactions allow individuals to engage in social learning, establish dominance hierarchies, and strengthen social bonds through grooming and other affiliative behaviours. The continual forming and dissolving of subgroups ensure that social ties are broad and flexible, which can benefit genetic diversity and resilience against environmental changes (Nigam et al., 2022).

The mating and calving seasons occur at different times across regions. The mating season in a central Indian gaur population has been reported between December and January, with calving in August and September (Dunbar-Brander, 1923 in Ahrestani and Karanth, 2014; Nigam et al., 2022). In contrast, the peak rutting season in a southern Indian population has been reported between November and March (Dunbar-Brander, 1923 in Ahrestani and Karanth 2014; Ashokkumar et al., 2011) and in Northeastern population and Nepal it was reported between March to April with calving in December to January (DNPWC, 2020).

2.2.2 Habitat Ecology

Gaur prefers to live in distant woodland places away from human activities. They have been observed to feed regularly at forest edge habitats and in regenerating woods (Sankar et al., 2015). The habitat utilisation pattern in gaur is influenced by the sex, social structure and size of the herd (Conry, 1989; Sankar et al., 2015). Solitary bulls prefer montane forests (>1000 m elevation), while the herds prefer mixed deciduous and semi-evergreen forests in lowlands (1000 m elevation), which provide high-quality food for gestation and lactation. In the rainy season, gaur frequently utilises deciduous woodlands and grasslands. During the dry season, gaur migrates to evergreen forests and mountainous terrain for food and water (Schaller, 1967).

2.2.3 Nutrition & Feeding Ecology

Gaur has high metabolic requirements as they are large-bodied animals; they need a diversity of plants to forage, including bamboo, grasses, herbs, shrubs, climbers, tree bark, and fruits (Sankar et al., 2004; Ahrestani et al., 2012). They are grazers, although they adapt to browsing other plants during dry seasons when grasses and bamboo are sparse (Gad, 2011; Ahrestani et al., 2012). According to Ashokkumar (2004), grasses comprise a prominent component of the gaur diet. Gaur eats a wide variety of vegetation, showing that it is a polyphagous feeder. Major food species are from the plant families of *Poaceae, Fabaceae, Asteraceae and Malvaceae* (Nayak & Patra 2015). Grass comprises a major proportion (66%) of their diet, followed by browse, herbs and others (Chetri, 2006). Gaur has been reported to be feeding on 155 plant species from 38 families in Mudumalai's tropical dry deciduous forest (Arrendran, 2000) whereas Nigam et al. (2022) reported gaur to be consuming 112 plant species belonging to 39 groups, including 42 trees, 35 grass, 17 shrubs, 12 herbs, and six climber species in the Bandhavgarh tiger reserve. A total of 151 species of food plants were identified to be consumed by gaurs in the Parambikulam Wildlife Sanctuary, which supports a vegetation type ranging from evergreen to moist deciduous (Easa, 1998).

Gaur's diet primarily includes *Aegale marmalos, Bauhinea spp., Cassia fistula, Cordia myxa, Diospyros melanoxylon, Emblica spp., Gmelina arborea, Terminalia bellerica, and Randia dumetorum* however, tender bamboo seeds and herbs also contribute to its diet. Gaur have been reported to be feeding on the bark of numerous tree species, such as Adina cordifolia in central India and *Wendlandia natoniana* in southern India (Brander, 1923; Schaller 1967), bark of *Phyllanthus emblica* and *Tectona grandis* during the summer season in central Indian highlands (Pasha et al., 2004). Gaur is known to be an obligate drinker and needs water every day (Sankar et al., 2001).

2.2.4 Ranging Patterns

Schaller (1967) reported the daily distance covered by gaur as 3.2 - 4.8 km/day in Kanha. The home range size has been diversely reported to range from 23.5 km^2 in Kanha (Schaller, 1967) to 13 km^2 in Taman Negara National Park, Malaysia (Weigum, 1972). It is influenced by habitat conditions, seasonal changes, resource availability, and anthropogenic disturbance (Prayurasiddhi, 1997; Prayoon et al., 2024; Sankar et al., 2013).

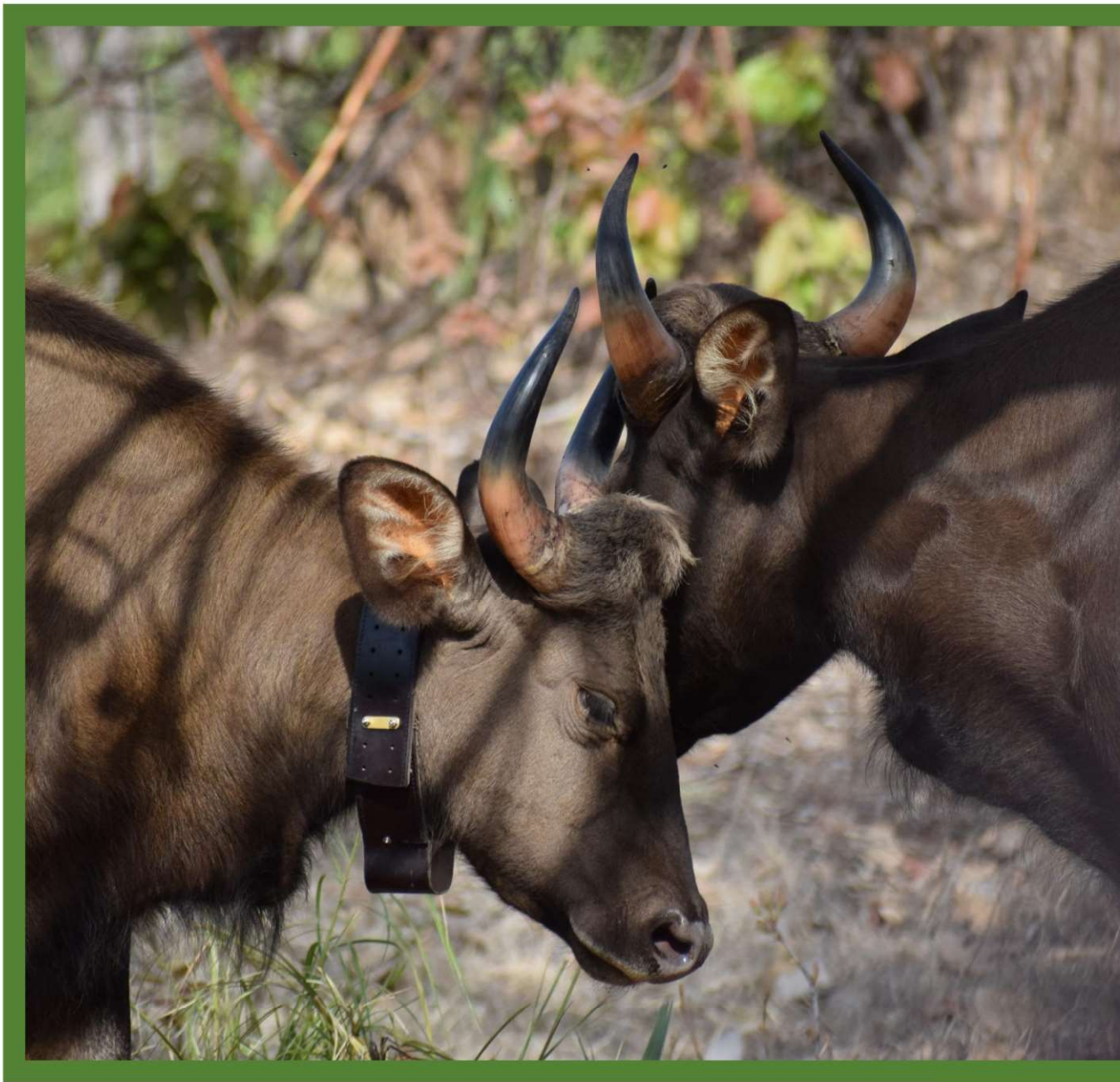
Table 2.1. Home range of gaur *Bos gaurus* of different regions

Area/region	Home Range (km^2)	Citation
Bandhavgarh Tiger Reserve (AKDE method)	209.69	Nigam et al., 2022
Kanha Tiger Reserve	23.5	Schaller (1967)
Bandipur National Park	20.5	Karanth & Sunquist (1992)
Biligiri Rangaswamy Temple Wildlife Sanctuary	10.3	Ramesh et al. (2012)

Area/region	Home Range (km^2)	Citation
Royal Belum Forest, Malaysia	8.5	Srikosamatara & Suteethorn (1995)
Phu Khieo Wildlife Sanctuary, Thailand	15.3	Gray et al. (2012)
Huai Kha Khaeng Wildlife Sanctuary	66	Prayurasiddhi (1997)
Pench Tiger Reserve, Madhya Pradesh (Male)	12.61 (male), 13.80 (female)	Sankar et al. (2000)
Central Pahang, Malaysia	70.18 (male), 52.13 (female)	Conry (1981)
Ulu Jelai Forest Reserve, Pahang (AKDE method)	29.62	Rizal et al. (2020)
Dong Phayayen-Khao Yai Forest, Thailand, (AKDE method)	30.15	Prayoon et al. (2024)

2.2.5 Behavioural Attributes

Gaurs are typically diurnal but have been observed to be nocturnal in places with heavy human disturbance. They have bimodal feeding and locomotion patterns, with peaks in the morning and evening. According to Ashokkumar et al. (2011) and Sankar et al. (2013), animals avoid the afternoon heat by moving to vegetation cover for rest and rumination. Gaur is usually a grazer animal and starts feeding activity at dusk in open areas where grasses are plentiful. Feeding activity is modest, less than 10% during the midday hours, whereas resting activity progressively increases, reaching a peak at noon, and gradually reduces. During the warmest part of the day, the animals rest under the cover, and rumination is usually noticed. Moving is consistent throughout the day and occurs more frequently in the morning and evening. A watchful gaur stands with its head elevated, ears erect, and head directed towards the source of danger (Ashokkumar et al., 2004).



2.2.6 Threats

Habitat fragmentation and destruction, loss of connectivity, rampant poaching, and infectious diseases have been reported to be the major threats to the species' long-term survival and have contributed to gaur population decline over most of Southeast Asia (Davidar, 1997; Choudhury, 2002). The population is exceptionally fragmented on the Indian subcontinent, where the gaur population is the greatest.

The recent past has witnessed major land use changes (alterations in landscape dynamics), habitat degradation and fragmentation within the protected area network of central Indian regions. Though once well-connected through corridors, the region has witnessed a disruption of habitats, resulting in decreased diversity and the transformation of the said habitats into agricultural lands and wastelands.

The turn of the twentieth century witnessed a remarkable decrease in the population densities as well as local extinctions of Gaur from some Protected Areas (PA's), namely Bandhavgarh Tiger Reserve and Sanjay Dubri National Park in Madhya Pradesh; Thattakad in Kerala and Kanger Valley National Park in Chhattisgarh. The major reasons for their decline have been primarily attributed to disruption of migratory routes, loss of habitat, poaching, predation especially at the calf and sub-adult stage, disease, insurgency, straying and various developmental activities (Choudhury, 2002; Imam, 1985). These known extinctions have happened in a relatively short span of time and have necessitated urgent measures to revive the populations. The possible solution besides habitat improvement, habitat connectivity, and law enforcement involves active management of the species by reintroduction or replenishing them in vacant suitable habitats (Choudhury, 2002; Imam, 1985).

Adding to the complexity of gaur conservation is the increasing threat of diseases such as Foot and Mouth Disease, Anthrax, Haemorrhagic septicaemia, and, more recently, tuberculosis, which are emerging as potential threats, possibly due to interactions with livestock (Nigam et al., 2022). This species is perhaps more prone to disease losses due to its genetic proximity to domestic livestock. These diseases, transmitted through close contact and shared grazing areas, can significantly impact gaur populations, increasing morbidity and mortality rates. The interaction between wild and domestic animals not only facilitates the transmission of these diseases but also exacerbates the vulnerability of gaurs due to their limited genetic diversity compared to domestic cattle.

Due to decreasing meta-population connectivity, most subpopulations have been reported to be no longer viable (Choudhury, 2002). This fragmentation of habitats and isolation of populations further diminishes gaurs' genetic pool and resilience, making them more susceptible to diseases and environmental changes. Therefore, enhancing habitat connectivity is crucial for maintaining viable gaur populations. Reconnecting fragmented habitats through wildlife corridors can facilitate gene flow between isolated subpopulations, reducing the risk of inbreeding and boosting the species' overall health.

3. Sanjay-Dubri Tiger Reserve: An overview

3.1 Sanjay-Dubri Tiger Reserve (SDTR)

Sanjay Dubri Tiger Reserve had a history of gaur presence until 1998 that went locally extinct, with the last official records of its presence documented in the management plan (Alawa, 1998). Historically, the SDTR had strong evidence of gaur presence, making it evident that the area supported the viable population of gaur, which diminished and later became extinct with time. Before the local extinction of gaur in SDTR, a small population was reported from the Machmahua, Kharsoti, Baigwana, Runda, and Bhadora areas of the Mohan range during the open season (Alawa, 1998). However, no definitive information existed about their presence/movement during the rainy season, and it was believed that these animals migrated to Chhattisgarh and Jharkhand during the monsoon season.

3.1.1 Area

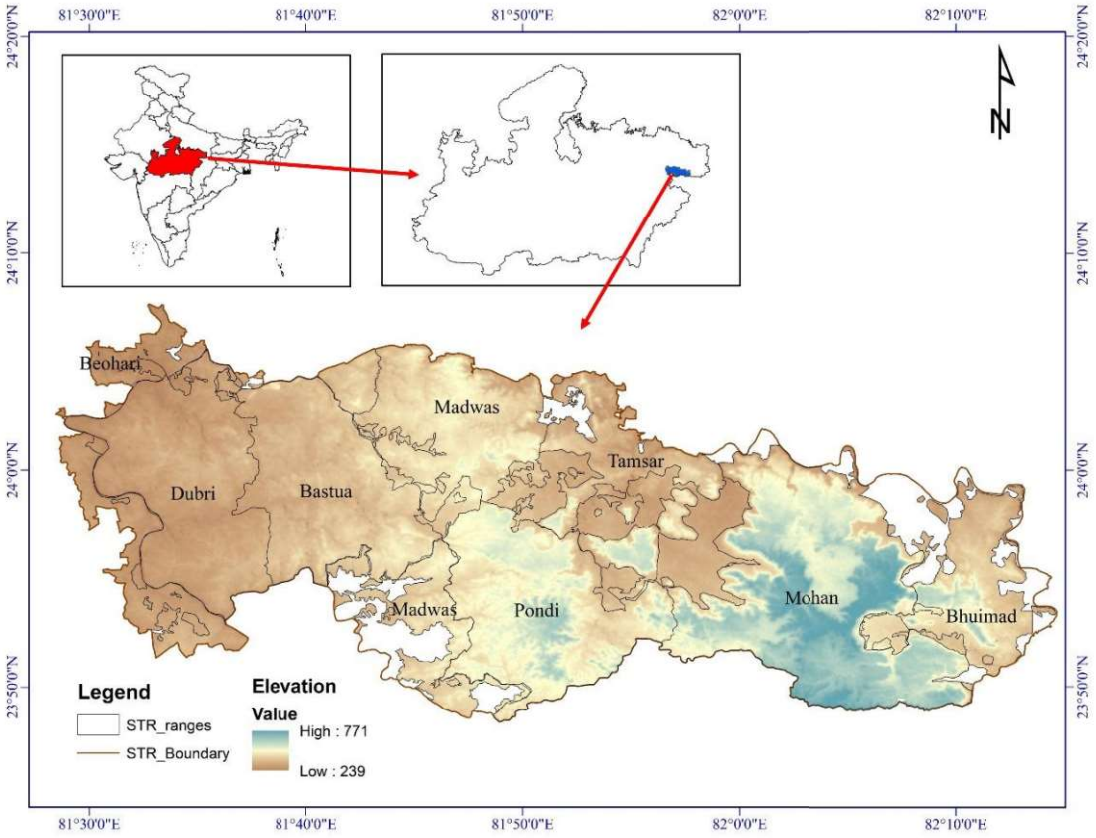
The reserve is situated in the northeastern part of Madhya Pradesh (Map. 3.1) and is bordered by Guru Ghasidas National Park of Chhattisgarh. The park has a total geographical area of 1643.83 km^2 consisting of Sanjay National Park and Dubari Sanctuary as core (831.25 km^2) and buffer area (812.58 km^2) in Sidhi and Shahdol districts of Madhya Pradesh. The core area is situated in the district of Sidhi, and the buffer zone covers parts of Beohari Tehsil (District Shahdol), Majhauli and Kusmi Tehsil of District Sidhi. The entire tract of the Core and Buffer of Sanjay Tiger Reserve is situated between longitude 82° 10' 48" to 82° 14' 40" and latitude of 23° 48' 57" to 23° 49' 06". It is a part of the Bandhavgarh-Sanjay-Guru Ghasidas- Palamau landscape and has been identified as one of the potential tiger meta-population landscapes.

3.1.2 Topography

The general topography of the reserve is hilly and undulating over a greater portion, especially towards plateau portions. The elevation of STR varies from 1400 to 2400 (425m to 732m) above M.S.L.

The mean annual rainfall is 1303 mm. The normal fluctuations of the mean annual rainfall are expected to have a range of 1059.70 mm to 1277.10 mm. Annual Temperature is found to range between 41.8 ºC to 7.4 °C. Almost 95% of the precipitation is received from the South-East monsoon and a very small portion from the North- East Monsoon during winter. The relative humidity ranges between 80 and 90% during the monsoon period.

Plenty of rivers and nullahs (perennial and seasonal) exist in and around the park and sanctuary. The reserve is an important catchment area of rivers Gopad, Banas, Son, Hasdo, Mawai and their tributaries.



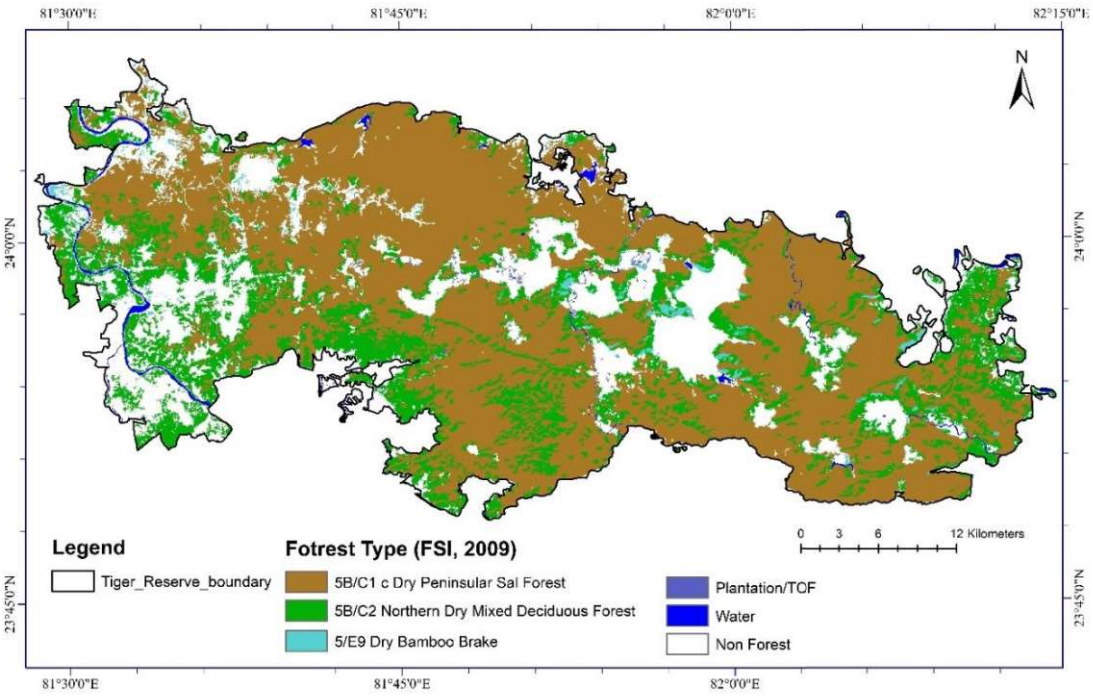
Map 3.1: Map showing geographical location of SDTR.

3.1.3 Forest Types & Vegetation

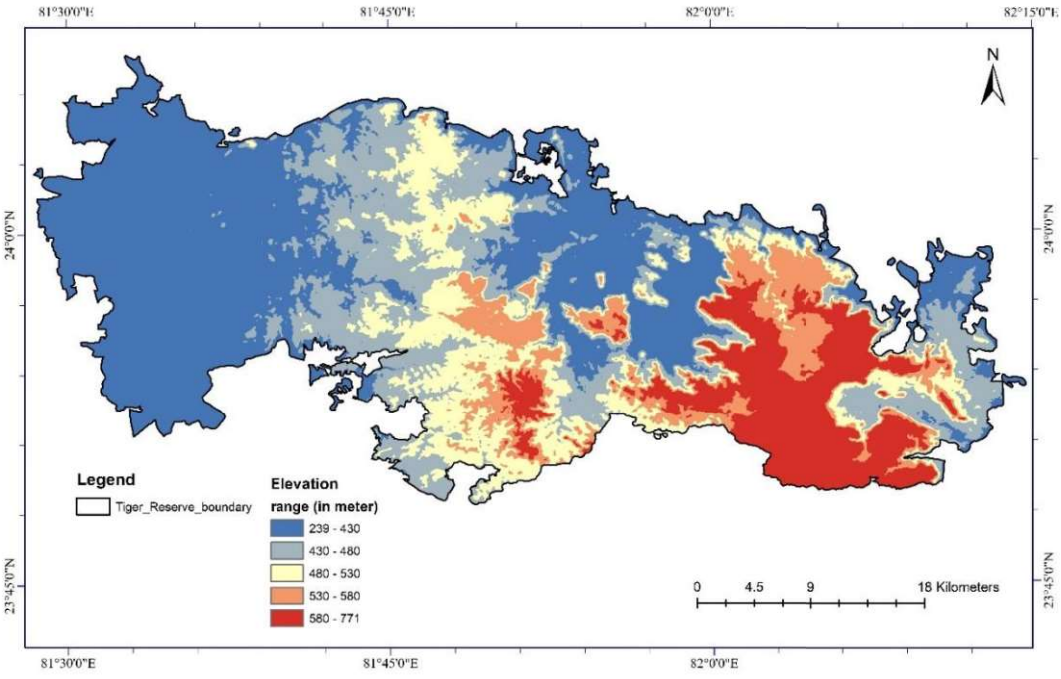
The broad forest type of SDTR (Map 3.2) falls under North Indian moist deciduous peninsular sal (3C/C2e) and North Indian dry deciduous peninsular Sal (5B/C1c) (Champion and Seth 1968). Within North Indian moist deciduous peninsular Sal, the forests typically form a high forest in which it constitutes about 60 - 80% of the top canopy, which is 20–30 m high. The undergrowth is abundant with the presence of climbers. The main associates are *Terminalia tomentosa, Pterocarpus marsupium, Anogeissus latifolia, Madhuca indica, Phyllanthus emblica, Buchanania lanzan, Diospyros melanoxylan, Terminalia chebula, Kydia calycina, Ougeinia oojeinensis, Bridelia retusa, Bauhinia retusa* and *Phoenix acaulis* and North Indian dry deciduous peninsular sal, the upper canopy in this forest type is usually light, open and irregular, the trees having relatively short bole and poor form and a height rarely over 10 m. The canopy is made entirely of deciduous trees. The main species found are *Anogeissus latifolia, Acacia catechu, Butea monosperma, Buchanania lanzan, Acacia leucophloea,* etc. Other than these, the forest also includes the 5e/9 Northern Tropical Dry Deciduous Forest type; these forests are primarily found in the central and northern parts of India and areas with a tropical climate that experiences a dry season. The forests are dominated by deciduous trees, which shed their leaves during the dry season to conserve water. Some of the common tree species found in this type of forest include Bamboo mixed forest

(*Dendrocalamus strictus and Bambusa valgaris*), sal (*Shorea robusta*), and various species of acacia (*Acacia spp.*).

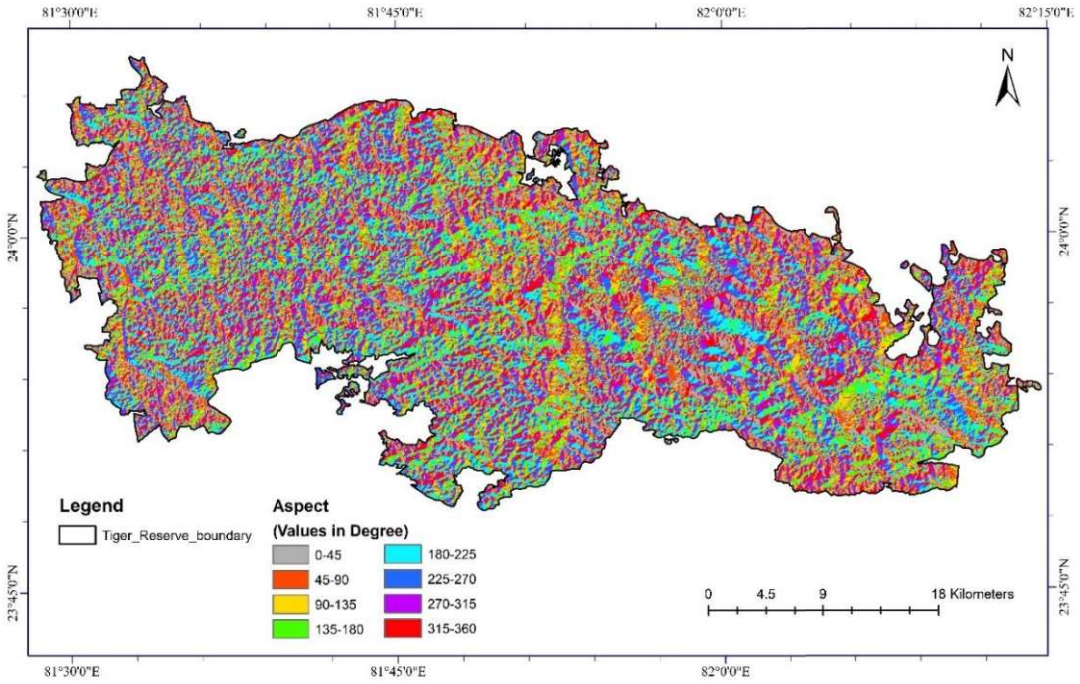
The dominant vegetation in the Sanjay National Park and Dubri Wildlife Sanctuary is Sal Forest (*Shorea robusta*), covering approximately 80% of the total area. This is followed by mixed forest, bamboo forest, bamboo-sal mixed forest, Scrubland, and Grassland.



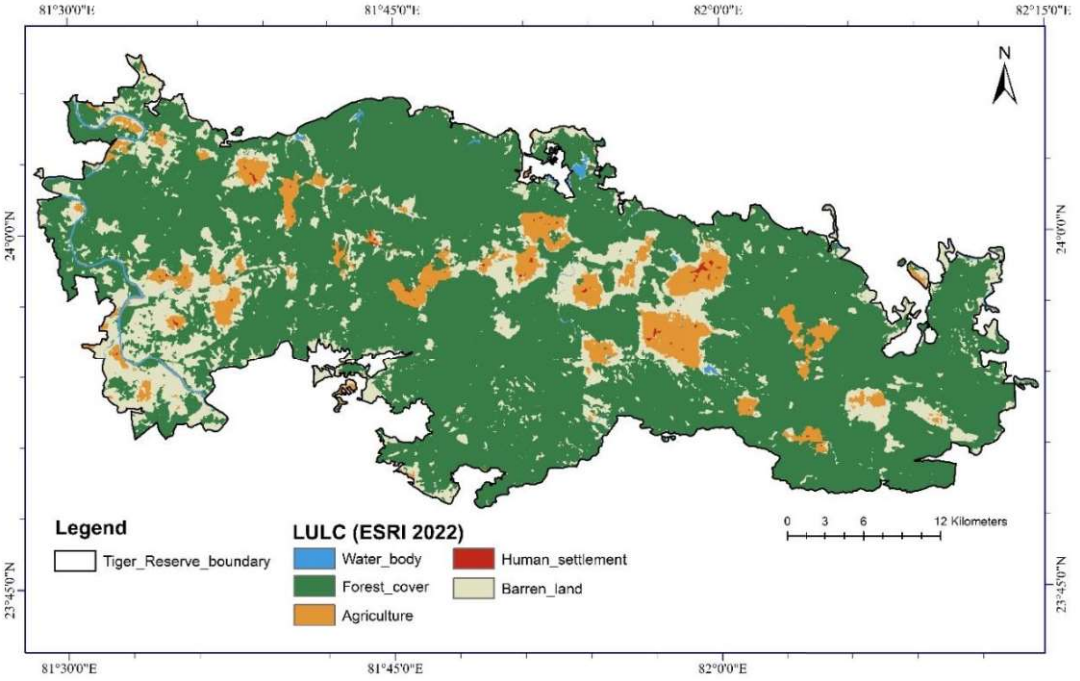
Map 3.2: Forest Types of Sanjay Dubri Tiger Reserve



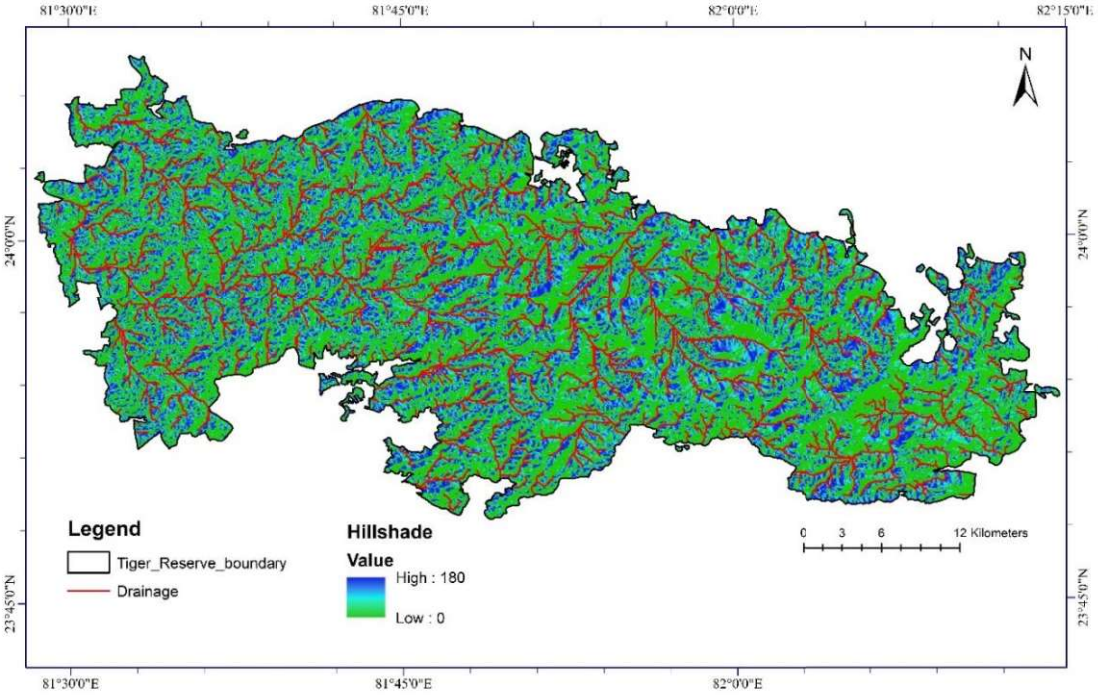
Map 3.3: Digital elevation of Sanjay Dubri Tiger Reserve



Map 3.4: Aspects map of Sanjay Dubri Tiger Reserve



Map 3.5: Land use land cover map of Sanjay Dubri Tiger Reserve



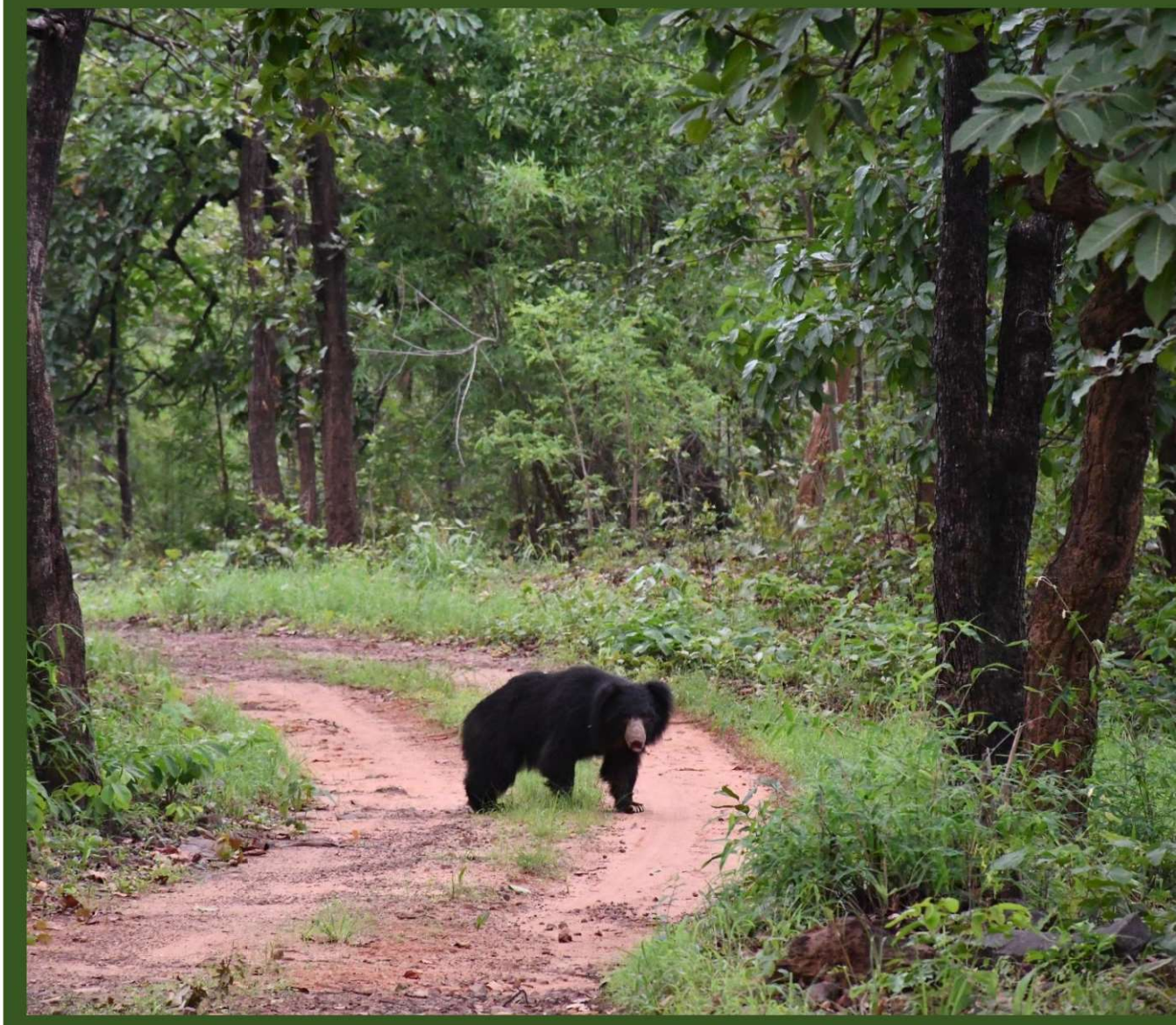
Map 3.6: Hill shade map of Sanjay Dubri Tiger Reserve

3.1.4 Faunal Attributes

The Sanjay Dubri Tiger Reserve is home to a diverse array of animals including tiger (*Panthera tigris*), leopard (*Panthera pardus*), jungle cat (*Felis chaus*), hyena (*Hyaena hyaena*), jackal (*Canis aureus*), and Indian fox (*Vulpes bengalensis*) as notable carnivores. Additionally, the reserves support a substantial population of Sloth bears (*Melursus ursinus*). The primary ungulates that serve as prey for these carnivores include chital (*Axis axis*), nilgai (*Boselaphus tragocamelus*), sambar (*Rusa unicolour*), four-horned antelope (*Tetracerus quadricornis*), chinkara (*Gazella gazella*), barking deer (*Muntiacus muntjak*), and wild pig (*Sus scrofa*). Two primate species, the grey langur (*Semnopithecus entellus*) and rhesus macaque (*Macaca mullata*) (Alwa, 2006).

The reserve is home to around 309 bird species, including commonly seen Peafowl (*Pavo cristatus*), Racket-tailed drongo: (*Dicrurus paradiseus*), Golden-hooded oriole (Oriolus oriolus), Indian treepie (*Dendrocitta vagabunda*) Rufous treepie (*Dendrocitta vagabunda*), Lesser adjutant (*Leptoptilos javanicus*), Red-headed vulture (*Sarcogyps calvus*) Cinereous vulture (*Aegypius monachus*), White-rumped vulture (*Gyps bengalensis*), Egyptian vulture (*Neophron percnopterus*), Nightjar (*Caprimulgus indicus*), Indian Roller (*Coracias benghalensis*), Woolly-necked stork (*Ciconia episcopus*), Kingfishers (Family *Alcedinidae)* (Alcedo spp.), Crested Serpent Eagle (*Spilornis cheela*), Brown Fish Owl (*Ketupa zeylonensis*) etc.

Among the reptiles, the critically endangered species- Gharial (*Gavialis gangeticus),* narrow-headed soft-shelled turtle (*Chitra indica*), Crocodile (*Crocodylus palustris*) and Garden lizard (*Calotes versicolor*), Chameleon (*Chamaeleo zeylanicus*), Skink (*Eutropis carinata*), Bengal monitor (*Varanus bengalensis*), Common cobra (*Naja naja*), Common krait (*Bungarus caeruleus*), Russell's viper (*Daboia russelii*), Saw-scaled viper (*Echis carinatus*), Rock python (*Python molurus*), Rat snake (*Ptyas mucosa*) etc.



3.1.5 Corridors

There are two important corridors connected with the SDTR (Qureshi et al, 2014; Dhmorikar et al., 2022)

Corridor I: The corridor between North Shahdol division, between the Panpatha sanctuary of Bandhavgarh and Dubri sanctuary, is a long strip of about 30 km with a width of almost 15km fragmented at several places. The tigers use this corridor to cross over from Bandhavgarh to SDTR. A large part of the area has been notified as a buffer.

Corridor II: The area bounded by Dubri Sanctuary and Sanjay National Park in the north and the forests of Korea Division and Guru Ghasidas National Park (Chattisgarh state) in the south, connecting SDTR and Guru Ghasidas National Park is another important corridor. Portion of this corridor, falling in the state of MP, has been notified as part of the buffer area of Sanjay-Dubri. It is used by the tiger of the reserve to cross over from Dubri sanctuary to Sanjay National Park area and occasionally to Guru Ghasidas National Park, Chhattisgarh.

4. Potential feasibility of Gaur in Sanjay Tiger Reserve

4.1 Population Viability Analysis

Population Viability analysis (PVA) is an important tool used to estimate the probability of extinction of a species over time and provides a valuable understanding of the long-term survival prospects of the species in its new environment. By incorporating data on habitat conditions, PVA can help determine if the available habitat is sufficient to support a self-sustaining population. This includes assessing factors like food availability, water resources, and habitat characteristics. It also allows testing different scenarios and management interventions, taking into consideration the effects of habitat restoration, disease outbreaks, or climate change on the species.

All scenarios were run with the default inbreeding depression and density dependence option provided in VORTEX 9.93. Population persistence (P), stochastic rate of increase (r), and population size for 100 years were evaluated. For each of the following scenarios, 500 simulations were performed:

The (PVA) was most sensitive to the number of individuals reintroduced as source population, and the analysis carried out under the following scenarios showed the persistence of gaur within acceptable risk of extinction (<5%) for the next 100 years.

Scenario 1. Reintroduction of 50 animals with a sex ratio of 74% females and 26% males (3 female over 1 male – 3:1 ratio)

In 100 iterations of 50 reintroduced populations, all survived, with a probability of success of 1.00 (Figure 4.1), with an adult sex ratio of 67 males/100 females in 100 years. The mean growth rate (r) was 0.2642 (0.0187 SE, 0.1866 SD), having a 5.67 deterministic growth rate/year. The final observed heterozygosity was 0.9409 (0.0019 SE; 0.0185 SD) with the scenario of predation of a mean of 5 individuals per year (derived from the Bandhavgarh reintroduction study (WII, 2022).

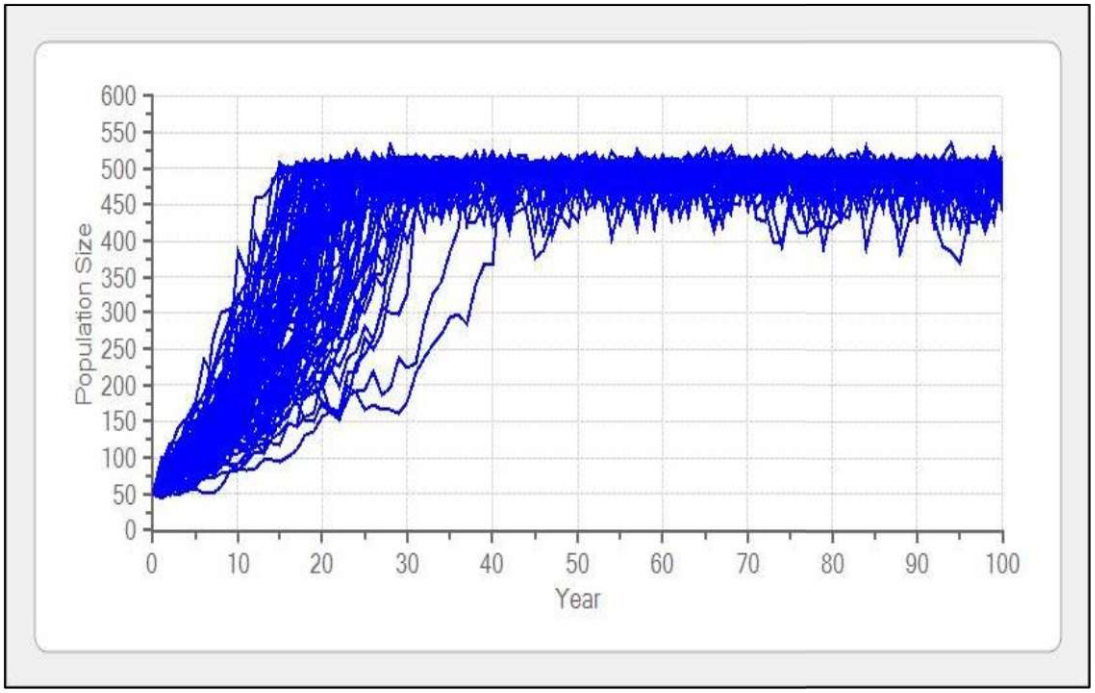


Figure 4.1: Reintroduction of 50 animals with a sex ratio of 74% females and 26% males (2.8 female over 1 male, 2.8:1 ratio) over 100 years.

Scenario 2. Reintroduction of 50 animals and subsequent supplementation of 20 individuals with a 3:1 (female: male) sex ratio every 10 years:

This scenario was predicted based on the parameters as reintroduction of 50 animals and subsequent supplementation of 20 individuals with a 3:1 (female: male) sex ratio every 10 years of reintroduction with this scenario, including predation by the tiger of 5 individuals/year at any age, has shown a mean growth rate (r) was 0.1491 (0.0035 SE, 0.1148 SD) and the deterministic growth rate was estimated at 6.69 individual/ year. The probability of survival is 100%. as the female-biased ratio of supplementation will further improve the situation (Figure 4.2).

The final observed heterozygosity was 0.9710 (0.0011 SE; 0.0105 SD) in population-based models. It is suggested that final heterozygosity increased in the second scenario by supplementing 20 individuals with a 3:1 Female-male ratio. The supplementation of 20 animals at an interval of 10 years will reduce any predation, genetic inbreeding or disease-related catastrophes and help improve the genetic heterozygosity in the recovering population. The gaur population is susceptible to most livestock-related diseases, and local extinctions in the Indian sub-continent have been ascribed to diseases and habitat loss (Nigam et al., 2021).

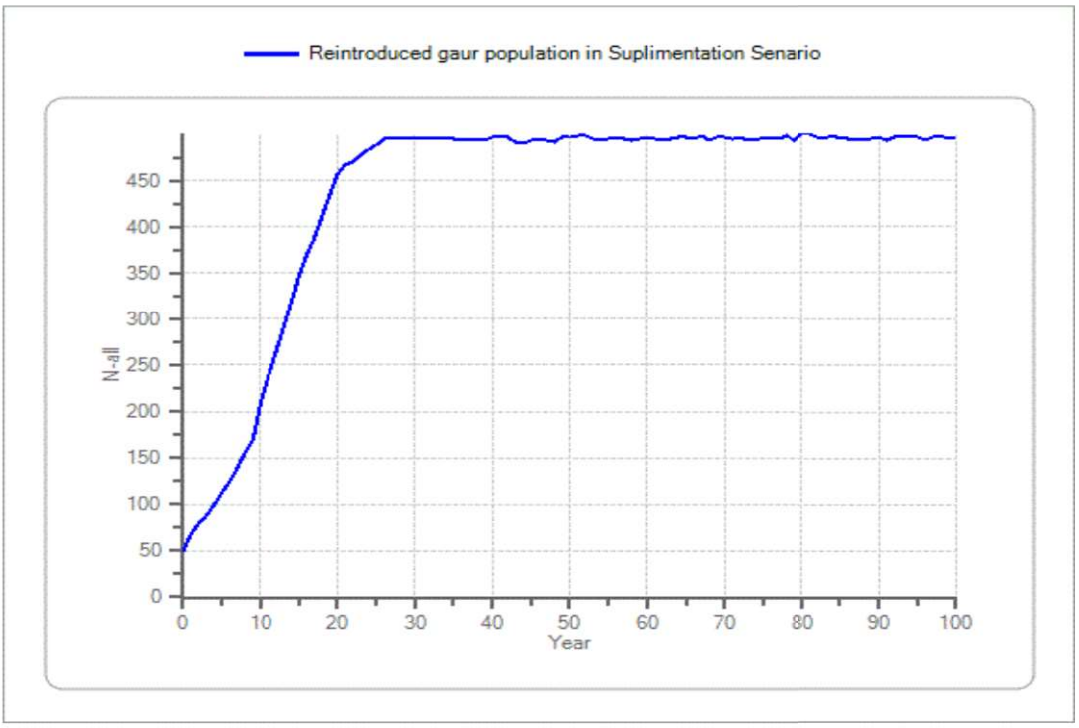


Figure 4.2: Mean Population (N-ALL) after 100 years of Reintroduction of 50 animals and subsequent supplementation of 20 individuals with a 3:1 (female: male) sex ratio after 10 years of reintroduction

4.2 Habitat Suitability Analysis

The habitat suitability study was conducted to understand the suitable habitats and connectivity on gaur preferred ranges within and around Bandhavgarh and Sanjay Tiger Reserve of Madhya Pradesh state. The habitat preference of gaur was quantified on a scale of low to high to assess a suitable habitat for further management implementation. The previous study of gaur home ranges in Bandhavgarh revealed that gaurs within herd select habitats based on land cover type, terrain ruggedness, availability of palatable vegetation and predator density (Nigam et al., 2022). This information identified possible gaur suitable habitats using species distribution modelling (Huck et al., 2011). The potential distribution area of gaur was estimated through the presence data of species using maximum entropy species distribution modelling in MaxEnt software version 3.4.1 (Phillips et al., 2006). This species distribution modelling used a series of environment variables such as forest type, forest cover, elevation, slope, terrain ruggedness and disturbance (nightlight). Combining features (Linear, product, quadratic, hinge and threshold) and regularisation multipliers (6; 1-6) and default 'Auto' feature (with default regularisation multiplier; 1) were used to design models for this study. The ten-percentile training presence logistic threshold was selected as the threshold value for defining the species' presence. This threshold value was used to reclassify our model into 'non-potential', 'moderate potential' and 'high potential' distribution areas. The area of these reclassified predicted distribution areas was calculated using threshold value using software ArcGIS 10.5 (ESRI) to convert the continuous habitat suability map to a binary suitable/unsuitable map.

4.2.1. Gaur habitat suitability in Sanjay Tiger Reserve:

In all 10 variables used for the model, the mean diurnal range, different forest types, land use, land cover, and annual precipitation were the most important variables determining habitat suitability, whereas the terrain ruggedness, seasonal precipitation and elevational gradient were identified as the least important variables. The regularised training gain of the model without the mean diurnal range was less than that of the model using without other single variables. The mean diurnal range was considered a more useful variable to the model. Similarly, the regularised training gain of the models without forest type, land use land cover and annual precipitation, indicated that these variables could be useful predictors of habitat suitability for the gaur.

The most potential areas of distribution identified from the model were located within highly dense forest cover, mainly within protected areas and areas with the least human disturbance. The model suggested less suitable habitats for higher human disturbance (LULC), low precipitation, and low tree density (Nigam et al., 2022). Overall potential habitat suitability of gaur was estimated for all the tiger reserves in Madhya Pradesh as follows (Table 4.1):

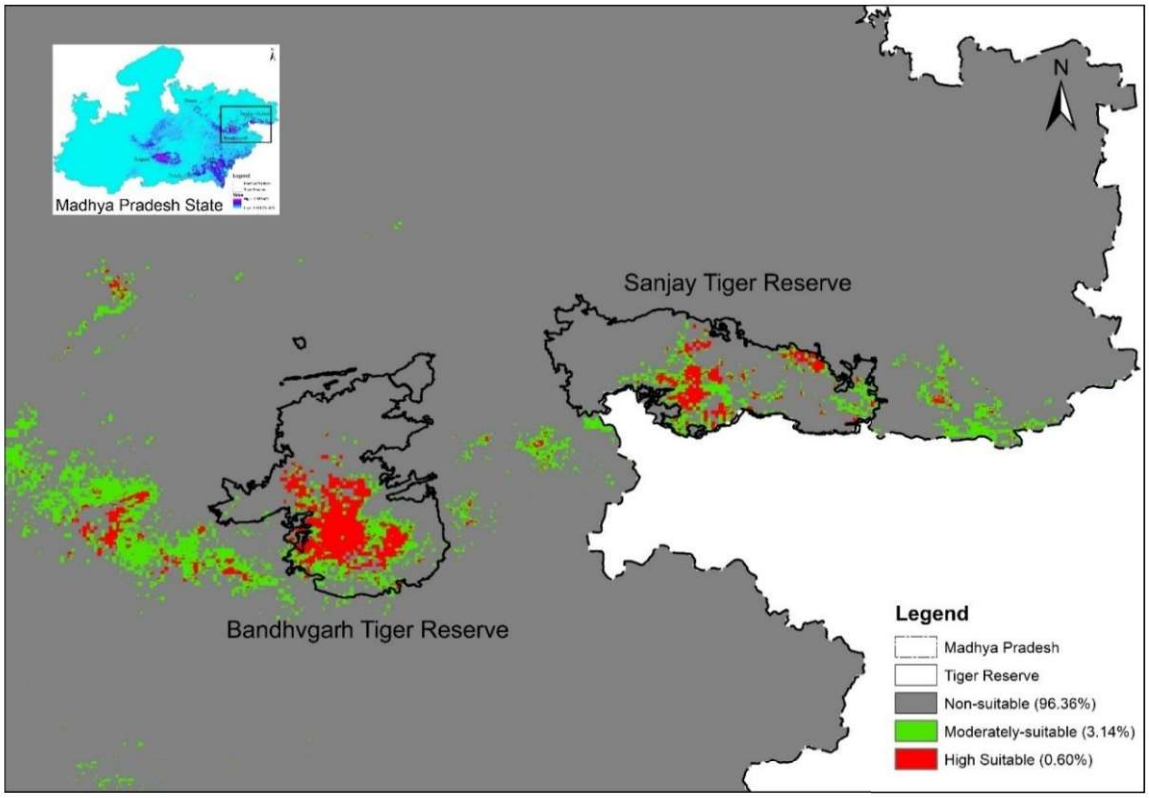
Table 4.1: Habitat Suitability of Gaur in both the tiger reserves

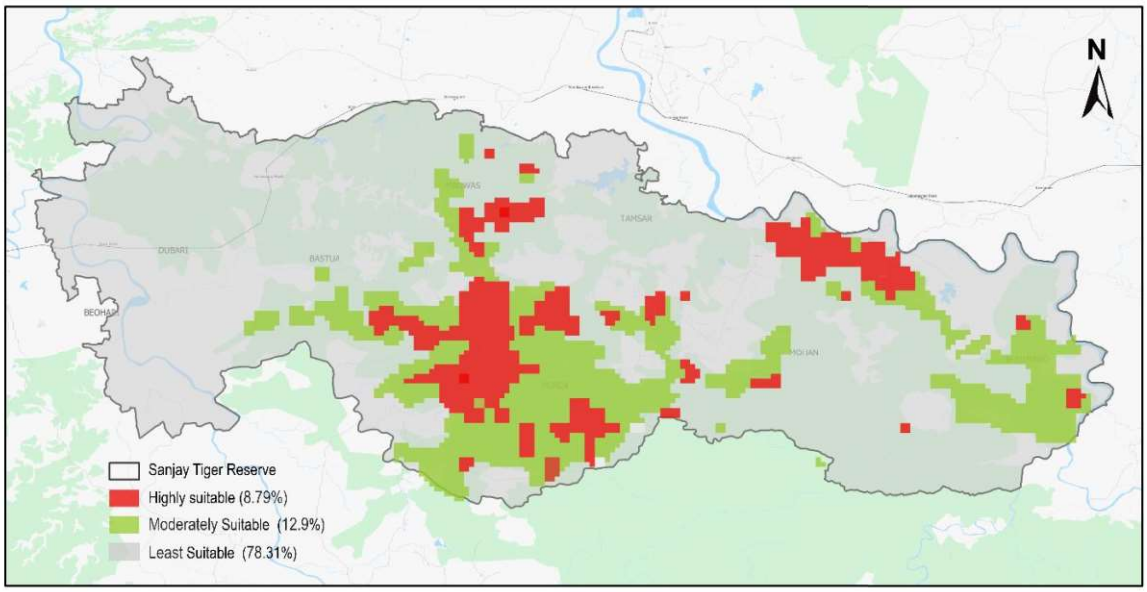
Tiger Reserves in Madhya Pradesh	Total available area (in km2)	Least/non-suitable		Moderately Suitable		Highly Suitable	
		(in km2)	(% area)	(in km2)	(% area)	(in km2)	(% area)
Bandhavgarh	1700.39	1180.24	69.41	209.49	12.32	310.66	18.27
Sanjay-Dubri TR	1508.00	1180.91	78.31	194.53	12.9	132.55	8.79

*Data Source: (WII, 2022).

The model estimated 21.69% (327.08 km2) area as a potentially suitable area of gaur in Sanjay Tiger Reserve, in which 8.79% (132.55 km²) and 12.9% (194.53 km²) area were identified as high and moderate potential area, respectively, and 78.31% (1180.91 km²) area was identified as least-potential areas for gaurs of total area 1508.00 km2 of Sanjay Tiger Reserve (Map 4.1 & 4.2) (Nigam et al., 2022).

The suitability study showed that the Mohan and Pondi ranges of SDTR are potentially suitable for reintroduction. Historically, the gaur population has lived mainly in the Mohan and Pondi ranges, though movement into other parts of the park and outside, especially during monsoons, was also reported. The Pondi and Mohan range was selected as an ideal release site based on the above.





Map 4.1 & 4.2: Overall Landscape Habitat Suitability of Gaur in and around Sanjay and Bandhavgarh Tiger Reserves, Madhya Pradesh

4.3 Habitat, Food and Water requirements of Gaur at Sanjay Tiger Reserve:

Gaur, a generalist feeder, prefers browsing during the dry season and predominantly grazes during monsoon. Their diet primarily comprises of shoots and foliage of trees, shrubs, buds, and fruits of species such as *Diospyros melanoxylon and Aegale marmalos.* Additionally, tender seeds of bamboo, herbs, grasses, and bark of trees like *Adina cordifolia and Tectona grandis* are included. Periodically, gaur may visit salt licks. Being an obligatory drinker, gaur requires water daily and may visit water bodies twice during the summer months.

As per the field assessment carried out by the forest department (SDTR), a total of 139 palatable plants belonging to 39 families, including 54 tree species, 17 shrub species, 22 herb species, 40 grass species, and six climber species, with Leguminosae accounting for the highest number (24%), followed by Gramineae (19%), have been recorded. The details of the food plants available for gaur in SDTR are provided in Table 4.2.

Table 4.2: food plant available in Sanjay Tiger Reserve (SDTR Departmental Records)

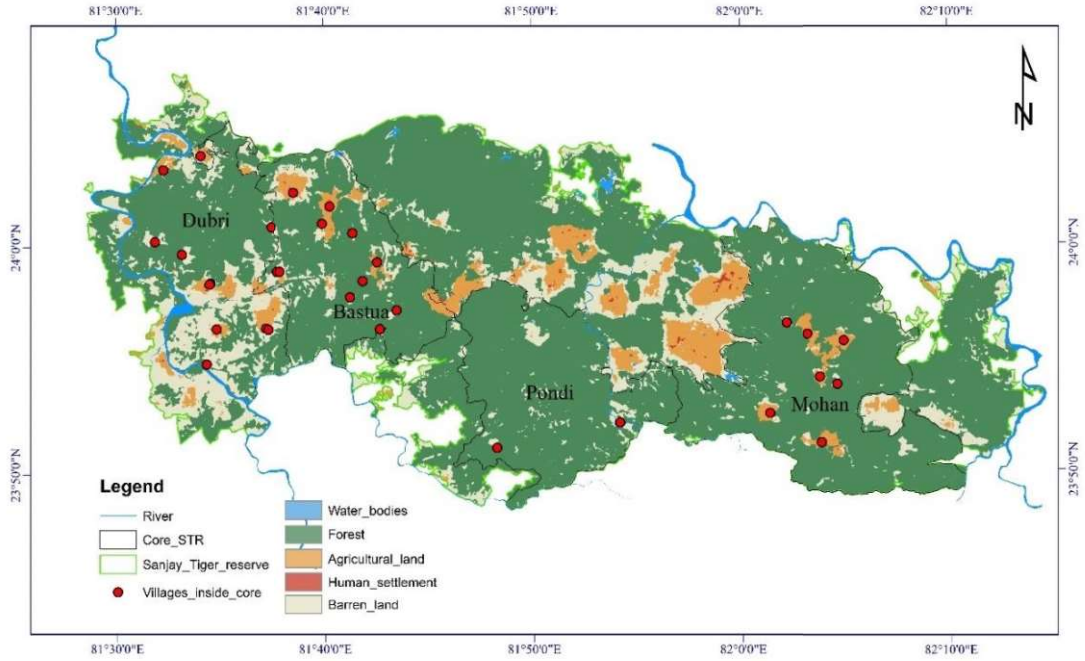
Sr no.	Plant Species	Family
	Trees	
1	*Anogeissus latifolia*	Combretaceae
2	*Buchanania lanzan*	Anacardiaceae
3	*Terminalia tomentosa*	Combretaceae
4	*Zizyphus xylopyra*	Rhamnaceae
5	*Acacia catechu*	Fabaceae
6	*Acacia leucophloea*	Mimosaceae
7	*Adina cordifolia*	Rubiaceae
8	*Aegle marmelos*	Rutaceae
9	*Albizzia odoratissima*	Fabaceae
10	*Albizzia procera*	Fabaceae
11	*Bauhinia variegate*	Fabaceae
12	*Bauhinia recemosa*	Fabaceae
13	*Bombax ceiba*	Malvaceae
14	*Boswellia serrata*	Burseraceae
15	*Bridelia hamiltoniana*	Phyllanthaceae
16	*Bridelia retusa*	Euphorbiaceae
17	*Buchanania lanzan*	Anacardiaceae
18	*Butea monosperma*	Fabaceae
19	*Careya arborea*	Lecythidaceae
20	*Cassia fistula*	Fabaceae
21	*Chloroxylon swietenia*	Meliaceae
22	*Dalbergia sissoo*	Fabaceae
23	*Dalbergia paniculata*	Fabaceae
24	*Diospyros melanoxylon*	Ebenaceae
25	*Emblica officinalis*	Phyllanthaceae
26	*Ficus benghalensis*	Moraceae
27	*Ficus religiosa*	Moraceae
28	*Flacourtia indica*	Bixaceae

Sr no.	Plant Species	Family
29	*Ficus rumphii*	Moraceae
30	*Helicteris isora*	Malvaceae
31	*Lagerstroemia parviflora*	Lythraceae
32	*Lannea grandis*	Anacardiaceae
33	*Madhuca indica*	Sapotaceae
34	*Mangifera indica*	Anacardiaceae
35	*Mitragyna parviflora*	Rubiaceae
36	*Miliusa tomentosa*	Annonaceae
37	*Pterocarpus marsupium*	Fabaceae
38	*Phyllanthus emblica*	Euphorbiaceae
39	*Saccopetalum tomentosum*	Annonaceae
40	*Schleichera oleosa*	Sapindaceae
41	*Semecarpus anacardium*	Anacardiaceae
42	*Soymida febrifuga*	Meliaceae
43	*Sterculia urens*	Malvaceae
44	*Syzygium cumini*	Myrtaceae
45	*Shorea robusta*	Dipterocarpaceae
46	*Tamarindus indica*	Fabaceae
47	*Tectona grandis*	Lamiaceae
48	*Terminalia arjuna*	Combretaceae
49	*Terminalia bellirica*	Combretaceae
50	*Terminalia chebula*	Combretaceae
51	*Terminalia elleptica*	Combretaceae
52	*Terminalia tomentosa*	Combretaceae
53	*Wrightia tinctora*	Apocynaceae
54	*Xylia xylocarpa*	Fabaceae
	Shrubs	
1	*Asparagus racemosus*	Asparagaceae
2	*Euphorbia tirucalli*	Euphorbiaceae
3	*Grewia sps*	Malvaceae
4	*Grewia hirsuta*	Malvaceae
5	*Helicteres isora*	Malvaceae
6	*Holarrhena antidysentrica*	Apocynaceae
7	*Ixora parviflora*	Rubiaceae
8	*Ipomoea carnea*	Convolvulaceae
9	*Lantana camara*	Verbenceae
10	*Ocimum tenuiflorum*	Lamiaceae
11	*Phoenix acaulis*	Arecaceae
12	*Sida acuta*	Malvaceae
13	*Urginea indica*	Asparagaceae
14	*Woodfordia fruticosa*	Lythraceae
15	*Wrightia tinttoria*	Apocynaceae
16	*Zizyphus oenobila*	Rhamnaceae
17	*Zizyphus mauritiana*	Rhamnaceae
	Herbs	
1	*Acacia pinnata*	Fabaceae
2	*Achyranthus aspera*	Amaranthaceae
3	*Alternanthera sessile*	Amaranthaceae
4	*Bulbostylis barbata*	Syperaceae
5	*Calycopteris floribunda*	Combretaceae
6	*Cassia tora*	Fabaceae
7	*Cleome Viscosa*	Cleomaceae
8	*Crotolaria albida*	Fabaceae
9	*Desmodium pulchelium*	Fabaceae
10	*Desmodium triflorum*	Fabaceae
11	*Elephantopus scaber*	Asteraceae
12	*Eranthemum purpureseens*	Acanthaceae
13	*Euphorbia hirta*	Euphorbiaceae

Sr no.	Plant Species	Family
14	*Hemidesmum indicus*	Apocynaceae
15	*Hygrophila Auriculata*	Acanthaceae
16	*Hyptis sauvelens*	Lamiaceae
17	*Justicia quinquangularis*	Acanthaceae
18	*Leucas aspera*	Lamiaceae
19	*Leucas biflora*	Lamiaceae
20	*Tridax Procumbens*	Asteraceae
21	*Vernonia cinera*	Asteraceae
22	*Cicer arietinum*	Fabaceae
	Grasses	
1	*Andropogon pumillus*	Poaceae
2	*Arundinellia pumilla*	Poaceae
3	*Bothriochloa spp.*	Poaceae
4	*Dendrocalamus strictus*	Poaceae
5	*Apluda varia*	Poaceae
6	*Aristida setacea*	Poaceae
7	*Thysanolaena maxima*	Poaceae
9	*Chloris dolicosticus*	Poaceae
10	*Chrysopogon montanus*	Gramineae
11	*Cynodon dactylon*	Poaceae
12	*Dactylectum agepticum*	Poaceae
13	*Dicanthium annulatum*	Poaceae
14	*Dicanthium aristatum*	Poaceae
15	*Digitaria setigera*	Poaceae
16	*Digiteria villosa*	Poaceae
17	*Echinochloa colonum*	Poaceae
18	*Elusine indica*	Poaceae
19	*Eragrostis tenella*	Poaceae
20	*Eragrostis intermedia*	Poaceae
21	*Eragrostis paniculatus*	Poaceae
22	*Heteropogon contortus*	Poaceae
23	*Imperata cylendrica*	Poaceae
24	*Oplismenus burmanii*	Poaceae
25	*Pasphalum flevidum*	Poaceae
26	*Pennisetum spp.*	Poaceae
27	*Saccharum spontaneum*	Poaceae
28	*Saccharum bengalense*	Poaceae
29	*Setaria intermedia*	Poaceae
30	*Setaria pumila*	Poaceae
31	*Sorghum controversum*	Poaceae
32	*Themeda triandra*	Poaceae
33	*Veteveria zizinoides*	Poaceae
34	*Rottbolia cochinchinensis*	Poaceae
35	*Themeda quadrivalvis*	Poaceae
36	*Thysanolaena maxima*	Poaceae
37	*Zea Maize*	Poaceae
38	*Urochloa ramose*	Poaceae
39	*Triticum aestivum*	Poaceae
40	*Saccharum officinarum*	Poaceae
	Climbers	
1	*Butea superb*	Fabaceae
2	*Bauhinia Vahilii*	Fabaceae
3	*Calycopteris floribunda*	Combretaceae
4	*Ziziphus oenoplia*	Rhamnaceae
5	*Hemidesmus indicus*	Asclepiadaceae
6	*Millettia extensa*	Leguminosae

4.4 Human settlements

There are 39 villages within the SDTR, each with a sizable population, having ~1500 households in and around the reserve. Considerable populations rely on natural resources for their livelihood, including fuelwood, agricultural equipment, food security, and minor forest produce.



Map 4.3: Human Settlement in SDTR.

The forest department has made considerable efforts towards village relocation thereby reducing anthropogenic pressure to consolidate habitats to support the herbivore population for carnivore conservation. Relocation of families from Trichuli and Domarpath villages has shown positive outcomes with the consolidation of areas and suitable habitats for herbivore use. The park management has implemented various protective measures to reclaim the vacated village areas through grassland management, wetland management, invasive management, livestock immunisation, and awareness programmes.

4.5 Possible Threats

Though various proactive measures such as habitat management, controlling invasive species, village relocation and running community awareness programs are being carried out in SDTR, the presence of 39 villages with more than ~1500 households (that are directly or indirectly dependent on the natural resources for their livelihood) and the livestock therein pose a challenge. Livestock ingress can lead to competition for scarce resources especially during dry months besides posing threats of disease spillover between populations. Forest fires, often exacerbated by human activities and climate conditions can threaten the habitat. Invasive plant ingress in certain pockets can complicate habitat by altering the ecosystem and outcompeting native flora and reduce the natural habitat for wild animals and need addressal in the long run.

5. Reintroduction Planning

The process of reintroducing gaur into the Sanjay Tiger Reserve was meticulously planned and executed in three distinct phases, namely, 1) Pre-Translocation Phase/ Preparatory Phase, 2) Translocation Phase and 3) Post-Translocation and Monitoring Phase (Table 5.1). These phased approaches were adopted to ensure that the operations were carried out effectively and efficiently. The translocation effort was guided by scientifically based approaches, underscoring the importance of informed decision-making in critical conservation initiatives. The IUCN/SSC (2013), Guidelines for Reintroductions and Other Conservation Translocations and the learnings from previous reintroductions formed basis for these interventions.

Table 5.1: The process of reintroducing gaur into the Sanjay Tiger Reserve

Sr. No.	Pre-translocation Phase	Translocation Phase	Post-Translocation and Monitoring Phase
1	Permission for translocation of gaur	Revisiting the capture & translocation essentials	Post-release monitoring inside the enclosure
2	Procurement of license for import of drugs & equipment	Selection of animals and herds	Release in wild
3	Procurement of radio collars & fabrication of colour-coded bands	Approaching animals & darting	Post-release monitoring i. Animal exploration, movement & ranging pattern ii. Population status iii. Stabilisation of glucocorticoid level (Faecal Cortisol Metabolite Levels.
4	Planning Workshop	Immobilisation	
5	Pre-assessment survey of source and recipient site	Animal Collaring	
6	Site selection and construction of soft-release enclosure	Procedures- i. Assessment of vital parameters ii. Assessment of physiological parameters iii. Animal weighing & moving	

Sr. No.	Pre-translocation Phase	Translocation Phase	Post-Translocation and Monitoring Phase
7	Selection of individual herds/animals for translocation	Biological sample collection & and laboratory investigation	
8	Infrastructure development & resources i. Transportation vehicle/ ramp ii. Stretcher	Loading of animals into transportation truck	
9	Reconnaissance survey of the route	Use of tranquillizers & and reversal drug	
10	Assigning team and task	Transportation consideration	
11	Mock drills & and training	Release of animals into soft-release enclosure at SDTR	
12	Veterinary protocols for capture and translocation		
13	Ensuring Biological sampling		
14	Ensuring Animal collaring and equipment		

5.1 Pre-Translocation Phase/ Preparatory Phase

Translocation and reintroduction are complex operations involving moving animals to new locations and correspond to significant investments, not only in terms of financial resources but also in human and material capital. These interventions are critical for conserving any species and essentially require proper assessments, preparedness, and planning. The success of these operations depends on many factors, including the suitability of the new habitat, the health and adaptability of the species, and the presence of adequate protection measures in the new location.

Given the high stakes and the significant resources involved, it is essential that these operations are reinforced by rigorous, scientifically based planning prior to the translocation. This involves comprehensive research and analysis to assess the feasibility of the translocation, identify potential risks and challenges, and develop strategies to mitigate these risks and ensure the successful adaptation and survival of the animals in their new habitat. The procedures involved in the Pre-Translocation Phase/ Preparatory Phase are provided below.

5.1.1 Permissions for translocation of Gaur

Gaur, a Schedule-I animal under the Wildlife (Protection) Act, 1972 (as amended in 2023), required permission for capture and translocation from the Government of India and the Chief Wildlife Warden, Government of Madhya Pradesh. Necessary permissions were sought prior to field operation and are placed in Annexure 1.

5.1.2 Procurement of licence for import of drugs and equipment

Narcotics are the drug of choice for immobilising wild bovids. The majority of drugs (opioids and neuroleptics) for use in Gaur are not available in India, and their procurement and use required administrative clearances, approval, and license. The Madhya Pradesh Forest Department facilitated the procurement of drugs and necessary approval. These included clearances from the Drug Controller General of India, the Ministry of Agriculture, Government of India (Dept. of Animal Husbandry and Dairying) and the Narcotic Commissioner, Ministry of Finance, Government of India (Central Bureau of Narcotics).

5.1.3 Procurement of radio collars and fabrication of colour-coded neck bands

The project proposal outlined a comprehensive plan for deploying GPS/VHF radio collars on the animals to facilitate post-release monitoring. This was facilitated by Iridium/GPS VERTEX Plus collars, Vectronics, Germany (GPS vertex 4D with iridium option, temperature sensor, activity sensor (32 Hz), mortality sensor and VHF Option) and VHF

radio collars Telonics, USA (MOD-515-3 VHF option and MS6A Mortality sensor) for which the procurement was carried out beforehand. These were designed to provide accurate location data and enable effective tracking of the animals' movements. Prior to the collaring process, the team ensured that all necessary equipment was in optimal condition and tested and primed before deployment. This meticulous preparation was crucial in ensuring the smooth execution of the collaring process and minimising potential risks to the animals.

In addition to the GPS/VHF Radio-collars, unique colour-coded neck bands were locally fabricated and used for individual identification of reintroduced animals for the initial period.

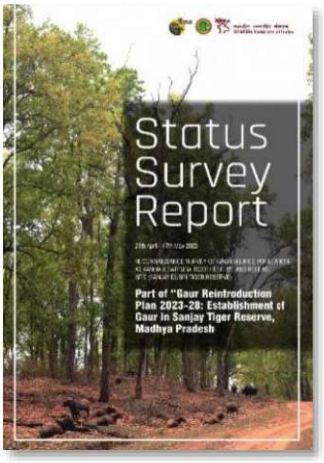
5.1.4 Planning Workshop

An inception-cum-planning workshop was organised at Kanha Tiger Reserve on 26th April 2024 to deliberate on the action plan for gaur reintroduction. A total of 31 officials, including Park Officials and Veterinary officers from KTR, STR, Bandhavgarh TR, Pench TR and SDTR, besides faculty from the School of Wildlife Forensic & Health, Jabalpur, and capture experts from Wildlife and Forestry Services, Ujjain, participated in the workshop. Various aspects of animal capture, translocation, critical considerations during field operation, learnings from Bandhavgarh Tiger Reserve, and monitoring essentials were discussed. Various activities required in the field capture and translocation operation were discussed in detail, and the action plan was finalised.

5.1.5 Pre-Assessment Survey of Source and Recipient Site

The pre-assessment survey included studying the population structure of the existing gaur population at the source site (KTR and STR) and the health assessment of individuals and herds destined for field capture planned during June 2023.

The health assessments were carried out at KTR and STR between 29th April - 6th May 2023 and 7th to 11th May 2023, respectively. The laboratory investigations of the non-invasive biological samples collected during the survey were carried out at the School for Wildlife Forensic & Health (SWFH), Nanaji Deshmukh Veterinary Science University, Jabalpur.



The assessment at SDTR (recipient site) aimed to assess the suitability of the release site and the availability of food plants suitable for gaur water. The survey was conducted from 12 to 17 May 2023.

A team comprising researchers from WII and field staff of respective reserves, officials, and veterinary officers conducted the entire field survey. The status survey report was prepared and formed the basis for field operation (WII-MPFD-SWFH, 2023).

A summary of the assessment is provided below-

Summary of pre-assessment surveys (WII-MPFD-SWFH, 2023)

Kanha Tiger Reserve (KTR): Situated amidst the diverse landscape of Madhya Pradesh, KTR boasts a rich habitat comprising flat hilltops, grasslands, dense forests, and riverine ecosystems across its core, buffer, and microsatellite core zones. In addition to supporting a good tiger population, KTR harbours a substantial gaur population estimated at 2746 individuals (Jhala et al., 2020).

The assessment in KTR involved an eight-day field survey conducted in April-May 2023, revealing the presence of five gaur herds distributed across four ranges. These herds exhibited varied group sizes, ranging from 2 to 31 individuals, with diverse age and sex compositions. Notably, the gaur population displayed a healthy body condition as indicated by overall body condition scores. Laboratory investigations revealed no significant parasitic load and were negative for select pathogens (WII-MPFD-SWFH, 2023). The report also highlighted the approachability of identified herds in KTR for facilitating captures. It advocated intensive monitoring with captive elephants for closer observation and potential darting. Based on criteria such as herd size, body condition score, laboratory findings and proximity to exit gates for ease of transportation, the report outlined prioritised herds for potential translocation The assessment furnished critical insights into the gaur population in KTR, setting the stage for potential translocation efforts.

Satpura Tiger Reserve (STR): The park is situated within the Satpura range and is home to and array of flora and fauna. Characterized by deep valleys, narrow gorges, dense forests, and a reservoir. STR, with an area of 2133 Km^2, includes 1339.26 Km^2 core and 794.04 Km^2 buffer zones and encompasses catchment areas of major rivers like Denwa, Nagdwari, and Tawa. Hosting a significant gaur population estimated at 6323 individuals (Jhala et al., 2020), STR serves as a vital habitat for this species.

A five-day field survey was carried out during May 2023. Five gaur herds across the Churna and Bori ranges of STR, displaying varying group sizes and demographic composition, were identified. The assessment revealed a healthy gaur population in STR, as indicated by overall body condition scores. Laboratory investigations further corroborated the good health and did not reveal any significant parasitic load and were negative for select pathogens (WII-MPFD-SWFH, 2023).

While most herds were approachable without discomfort or stress, one herd exhibited shyness towards vehicular and human presence, highlighting the need for regular monitoring and habituation with elephants. Like KTR, the report prioritised certain herds in STR for potential translocation initiatives, considering parameters like herd size and proximity to exit gates for efficient transportation. Overall, the assessment in STR furnished valuable insights into the gaur population, laying the groundwork for conservation strategies and potential translocation endeavours to ensure the species' long-term survival within the reserve.

Sanjay-Dubri Tiger Reserve (SDTR):

The assessment focused on SDTR's suitability as a release site for gaurs. In Madhya Pradesh's Sidhi district, SDTR encompasses Sanjay National Park and Dubri Wildlife Sanctuary within its 1674.51 km² area. The reserve features plains and gently undulating terrain, serving as the catchment for various rivers.

Based on the gaur habitat suitability (Nigam et al., 2022), a site for constructing soft release enclosure was selected by a five-member committee comprising Sh. Hariom, Dr. Abhay Senger, Sh. Nikunj Pandey, Ms. Kavita Rawat, and Ms. Sangeeta Kewat. The following criteria formed the basis for the selection of a site for constructing the soft-release enclosure.

a) Availability of a sufficient number of palatable grasses.
b) No or minimal impact of livestock, as the village is located quite far from the area.
c) The designated area is flat, with an abundant availability of food plants and water.
d) The designated area's flat nature facilitates long-term animal monitoring after release.
e) Availability of a monitoring camp in the area and good road connectivity.

A two-day habitat assessment survey was conducted in May 2023 at the enclosure site within Pondi range's Domarpath beat. The survey evaluated road connectivity from the highway to the enclosure and assessed available resources such as food and water within the enclosure. Results indicated good road connectivity to the enclosure site, facilitating animal transport. The habitat assessment identified 31 plant species within the enclosure, including trees, shrubs, and grasses. Notably, species like Dendrocalamus strictus and Chrysopogon fulvus were found abundantly, providing suitable forage for gaurs throughout the year.

Overall, the assessment suggested that SDTR provides adequate continuous forest with suitable resources for gaurs, highlighting the importance of completing enclosure preparations and implementing protective measures to facilitate successful gaur release in the reserve (WII-MPFD-SWFH, 2023).

5.1.6 Site selection and construction of soft-release enclosures at SDTR

Based on the landscape level habitat suitability analysis for gaur, the two ranges of SDTR, namely Pondi and Mohan, were found to be highly suitable for gaur. A site located in Domarpat, at the beat of Pondi range, with good vegetation, cover, and water, was selected by a team of SDTR officials. A 30-hectare enclosure with a predator-proof power fence was built for temporary holding of the gaur (figure 5.1). A 2-hectare enclosure was additionally constructed inside the bigger 30-hectare enclosure for holding animals for the initial period to support close monitoring. This enclosure also served as a transitional space where the gaur could adjust behaviourally and acclimatize to the new environment. Subsequently, the animals were released in the bigger 30-hectare enclosure This larger space continued to offer opportunities for intensive monitoring while providing a more expansive area for the gaur to adapt further. Here, the animals could continue their behavioral adjustments and develop natural social structures in a controlled but more natural setting. It also facilitated the development of cohesiveness and herd formation, provided protection from immediate predation, and allowed the animals to recover from the effects of tranquilizers and potential homing instincts.

An off-loading ramp was prepared for easy off-loading of the animals from the trucks. A small 2-hectare plot, also power-fenced, was built inside the larger enclosure to hold the animals during the initial days (2-4 days) for closer observations.

Based on the habitat assessment carried out by the SDTR field team, 31 species were identified within the enclosure, including 15 trees, 5 Shrubs, and 11 species of grasses (Table 5.2). *Dendrocalamus strictus* and *Chrysopogon fulvus* were highly abundant species in the enclosure. All the shrubs and grass species were identified as palatable for the gaur during summer and winter.

Table 5.2 Floral diversity inside the enclosure.

Sr. No.	Tree	Shrub	Grasses
1	*Anogeissus latifolia*	*Helicteres isora*	*Dendrocalamus strictus*
2	*Shorea robusta*	*Grewia hirsuta*	*Heteropogon contortus*
3	*Madhuca longifolia*	*Ziziphus nummularia*	*Chrysopogon fulvus*
4	*Diospyrus melanoxylon*	*Grewia rothii*	*Themeda triandra*
5	*Lagerstremia parviflora*	*Nyctanthes arbortristis*	*Sorghum halepense*
6	*Terminaloia tomentosa*		*Dichanthim annulatum*
7	*Pterocarpus marsupium*		*Cynodon dactylon*
8	*Acacia catechu*		*Apluda mutica*
9	*Buchanania cochinchinensis*		*Eragrostis tenella*
10	*Haldina cordifolia*		*Eragrostis minor*
11	*Semecarpus anacardium*		*Eragrostis uniolodies*
12	*Terminalia arjuna*		
13	*Ziziphus xylopyrus*		
14	*Cassia fistula*		
15	*Phyllanthus emblica*		

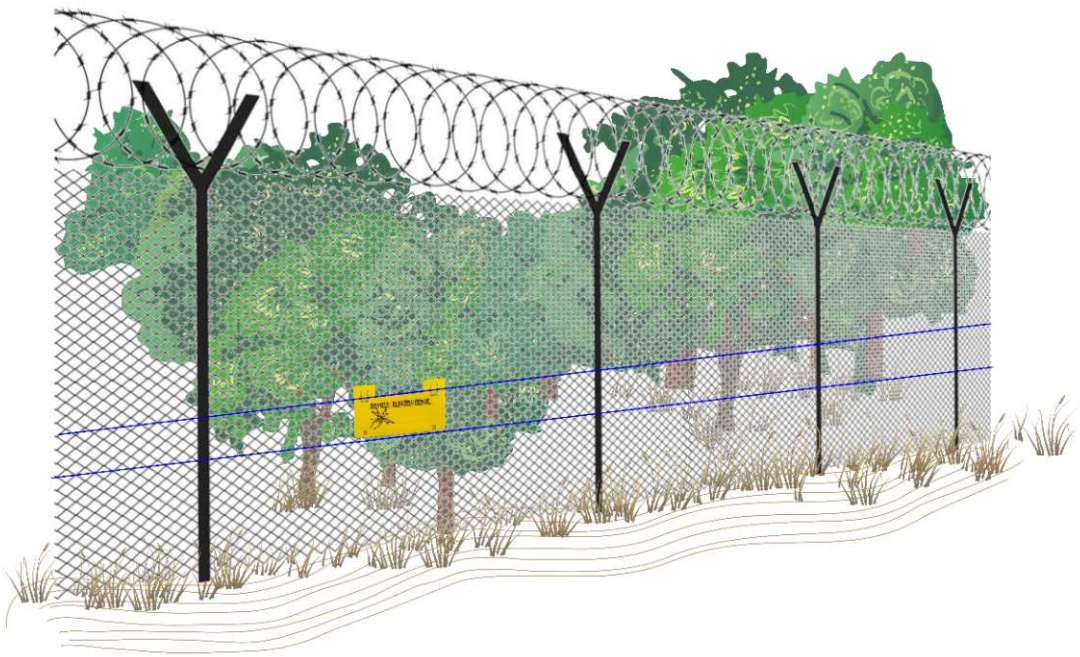


Figure 5.1: Schematic diagram of fences along the enclosure

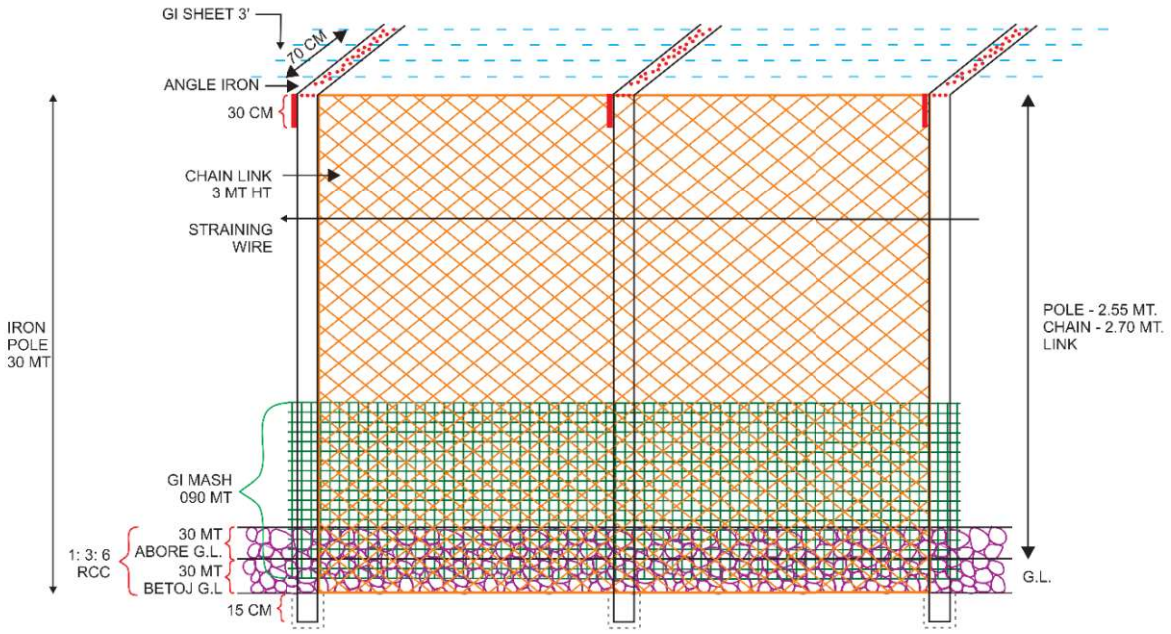
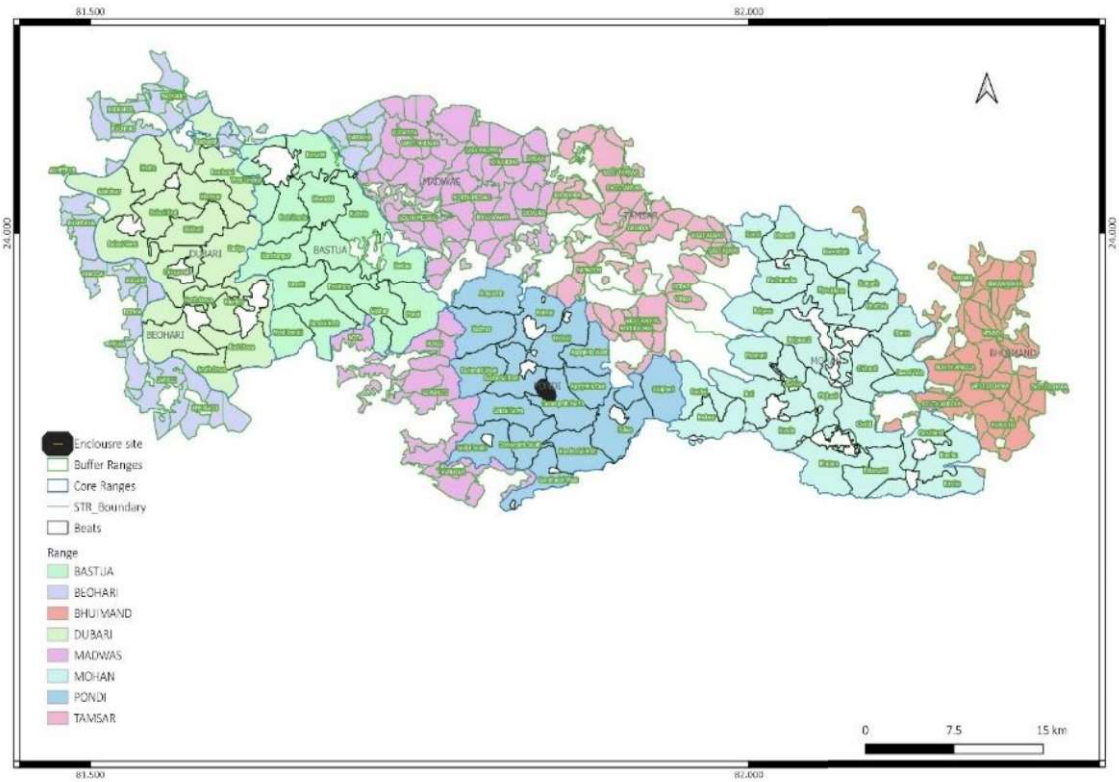
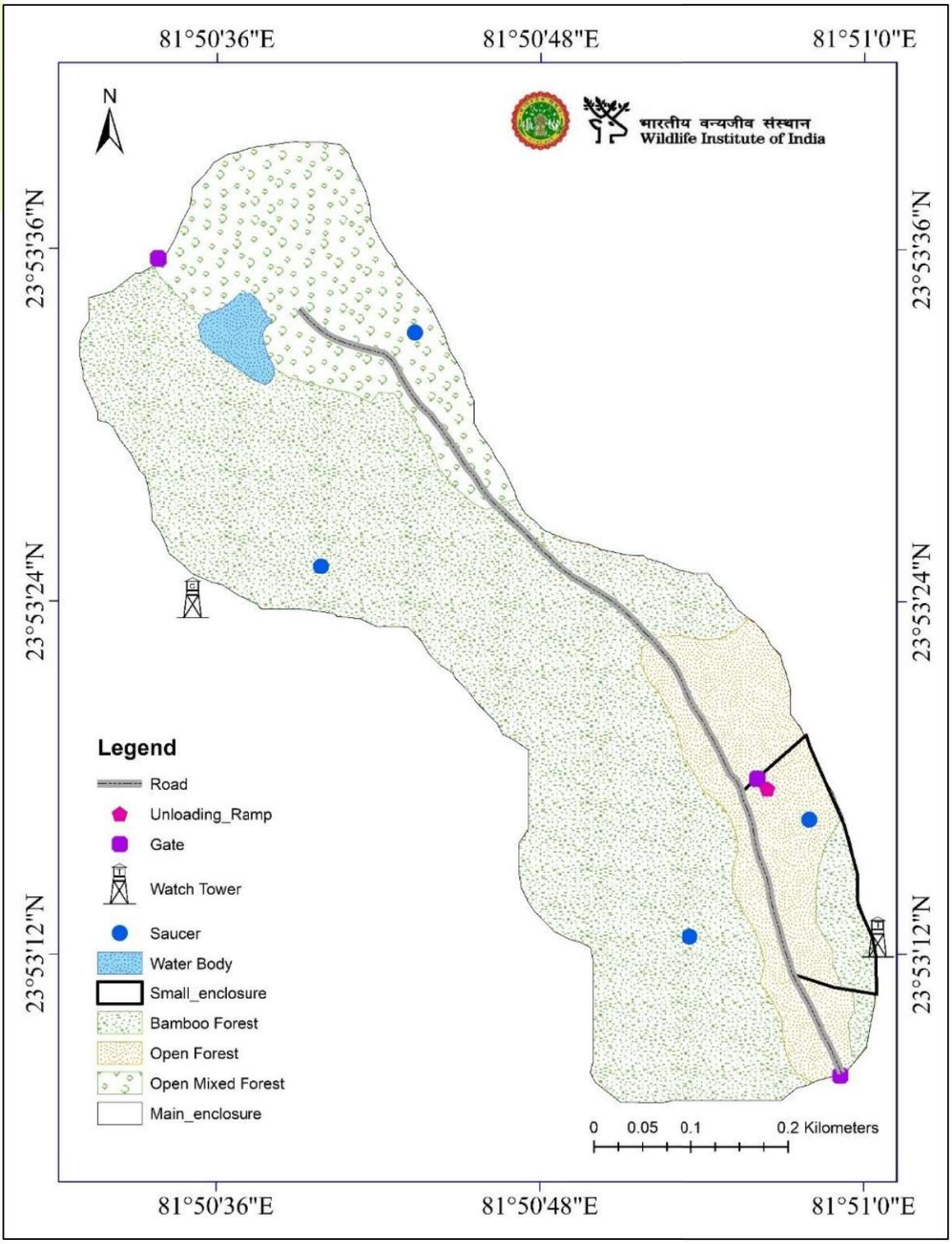


Figure 5.2: Schematic diagram of fencing constructed in SDTR enclosure (Shukla et al., 2015)



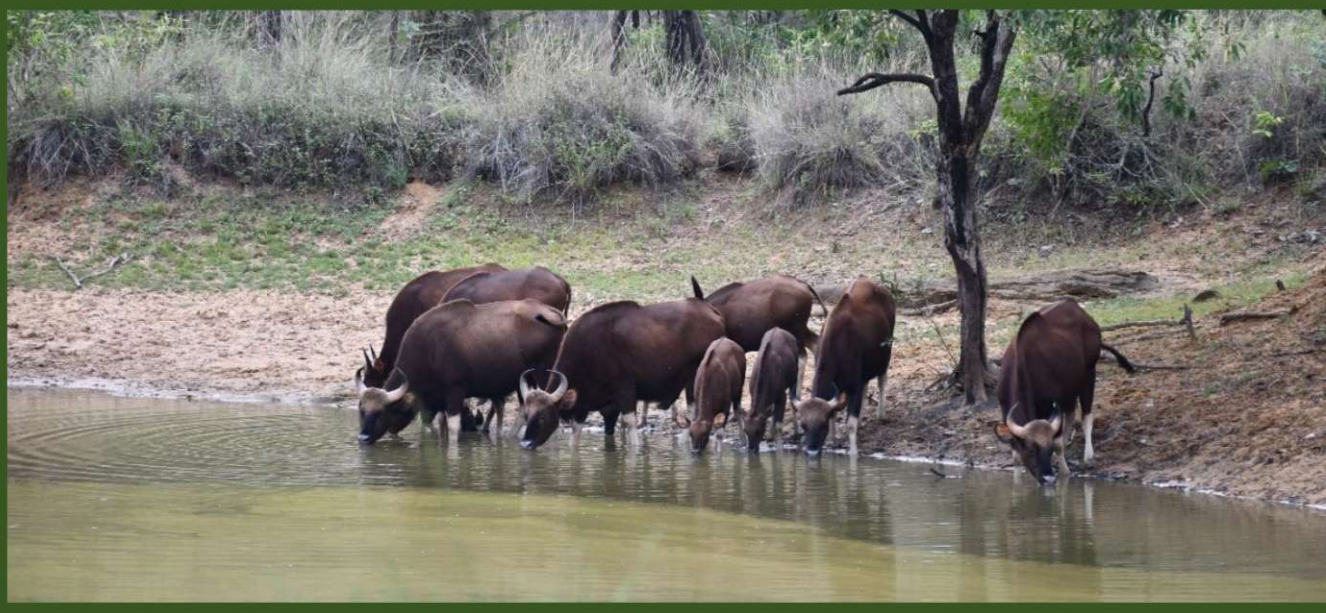
Map 5.1: Map Showing the location of the enclosure site in the Pondi range of Sanjay Dubri Tiger Reserve



Map 5.2: Enclosure design at release site in the Pondi range of Sanjay-Dubri Tiger Reserve

5.1.7 Selection of herd/individual(s) for translocation

During the survey, the herd composition and size, age classes within the herd and physiological status (lactating, young ones to defend) were recorded and formed basis for selecting individuals destined for reintroduction.



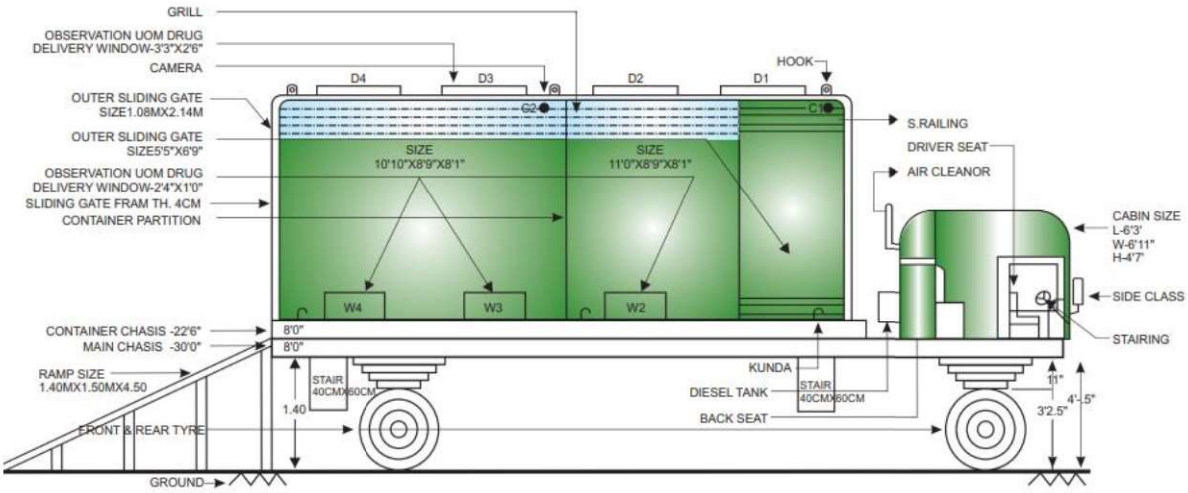
5.1.8 Infrastructure Development and Resources

(i) Transportation vehicle/ramp

Transport trucks were already available in Kanha and Bandhavgarh, and they were requisitioned to transport the animals. The vehicles were prepared for roadworthiness. Inspection of the vehicle was aimed at ensuring proper non-slippery flooring (bolted and well-secured rubberised mats), smooth surfaces (to avoid any possible injury to animals during travel), cooling systems (sprinklers), animal monitoring systems (CCTV cameras), adequate ventilation, communication facilities (VHF radio sets) and adequate option for visual and physical access to the animal. The option of keeping a backup vehicle to meet any emergency requirement was also provided. A support vehicle (TATA 407 with provisions of open side flaps) was also provisioned for carrying immobilised animals from the site of capture to the road head.

Vehicle dimensions (Pabla et al., 2011) (figure 5.3):

- Standard container length of ± 6.7 m.
- Roof of the container: minimum of 2.2 m internal height.
- Two external doors, one on the right rear side and one on the front right side of the front compartment.
- Doors 1.2 m wide suspended from 2.4 m rail with rubber stoppers to prevent over-opening or over-closing. Each door is provided with U U-shaped locking mechanism.
- Each door is suspended by two 500 kg (minimum) rollers.
- The bottom of each door runs behind a 6 mm steel flat bar.
- 'D' rubber attached below each door extending beyond the opening.
- 4 hatches are provided in the centre of the roof, 75 cm wide.
- Hatches raised and made waterproof.
- Latches to lock the hatches open.
- 1 adjustable partition with a sliding door in each compartment.
- Centre compartment sliding door operated from outside.
- All sliding doors are standard at 1.2 m wide and made of solid steel.
- Four side hatches 30 cm x 70 cm on both sides just above the base of the wall, except for the front right compartment, only one hatch to facilitate the opening of the sliding door.
- Lower container wall with 4 mm to allow free flow of urine.
- Floor checkered solid steel plate with 100 sq. cm grids made of round iron bars.
- Outside of the roof, a painted white and anti-skid surface (sprinkle sand on wet paint) was applied.
- Roof tapered by 5 cm from raised centre to side walls.
- 50 mm hollow tube welded between verticals to form a ladder to climb onto the roof.
- 75 cm mechanical louvres along both sides



RIGHT SIDE VIEW

Figure 5.3: Schematic diagram of transportation truck (Shukla et al., 2015)

(ii) Stretcher

A stretcher for lifting, weighing and loading immobilised animals into a transport vehicle is a critical component of the capture operation.

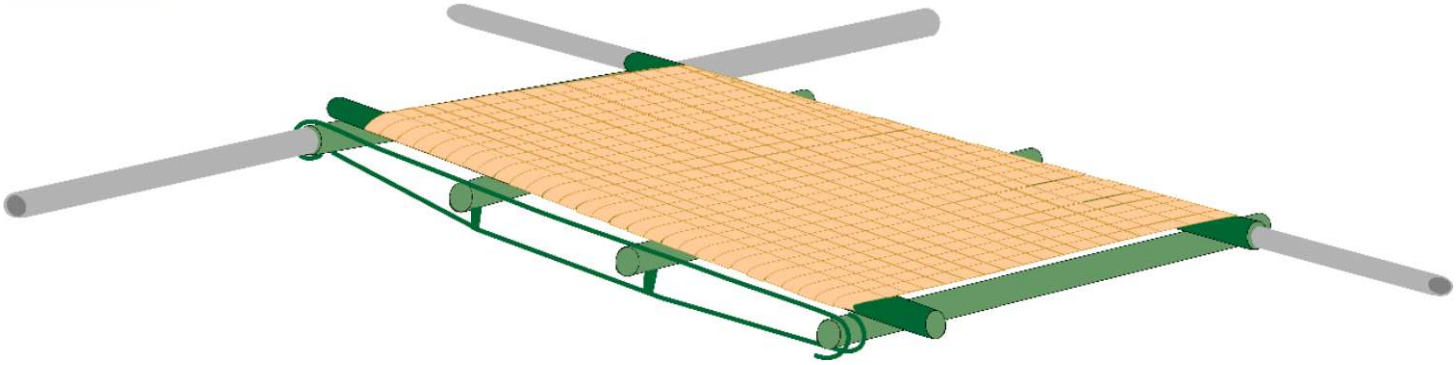


Figure 5.4: Schematic diagram of Stretcher

Stretcher Dimensions (Pabla et al., 2011) (figure 5.4)

- The outside width of the stretcher is not more than 110 cm.
- A diameter pipe 3 cm as a holding rail along the entire length on both sides.
- Four 4 cm hollow pipe cross members, equally spaced.
- Six 3 cm extensions to fit into the 4 cm cross members, 3 m in length.
- 90 cm wide double canvas covers for the full length of the internal 90 cm wide poles.
- This canvas has eyeholes along the full length on both undersides to allow stitching of canvas.
- Runners of 4 cm diameter pipe welded underneath the 90 cm bearers on 10 cm supports.
- Two stretcher rails made of 5 cm channel iron, 90 cm centres braced at 1 m from each end, designed to fit into the door slots under the door's lower rail.
- Length of the stretcher: 2 m.

5.1.9 Reconnaissance survey of the route

A dry run of the transport truck was carried out between the source (KTR and STR) to the release site (SDTR) to assess the time for the road journey, road conditions, suitability of the vehicle and halting points during the journey and to optimise the vehicular speed. The reconnaissance run was done under the supervision of identified field officers. The journey was planned to commence in the late evening to avoid human and vehicular disturbance and reach the release site early morning. However, for animals captured during morning hours, it was planned to commence the journey soon, taking due care of managing any emergencies if may arise. Proper arrangements for cooling animals, providing food and water during the journey, road clearances were critical during the day journey.

The distance between Kanha and SDTR was approximately 400 km, and it took an average of 12-14 hours to cover. In contrast, the distance between STR and SDTR was approximately 700 km, and required around 22 to 24 hours to cover it. The route maps are provided in **Annexure 2.**

5.1.10 Assigning team and tasks

The success of any capture operation depends on a team effort, with each member of the team having a pre-designated responsibility and role. Details of various teams responsible for carrying out different activities is outlined below-

(i) Team leader: Field Director, KTR and STR were designated as the team leaders and were responsible for the overall field operation at respective sites.

(ii)Tracking team: The team included trained koonkies (elephants) and well-trained mahouts, trained trackers and biologists who knew the area, animal behaviour, skills to locate the herd and hold the animals for effective darting along with necessary skills to locate the animal once darted.

(iii) Darting team: The team comprised of experienced veterinary officers who were responsible for animal darting. As capture required careful identification of animal destined for capture, Park Managers and biologist was also part of the team.

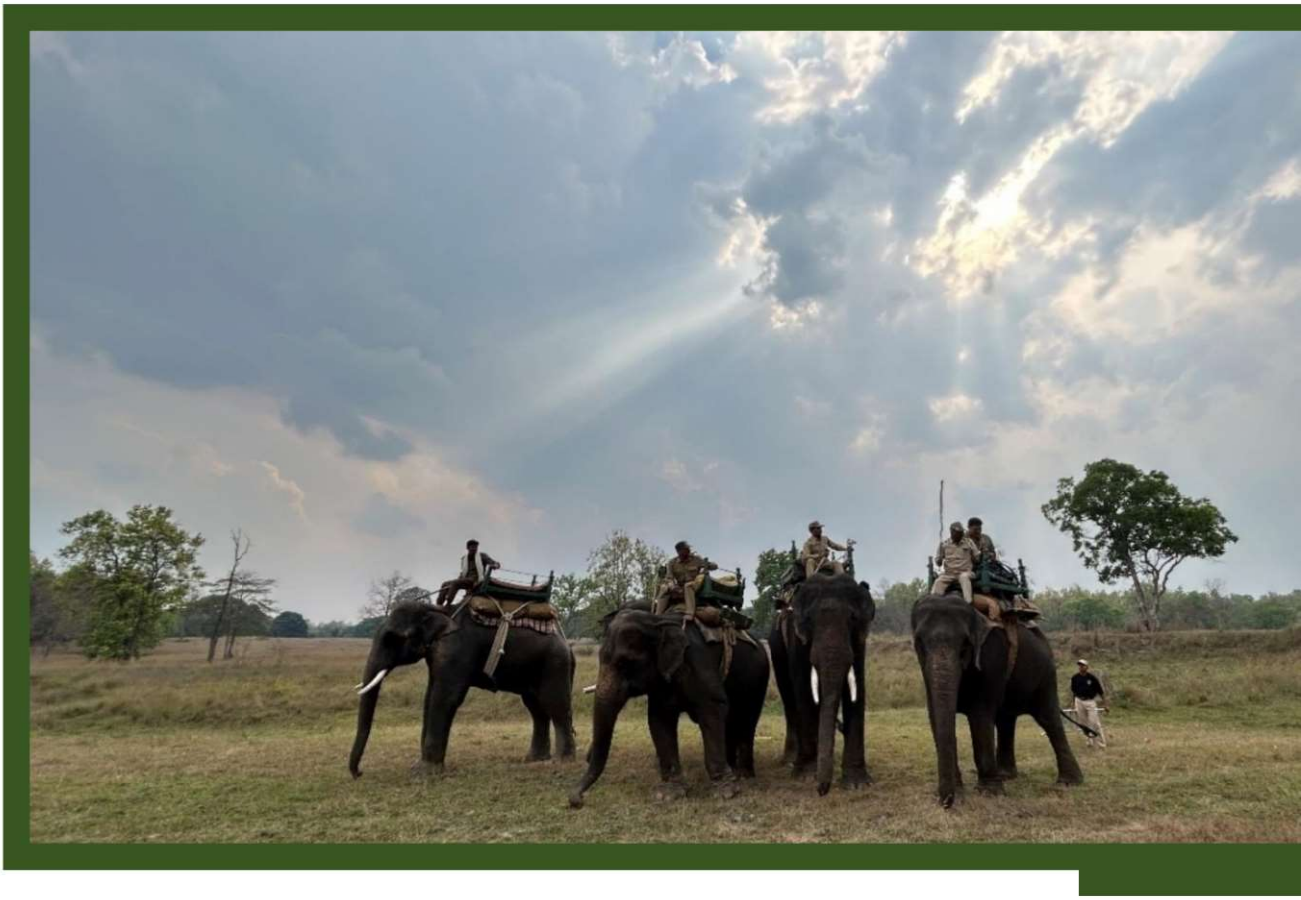
(iv) Veterinary emergency management team: The team comprised of experienced and well-trained veterinary officers whose decisions were important to safeguard the animal's life and personnel associated with the operation.

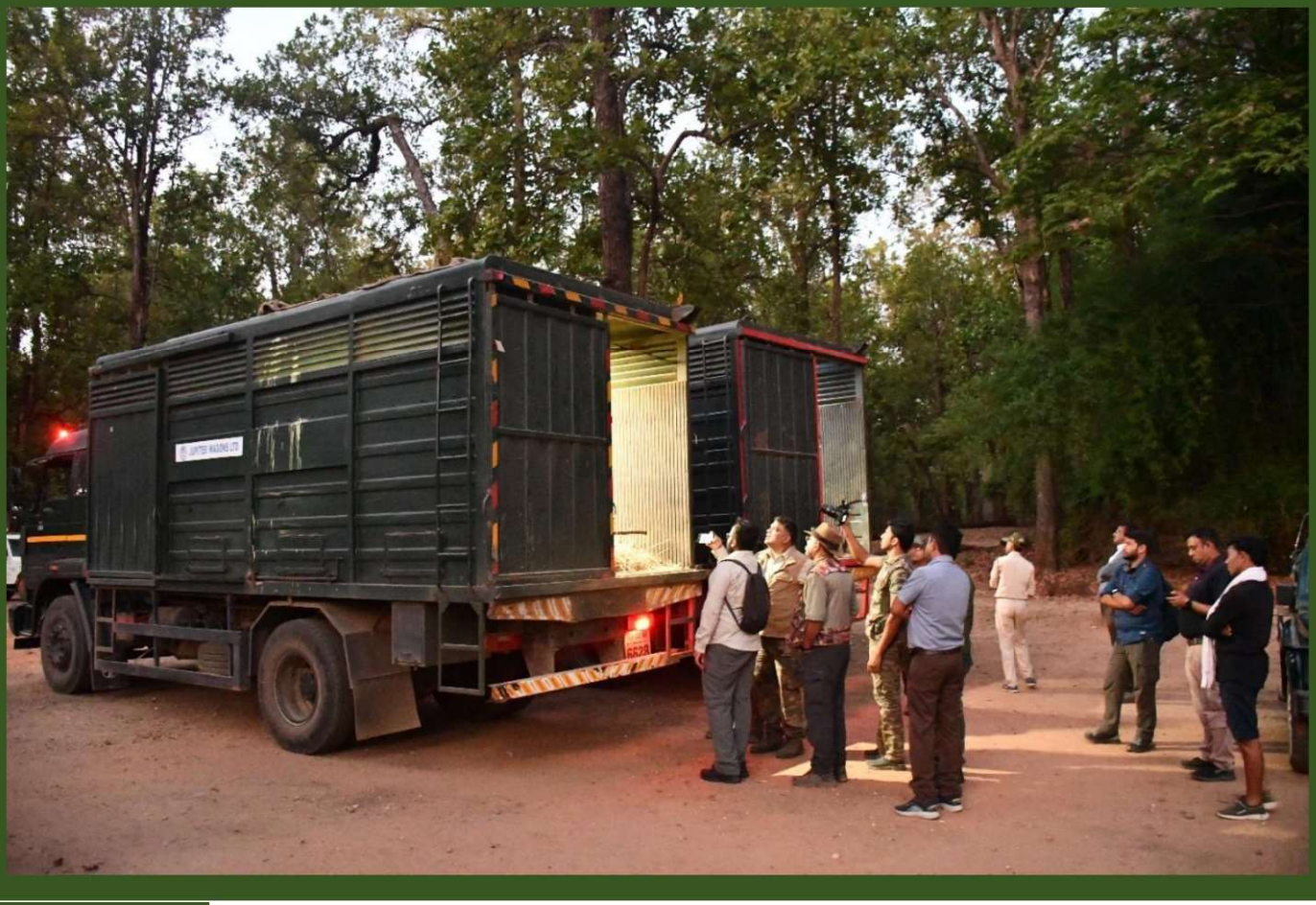
(v) Emergency medical support team (Nursing/ Medical Assistant).

(vi) Animal Loading Team: The team is comprised of experienced range officers and frontline staff who are responsible for animal loading under the supervision of a veterinary officer and expert biologist.

(vii) Transport team: Safe transport of animals is essential to ensure that they are subjected to minimum stress during the journey and reach their destination in good condition. The team included field officers, support staff, and skilled drivers. The overall transportation of animals was coordinated by an identified officer who was also responsible for ensuring vehicle roadworthiness, carrying out prior reconnaissance survey (road map), transporting animals and ensuring offloading at the release site. The role of drivers with experience in moving animals was critical.

(viii) **Animal restraint support team (Mahouts, Field staff):** Capture operations were supported by well-trained field staff, including Range Officers and their frontline staff, and mahouts. They were responsible for various logistic support, such as operational machinery, including loading/unloading and transportation essentials.





5.1.11 Mock drills and trainings

Simulated exercises and training form a crucial component of field operations. Regular mock drills and training sessions were conducted for the field staff, veterinary officers, transportation team, and collaring teams. These exercises were designed to enhance their skills, improve their understanding of the tasks, and prepare them for the scenarios they may encounter during the capture and translocation activities. Teams responsible for executing different aspects of the capture and translocation process were identified well in advance. This proactive approach allowed for sufficient time to expose these teams to the various facets of the field operation and provide them with the necessary training. This comprehensive training program ensured that each team member was well-versed in their respective roles and responsibilities, thereby enhancing the efficiency and effectiveness of the overall operation. These regular mock drills and training sessions not only ensured the smooth execution of the field operations but also contributed to the safety and well-being of both the capture team and the animals involved.

The mock drills and training involved the following:

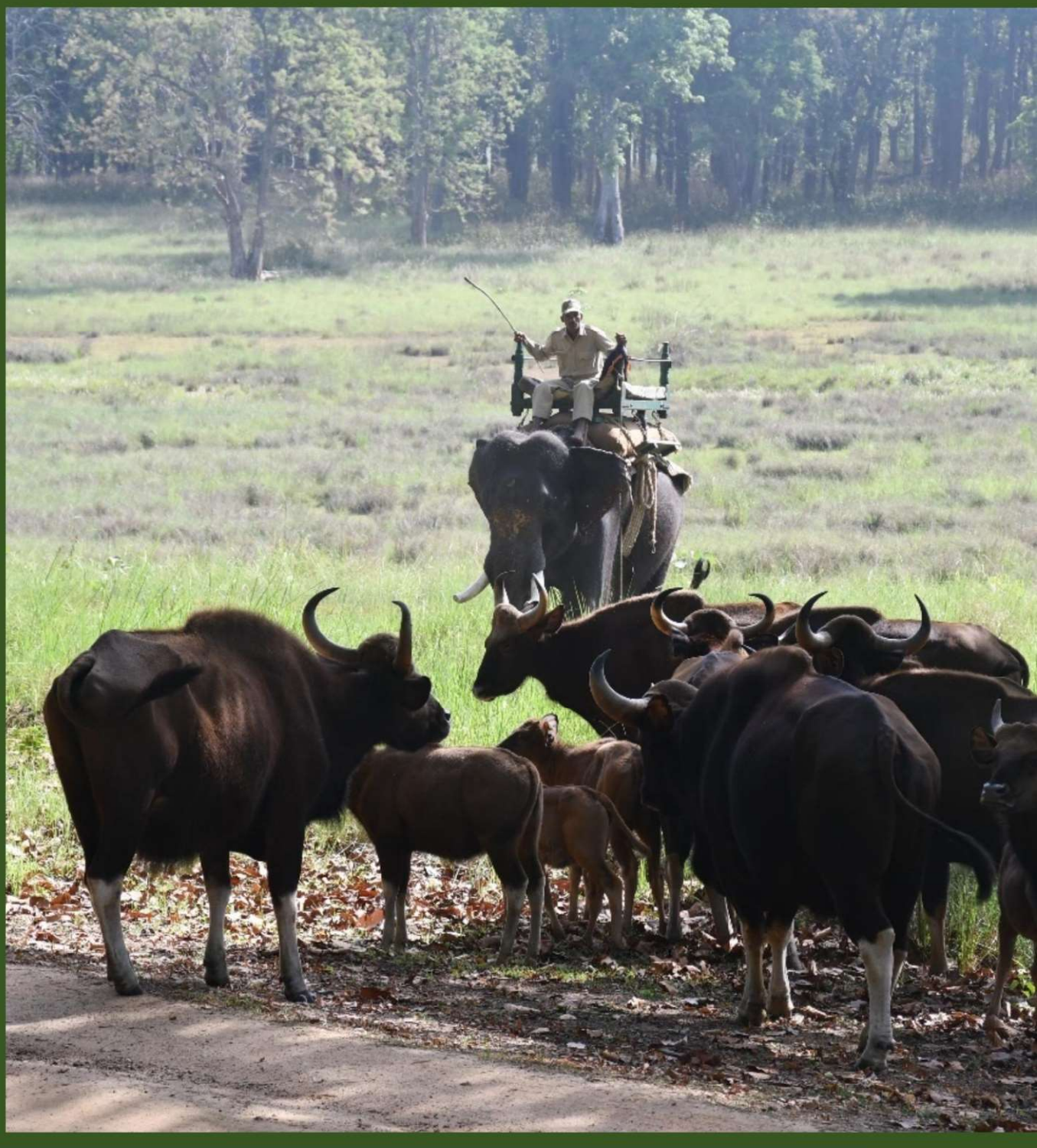
(i) Identification of teams for monitoring animal herds, capture and darting, loading/off-loading of immobilised animals, emergency management, weighing, transport, logistics/support, off-loading at Sanjay TR and post-release monitoring.

(ii) Practice by the darting team to dart from the elephant's back as well as the vehicle at variable distances before the actual operation.

(iii) Briefing of all the teams beforehand by the team leader on emergency procedures, and contingency plans.

(iv) Training to the mahouts for using captive elephants to approach the animal with care/caution and with an overriding degree of patience. Training of elephants for amalgamation with the gaur herd to naturally ease the presence of elephants was also crucial.

(v) Training to field staff and drivers involved in the operation, thereby minimising the likelihood of last-minute issues. The training covered many topics, including safety protocols, operational procedures, and emergency response strategies.



5.1.12 Veterinary protocols for capture and translocation

To ensure safe and effective animal capture and translocation, a detailed action plan was prepared in consultation with field veterinarians, park managers field officials and biologists. The summary of the veterinary protocol is provided in **Annexure 3.**

5.1.13 Biological Sampling

Biological samples were collected for assessing health and disease, for genetic studies besides individual profiling.

Biological sampling essentials

1. Blood in vacutainers (both plain and EDTA) for hematology, serum biochemistry, serology and genetic studies.
2. Dung sample in 10% formalin for assessing parasitic load and diet analysis Hair sample without preservatives for genetic and forensic study
3. Nasal swab for culture.
4. Sample collection kit: Sample collection vials, vacutainers (plain and EDTA), storage/ shipment, boxes, ice packs, tapes, Zip lock bags etc.

5.1.14 Animal collaring

The project envisaged deploying radio collars (satellite/GPS collars and VHF radio collars) onto the animals for post-release monitoring. Out of the 50 reintroduced gaur, 12 animals were fitted with Very High Frequency (VHF) radio collars (Round shaped-Telonics USA), six were fitted with Satellite-GPS collars (Oval shaped- VERTEX GPS Plus collars, Vectronic Aerospace, Germany), and 22 individuals were fitted with color-coded bands (self-fabricated).

Collaring Essentials

Fitting a collar on a gaur requires understanding the animal's neck girth and shape. The neck girth of gaur in adult females ranged from 74 cm - 98 cm, whereas it ranged from 80 cm - 120 cm in adult males/bulls. The collars must be fitted carefully to minimize chances of the collar getting tight or dropping off and entangling with herbage if loose. Seasonal weight fluctuations and increases in neck girth with age need to be considered while fitting collars. In the study by the USGS (Wild Horse & Burro Research, 1991), collars were found to be looser or tighter at different times of the year, though no major behavioural alterations were recorded.

5.2 Translocation Phase

The team assembled at KTR on 25 May 2023 to initiate the field operation. From 25 to 31 May 2023, mock drills were carried out for animal darting, animal lifting on stretchers and moving to transport containers, animal weighing, emergency management, and approach.

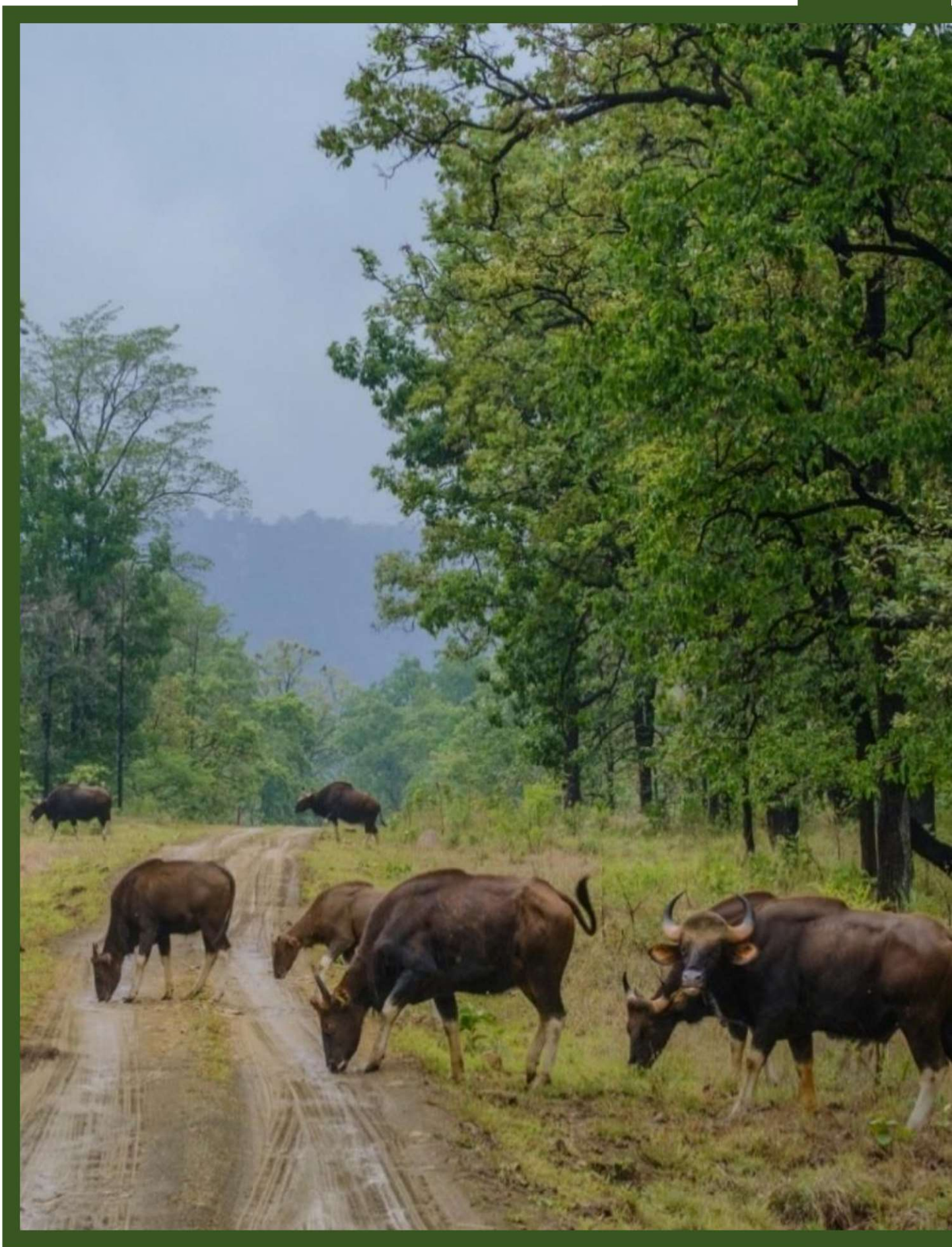
For capture at STR, the team assembled on 23rd June 2023, and similar mock drills were carried out from 23rd June to 25th June 2023. Phase-I of the field operations were carried out between 01st June 2023 to 7th June 2023 at KTR and 26th June 2023 to 30th June 2023 at STR. Phase II of the capture was carried out between 08th to 09th April 2024. The summary of the fieldwork is provided below:

5.2.1 Revisiting the capture and translocation essentials

This included briefing of all related procedures to team members, including park officials, veterinary officers, mahouts and frontline staff; ensuring the health status and fitness of captive elephants; checking the availability of appropriate immobilising drugs and medicaments; checking availability and functionality of the equipment; ensuring road worthiness of vehicle; seeking information on the weather forecast, road condition and logistic support required during transport of animal besides mock drills of all the procedures. The mock drills were conducted between 26th- 30th May 2023 at KTR and 24th-25th June 2023 in STR. As part of Phase II of the field capture operation, the mock drill was conducted from the 7th to the 8th of April 2024 at KTR.

5.2.2 Selection of animals and herds

The herds from both the source sites were selected based on the pre-assessment survey. The patrolling team, led by field officers and supported by mahouts and biologists, selected individuals from identified herds. Upon locating the herd, several factors were considered before initiating the operation. These included understanding the size and composition of the herd, the terrain conditions for darting, and the distance from the road. These considerations were crucial in ensuring the safety and success of the operation. The final selection of the individual gaur for capture was based on the animal's condition, including physiological status, age (based on horn characteristics and body size) and sex, with the action plan forming the basis for selection. As far as possible, the animals were captured from a single herd to maintain the social structure and bonding among the translocated animals.



5.2.3 Approaching animals and darting

Captive elephants were used to approach the animals. Darting was carried out from the elephant's back, and the dart was projected from approximately 25-30 meters, taking due care of proper intramuscular injections. In situations where the animal was in challenging terrain (such as undulating landscape or dense vegetation), the animal was gently guided with the help of captive elephants to more favourable terrain and open areas.

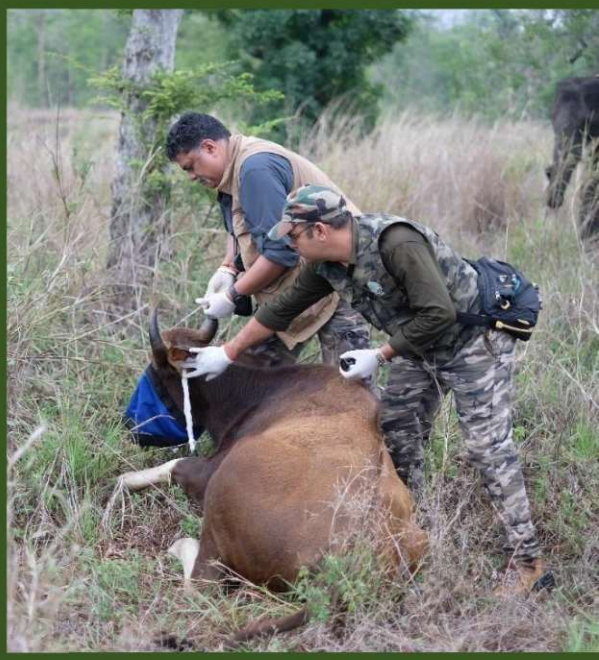
If the herd was not in capture suitable terrain, it was gently pushed to suitable terrain with the help of captive elephants. The timing of the capture operation was set to coincide with the desired timing of the release of animals.

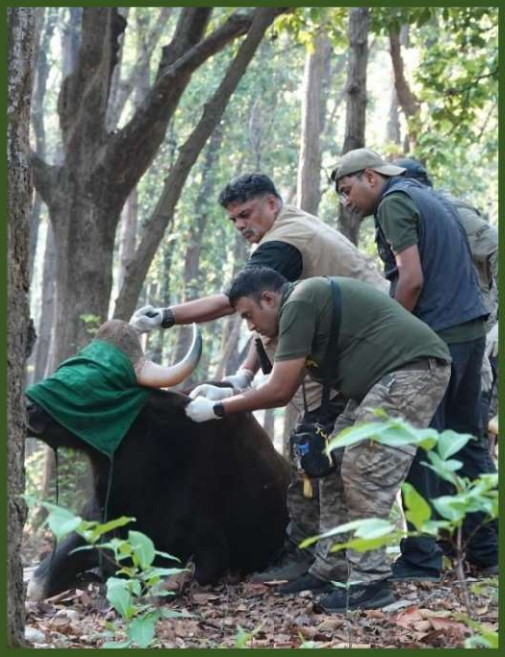
5.2.4 Immobilization

The selected animal was approached on the elephant's back for darting. Thiafentanil (0.01 0.001 mg/kg, THIANIL, Wildlife Pharmaceuticals (pty) ltd., 10 mg/ml) mixed with Azaperone (0.1-0.5 mg/kg, AZAPERONE, compounded by Novecy Pharmacy CC, V-Tech NV 50 mg/ml) was remotely injected employing 3.0 ml nylon darts using a DAN-INJECT projector (Model JM). The animal was left undisturbed until proper induction safe for handling was achieved. All the information collected during the field procedure was recorded in the set format provided in the veterinary protocols (WII, 2022).

5.2.5 Procedures

Following darting and after ensuring that the animals had achieved adequate sedation safe for carrying out procedures, they were approached and blindfolded to ensure reduction of ambient light intensity due to restriction in vision, making animal calmer during capture by reducing stress helped in preventing possible corneal drying. The animals were maintained in sternal recumbency with the proper holding of their heads. This positioning was critical throughout the operation as it ensured unobstructed airways for releasing ruminal gases and avoided any chance of aspiration of saliva/gut contents into the respiratory tract.





(i) Assessment of vital parameters

The veterinary team monitored the immobilised animal following proper positioning. This involved assessing the animal's state and the extent of anaesthesia and recording vital parameters (respiration, heart rate, body temperature, etc.). The animals were specifically monitored for signs of bloat/ tympany. The animal was also examined for wounds and injuries, and appropriate medical interventions were made when required.

(ii) Assessment of physiological parameters

Upon confirming that the animal's physiological parameters were stable, the immobilised animal was carefully shifted onto a stretcher and duly secured using straps (cotton). Simultaneously, the body measurements (horn attributes, body and limb lengths, neck and chest girth) were recorded for comprehensive health assessment and demographic studies and to establish baseline data for future monitoring and research purposes. This information is crucial for tracking growth patterns, understanding physical health, and ensuring the well-being of gaur post-release in SDTR. Before shifting the animal on the truck, rubber tubes were placed on horn tips to avoid injury to other animals during transportation.

(iii) Animal weighing and moving

The animal was shifted onto a small vehicle from the site of capture and moved to the road head where the transport vehicle was placed. The animals were weighed using a digital weighing machine hoisted on a horizontal beam duly supported by the identified team before loading onto the transport container. The animals were also directly loaded onto the transport truck depending on the location and circumstances. The physiological parameters of the animal and the level of sedation were assessed throughout the operation. Where needed, supplemental anaesthesia with Ketamine HCl (Ketamina-100mg/ml - 50ml vial, Biovet Pulawy Sp. z.o.o., Henryka Arciucha 2, Poland) was given intravenously to the animal, and in cases showing respiratory depression, supportive respiratory stimulant (DOXAPRAM) was administered.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A total of 50 gaur were reintroduced in SDTR from KTR and STR and the summary and the details are provided at table 5.3 and 5.4.

Table 5.3: Summary of Reintroduced gaur from Kanha & Satpura Tiger Reserve to Sanjay Dubri Tiger Reserve

Capture duration	Source location	Age and Sex Class				
		Adult Male	Adult Female	Sub-adult male	Sub-adult female	Total
Phase-I						
1st to 07th June 2023	Kanha Tiger Reserve	03	12	04	09	28
26th to 30th June 2023	Satpura Tiger Reserve	01	13	02	--	16
Phase-II						
8th & 9th April 2024	Kanha Tiger Reserve	02	03	--	01	06
	Total	**06**	**28**	**06**	**10**	**50**

Table 5.4: Details of Reintroduced gaur from Kanha & Satpura Tiger Reserve to Sanjay Dubri Tiger Reserve

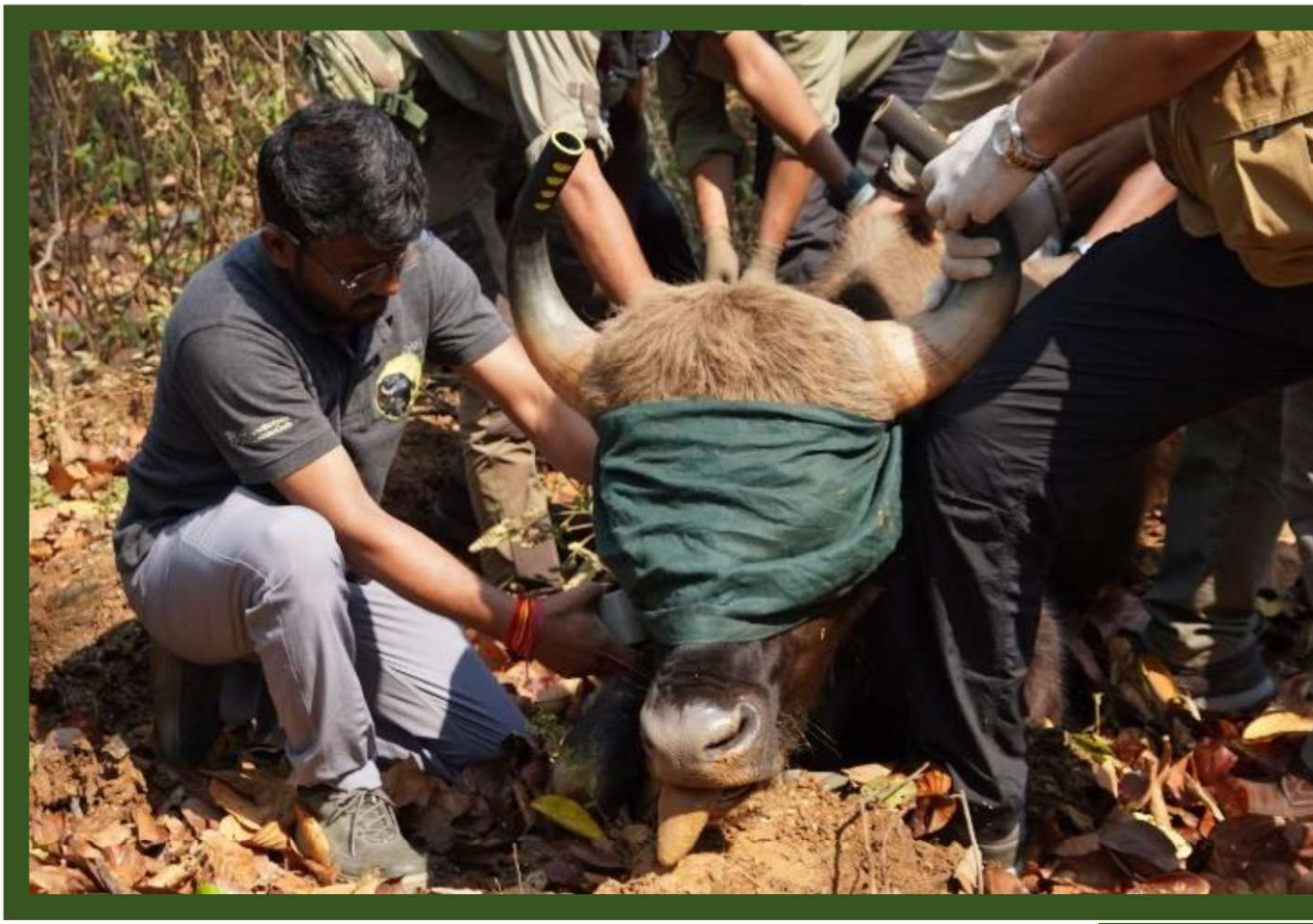
Sr. No	Capture Date	Gaur ID	Sex	Age Class	Colour-code/ VHF collar	Released in 2 ha. enclosure	Released in 30 ha. enclosure	Released in Open Forest
PHASE-I: CAPTURE FROM KANHA TIGER RESERVE (KTR)								
1	01-06-23	K-1	Male	Sub-adult		01-06-23	05-06-23	23-06-23
2		K-2	Female	Sub-adult				
3		K-4	Female	Sub-adult				
4		K-5	Male	Adult	No collar			
5	02-06-23	K-6	Female	Sub-adult	VHF Collar	02-06-23		
6		K-7	Female	Sub-adult				
7		K-8	Male	Adult	VHF Collar			
8		K-9	Female	Adult	VHF Collar			
9		K-10	Female	Adult	VHF Collar			
10		K-11	Female	Adult				
11		K-12	Female	Adult				

Sr. No	Capture Date	Gaur ID	Sex	Age Class	Colour-code/ VHF collar	Released in 2 ha. enclosure	Released in 30 ha. enclosure	Released in Open Forest
12	03-06-23	K-13	Female	Adult		03-06-23		
13		K-14	Female	Adult	No collar			
14		K-15	Female	Adult	VHF Collar			
15	04-06-24	K-16	Female	Adult	VHF Collar	04-06-24		
16		K-17	Male	Sub-adult	No collar			
17	05-06-23	K-18	Female	Adult	No collar	05-06-23	10-06-23	
18		K-19	Male	Adult	No collar			
19		K-20	Female	Adult				
20		K-21	Male	Adult	No collar			
21		K-22	Female	Sub-adult				
22	06-06-23	K-23	Female	Sub-adult	No collar	06-06-23		
23		K-24	Female	Sub-adult				
24		K-25	Female	Sub-adult				
25		K-26	Female	Sub-adult	VHF Collar			
26	07-03-23	K-27	Male	Sub-adult	No collar	07-03-23		
27		K-28	Female	Sub-adult	No collar			
28		K-30	Female	Adult	VHF Collar			
Phase -I: CAPTURE FROM SATPURA TIGER RESERVE (STR)								
29	26-06-23	S-1	Female	Adult		27-06-23	The 2 ha. The enclosure was open on 01-07-23 and the gaur moved out on 06-07-23 into 30 ha. Enclosure	19-08-23
30		S-2	Female	Adult	GPS Collar*			
31		S-3	Male	Sub-adult				
32		S-4	Female	Adult				
33	27-06-23	S-5	Female	Adult	GPS Collar	28-06-23		
34		S-6	Female	Adult				
35		S-7	Male	Sub-adult				
36		S-8	Female	Adult	GPS Collar			
37		S-9	Female	Adult				
38		S-10	Female	Adult				
39		S-11	Female	Adult				
40		S-12	Female	Adult				
41	28-06-23	S-13	Female	Adult		29-06-23		
42		S-14	Female	Adult				
43	29-06-23	S-15	Male	Adult	GPS Collar*	30-06-23		
44		S-16	Female	Adult	No collar			

Sr. No	Capture Date	Gaur ID	Sex	Age Class	Colour-code/ VHF collar	Released in 2 ha. enclosure	Released in 30 ha. enclosure	Released in Open Forest
PHASE -II: CAPTURE FROM KANHA TIGER RESERVE (KTR)								
45	08-04-24	K-31	Male	Adult	VHF Collar	09-04-24	21-04-23	08-05-24
46		K-32	Female	Adult	GPS Collar			
47	09-04-24	K-33	Female	Adult	VHF Collar	09-04-24		
48		K-34	Female	Sub-adult	VHF Collar			
49		K-35	Female	Adult	VHF Collar			
50		K-36	Male	Adult	GPS Collar			

5.2.6 Animal Collaring

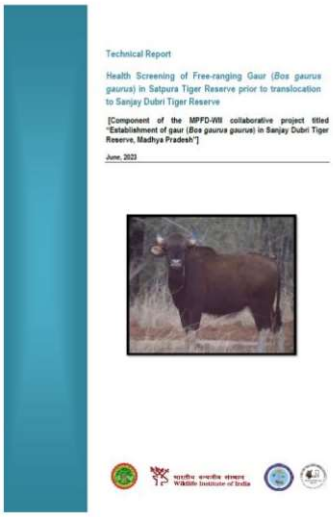
Adult males were primarily fitted with satellite collars, and females with VHF and satellite collars for post-release monitoring. six Vectronics Satellite/GPS/VHF collars and Twelve Telonics VHF radio collars were deployed on the animals. The satellite collars are programmed to give animal locations at four hourly intervals. All other individuals were fitted with colour-coded neck bands for individual identification and monitoring during the initial exploratory phase. The details of the collars are provided in Table 5.4.

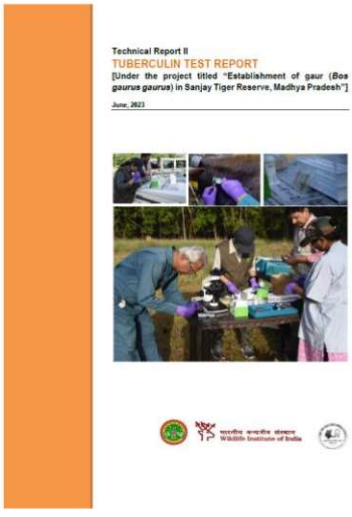


5.2.7 Biological Sample Collection and laboratory investigation

Biological samples were collected from the immobilised animals and subjected to detailed analysis at the field site (closer to the capture location) by the team from the School for Wildlife Forensic and Health (SWFH), Jabalpur. An intradermal tuberculin test was performed using PPD. A complete physical examination of the animal was done at this stage. Detailed analysis was carried out at the field laboratory of Kanha and SWFH, Jabalpur. The hematobiochemical values were within the normal range as reported by Shrivastav et al., 2014 and no significant differences were recorded. The serum samples were subjected to serological tests and found negative for brucellosis and tuberculosis. The tuberculin test results recorded after 48 hours at STR were negative for tuberculosis (WII-SWFH 2023).


Technical Report
HEALTH SCREENING OF FREE-RANGING GAUR (BOS GAURUS GAURUS) IN KANHA TIGER RESERVE PRIOR TO TRANSLOCATION TO SANJAY DUBRI TIGER RESERVE
[Component of the MPFD-WII collaborative project titled "Gaur Reintroduction Plan: Establishment of Gaur (Bos gaurus gaurus) in Sanjay Dubri Tiger Reserve"]
June, 2023


Technical Report
Health Screening of Free-ranging Gaur (Bos gaurus gaurus) in Satpura Tiger Reserve prior to translocation to Sanjay Dubri Tiger Reserve
[Component of the MPFD-WII collaborative project titled "Establishment of gaur (Bos gaurus gaurus) in Sanjay Dubri Tiger Reserve, Madhya Pradesh"]
June, 2023

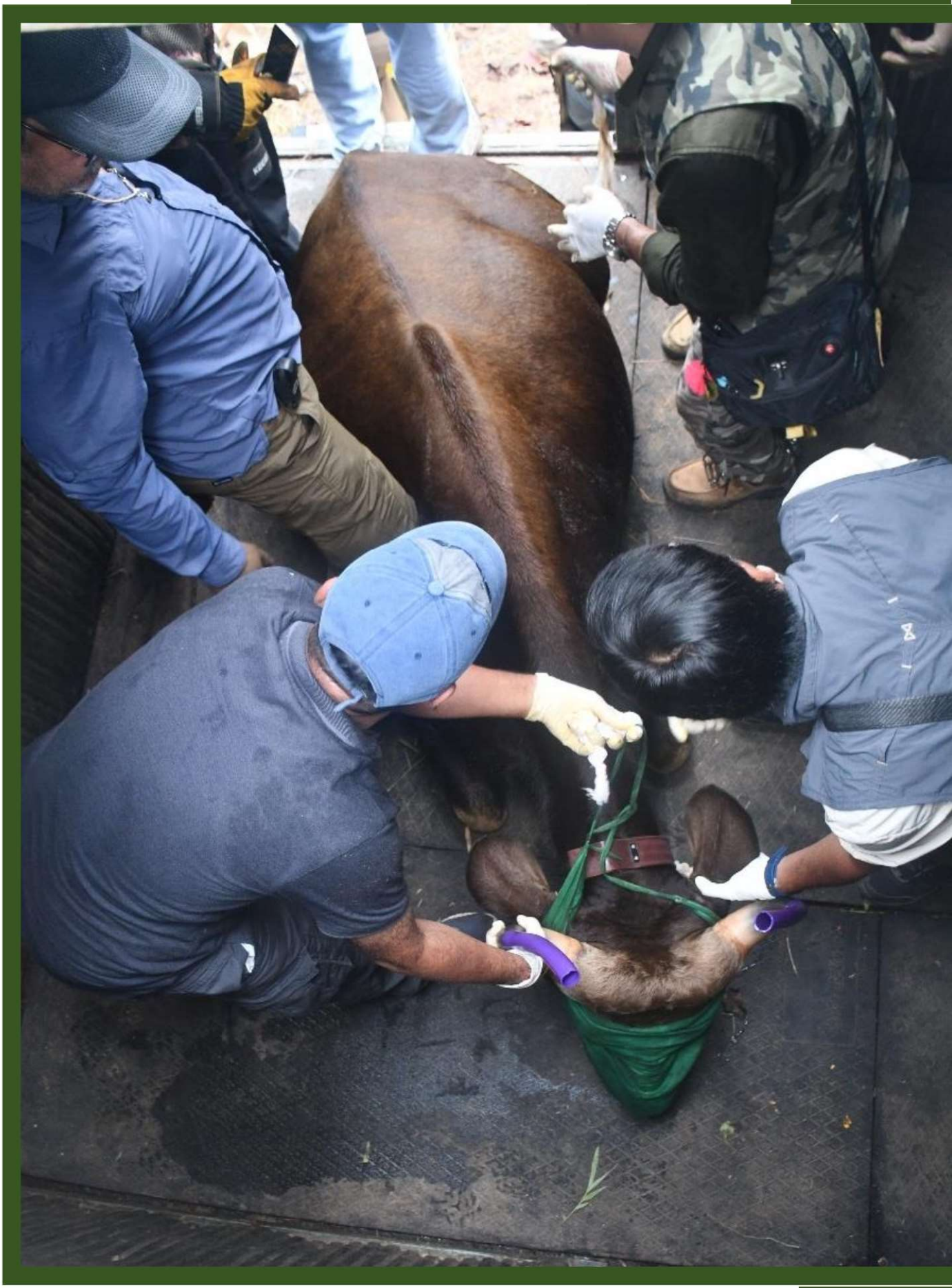

Technical Report II
TUBERCULIN TEST REPORT
[Under the project titled "Establishment of gaur (Bos gaurus gaurus) in Sanjay Tiger Reserve, Madhya Pradesh"]
June, 2023

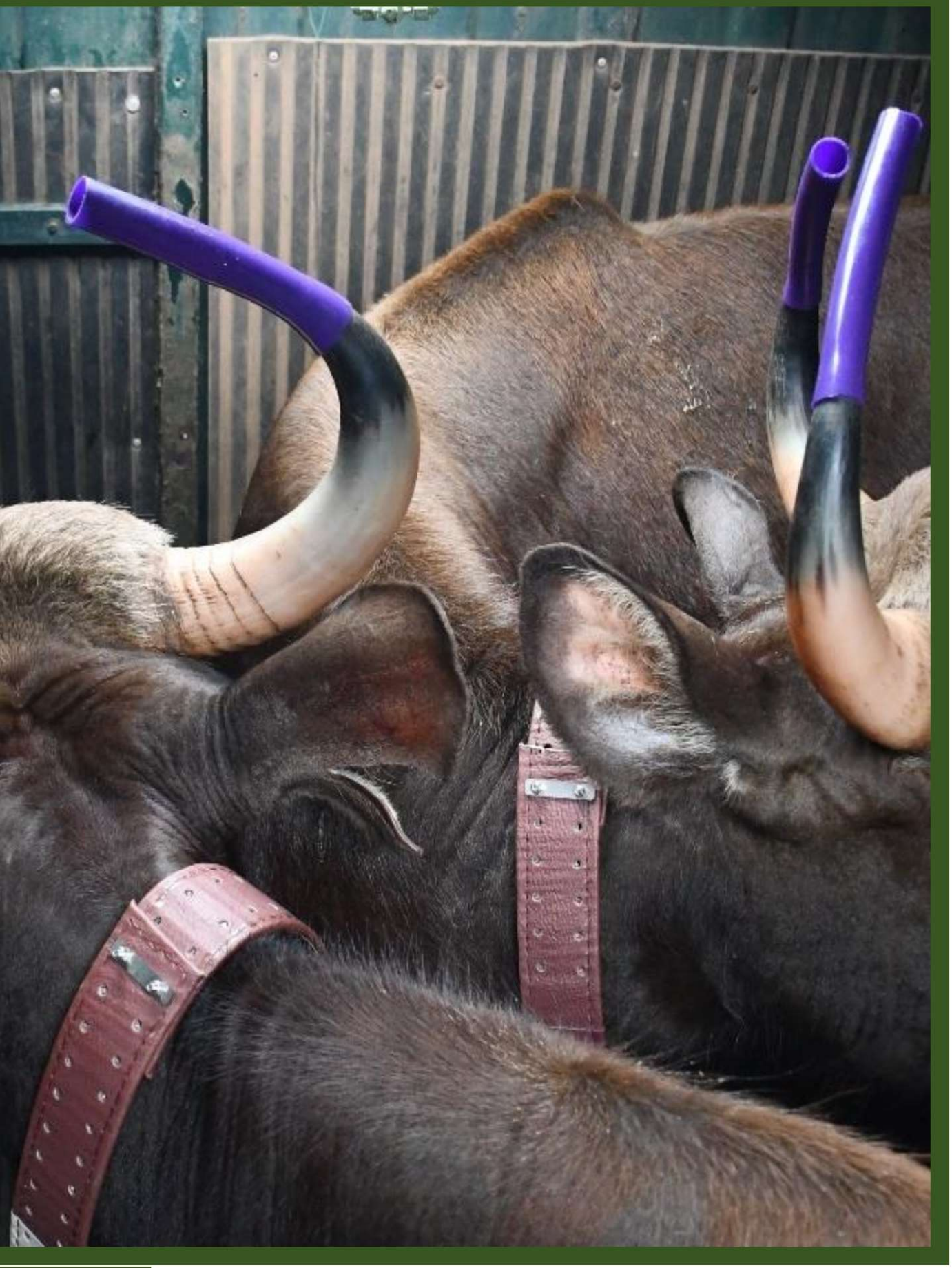
5.2.8 Loading of animals on transportation trucks

Careful consideration was given to the composition of the animals being loaded and transported in each truck. It was ensured that sub-adult female or male and mature bull were not mixed with other animals in the truck. Instead, they were transported independently. This precaution was taken to minimize stress and potential dominance fight among the animals during the transportation process.

5.2.9 Use of tranquillisers and reversal drugs

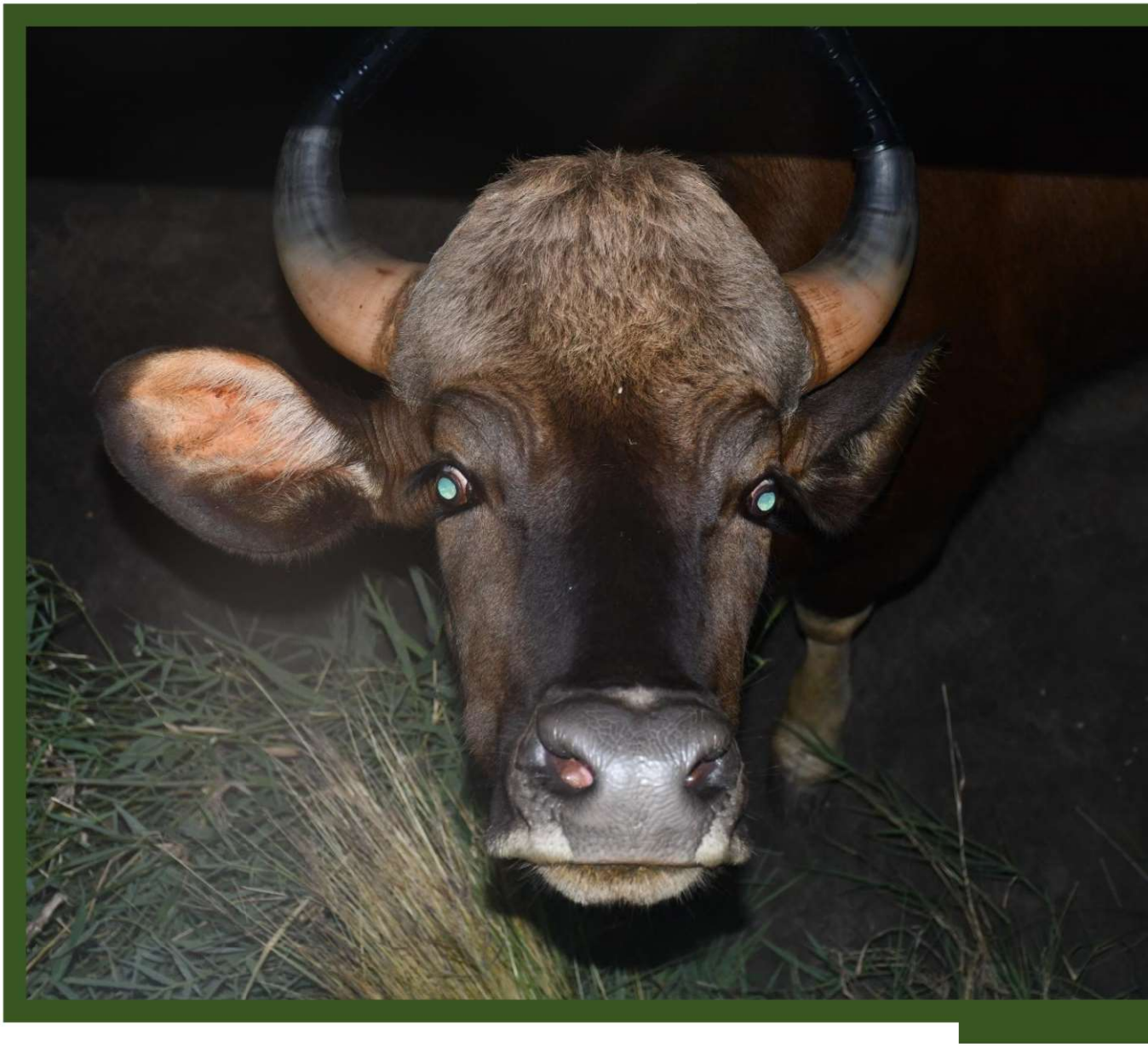
A short-acting tranquilliser, Azaperone (AZAPERON, Azaperone- 50mg/ml - 100 ml vial, Novecy Pharmacy CC, V-Tech), was used with the primary immobilising drug (Thiafentanil) in the dart. Subsequently, medium and long-acting tranquillisers were used to achieve the desired level of tranquillisation during transport and at the release site. These included Haloperidol (HALOPERIDOL - 20mg/ml - 50ml multi dose, Novecy Pharmacy CC, V-Tech) and Perphenazine enanthate (PERPHENAZINE 100, 100mg/ml-20ml Multi dose, Novecy Pharmacy CC, V-Tech). Additionally, a long-acting antibiotic and supplemental drugs (multi-vitamin etc.) were also administered to the animals. After all the procedures were done, the animals were given an antidote (Naltrexone TREXONIL, Wildlife Pharmaceuticals, 50 mg/ml) in the ratio of 10:1 of thiafentanil administered either intravenously or intramuscularly after offloading the animal inside the transport truck.





5.2.10 Transport consideration

Capture and translocations were timed to coincide with the cooler hours of the day (below 25° C) to avoid heat-related complications, as reported by Caulkett (2001). The journey was initiated in the late evenings to avoid any human and vehicular disturbance during transport and to plan animal release at the release site at SDTR in the early morning hours. The journey for animals that were captured in the morning commenced immediately, taking due care of necessary logistic arrangements to cool the animals and vehicles during noon hours. Special care was taken to maintain uniform speed during the journey, and speed was adjusted according to the local road conditions. The animals were monitored throughout the journey. The road Journey was initiated to cover the distance of about 400 kilometres from KTR and was covered in about 12 to 14 hours, whereas it took about 22 to 24 hours to cover about 700 kilometres from STR. It was ensured that the animals were in good condition throughout the journey. The animals were provided with green fodder and water on the way. Additionally, when required, the vehicles were cooled, especially during the day journey.



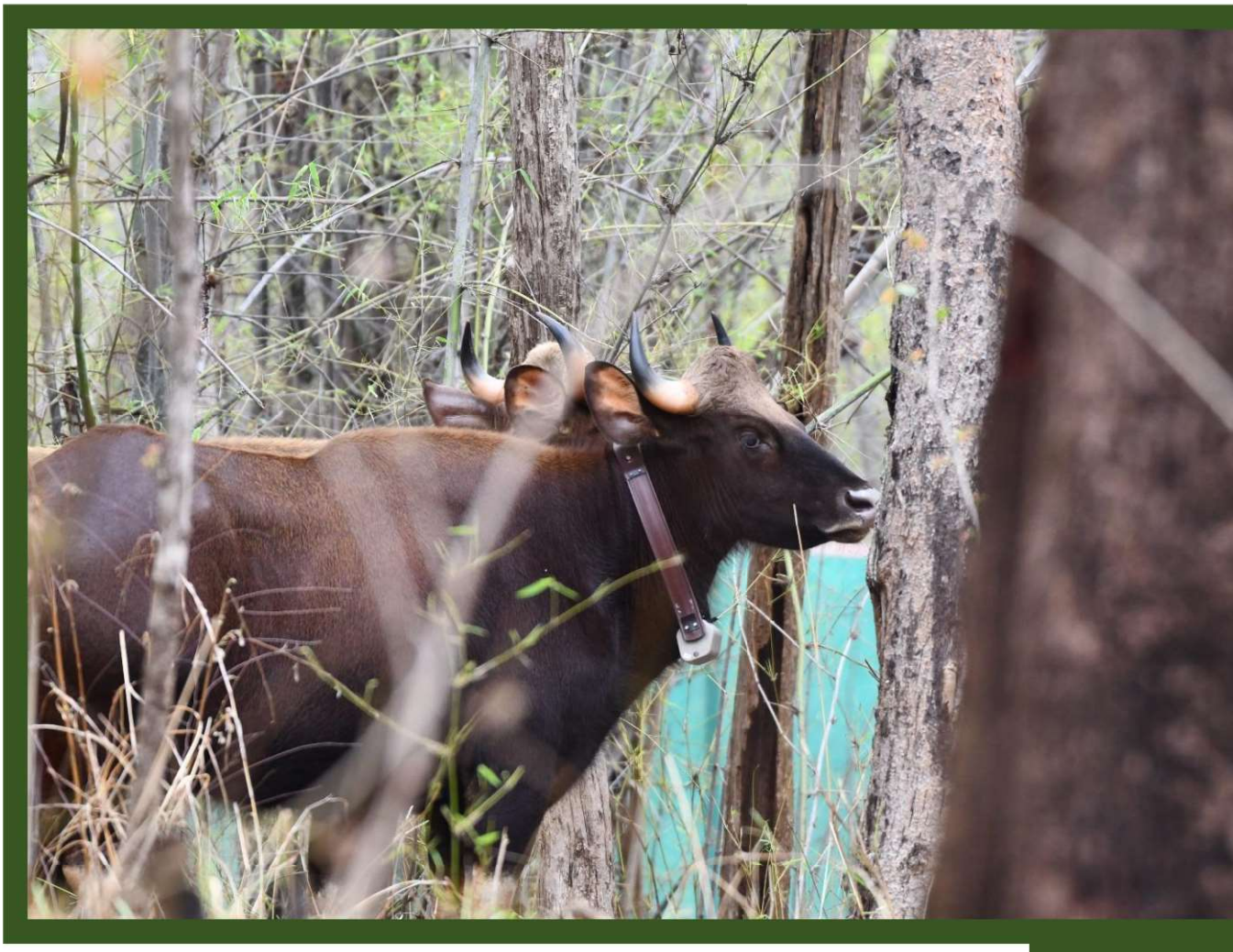
5.2.11 Release of animal into soft-release enclosure at SDTR

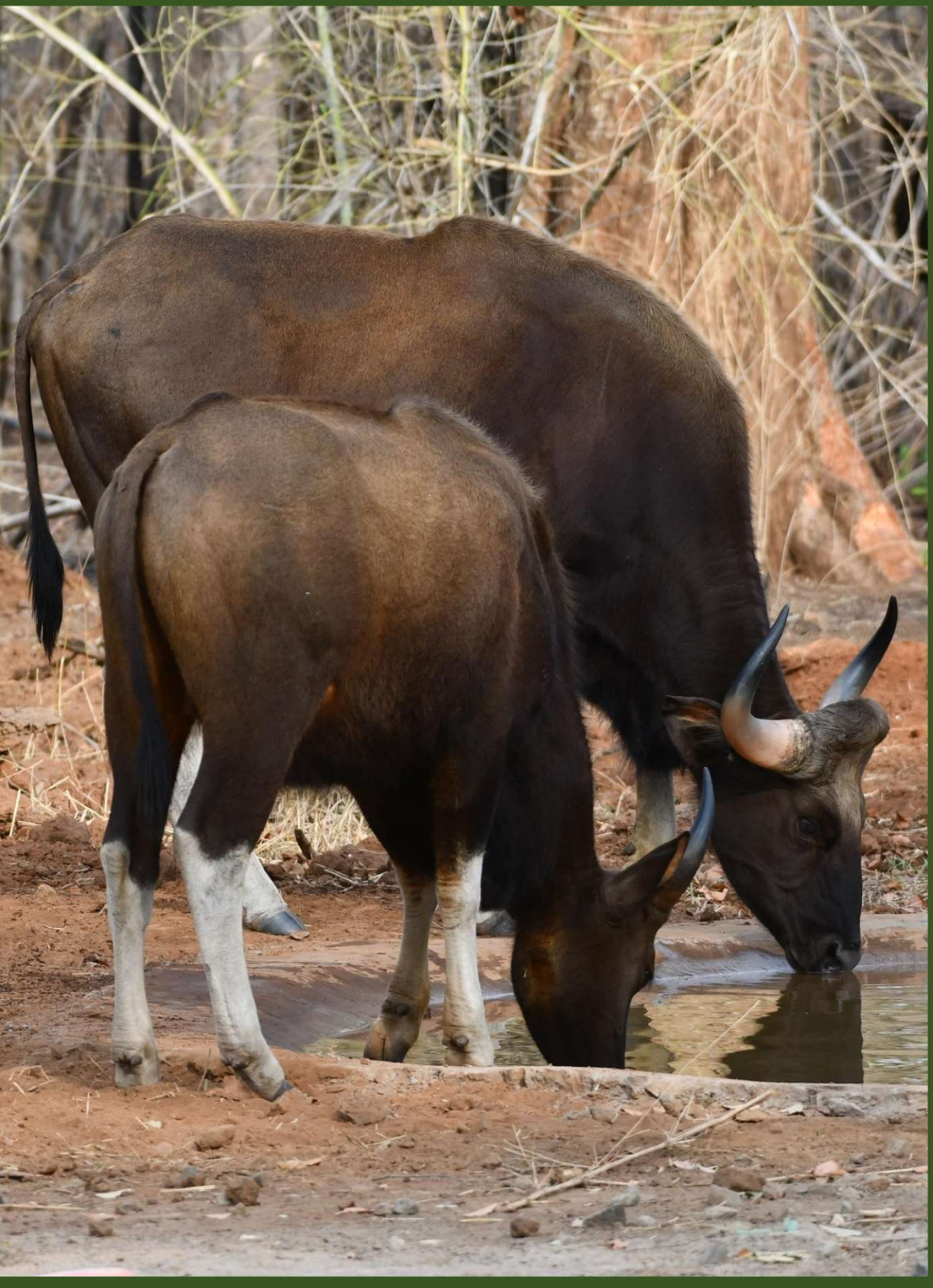
After reaching SDTR, animals were released in the soft enclosure for close inspection and monitoring. The truck with the animal was placed appropriately at the offloading ramp at the release site (enclosure at Pondi range). After ensuring that the animals were fit, active, and alert, they were released into the 2 ha. enclosure at SDTR.

In Phase I of the capture operation, a total of 28 animals were captured from Kanha TR and maintained in the smaller enclosure from 5th to 10th June 2023. Later, they were allowed to move into the bigger enclosure of 30 ha. The bigger enclosure offered a transitional space for behavioural adjustment, acclimatisation and adaptation to new environments, protection from immediate predation, avoiding homing-in, and adequate time for weaning of the tranquillizer effect. Additionally, it allowed the animals to express natural behaviour like socialising, developing bonding/ cohesiveness and forming herds. The animals were provided with supplemental food and water in both the enclosures. The herd was monitored intensively in the enclosure by the joint team of the Wildlife Institute of India and the frontline staff of Sanjay TR. These animals were subsequently released in the wild on 23rd June 2023.

A total of 16 gaurs were reintroduced from STR between 26th and 29th June 2023. The animals were initially released in a small soft-release enclosure (2 ha.) and subsequently came out into a 30 ha. enclosure on 06th July 2023 and were subsequently released in the wild on 19th August 2023.

In Phase II of the capture and translocation, six gaurs were captured and translocated from KTR to SDTR between 8th and 9th April 2024. The animals were initially released in a small soft-release enclosure (2 ha.) and subsequently came out into a 30 ha. enclosure on 21st April 2024 and subsequently released in the wild on 09th May 2024.





5.3 Post-Translocation Phase

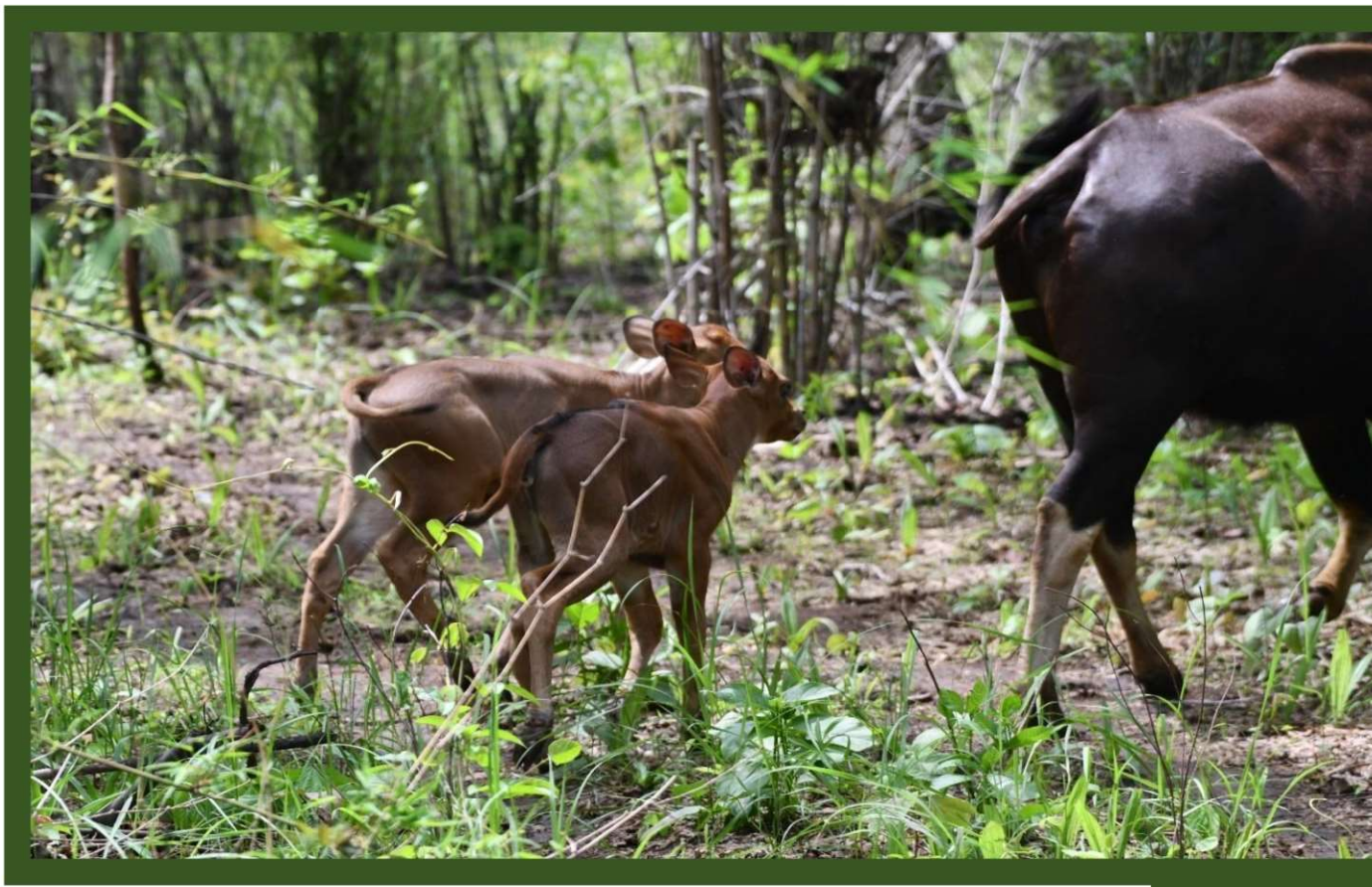
5.3.1 Inside the Enclosure

Monitoring the reintroduced gaur within the enclosure was critical to ensuring their health and well-being. This was achieved by observing their body condition using the Body Condition Index (BCI) (Riney, 1964). Though the animals showed loss of body condition during the initial days, the supplemental feeding and availability of natural vegetation within the bigger enclosure helped restore their body condition.

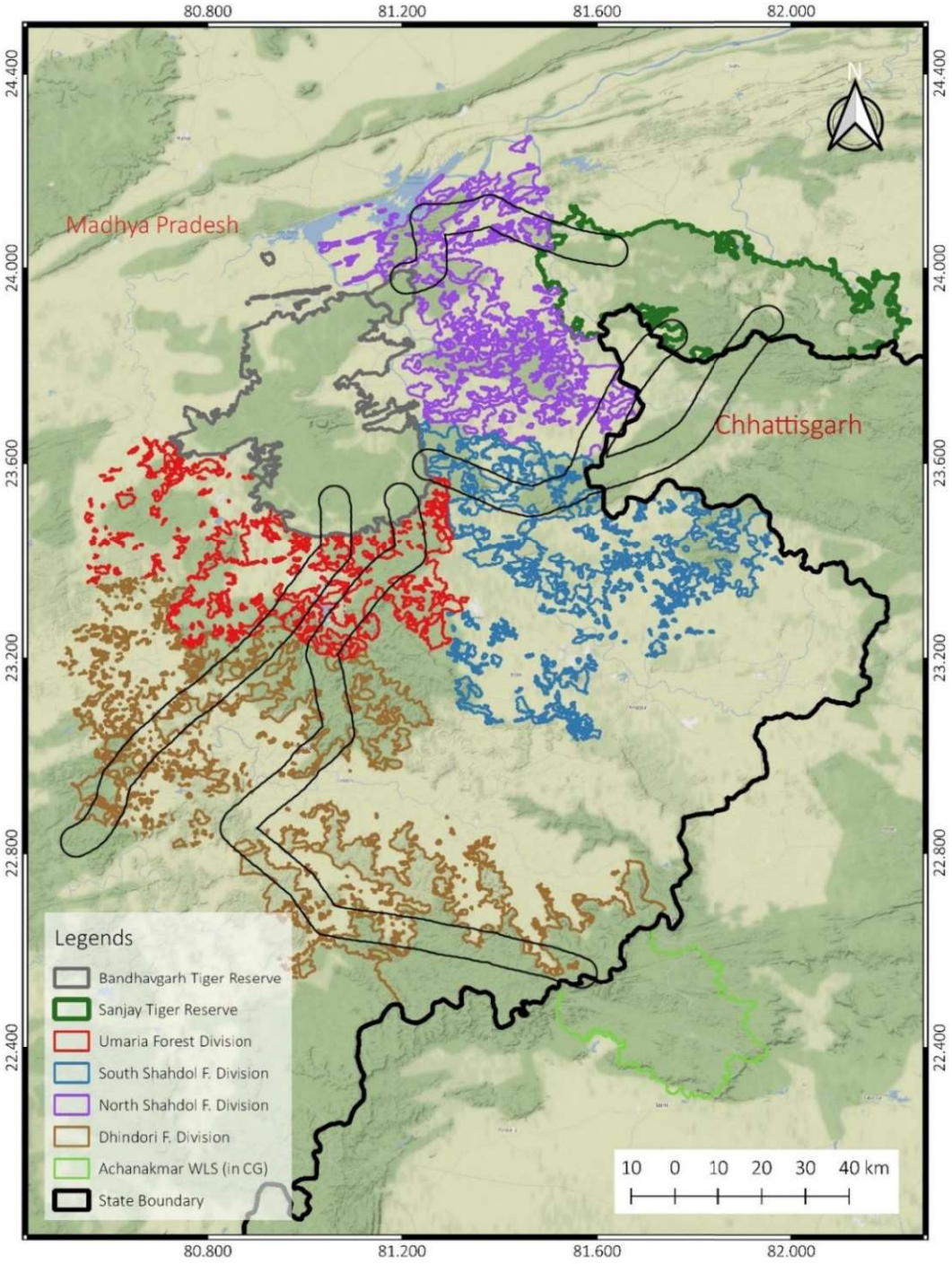
5.3.2 Release in the wild

An intensive monitoring program was implemented to track the gaur herd in the wild. This was aimed at gaining insights into various aspects of the gaur's behaviour and ecology, including their movement patterns, home range, activity pattern, population structure, behavioural pattern, and food habits.

The radio collared gaur were monitored by team comprising Wildlife Institute of India (WII) research fellows and forest officials from SDTR. The team employed homing-in and triangulation techniques to track the radio-collared gaurs and direct sighting records for individuals with colour-coded bands. Though the animals initially explored Pondi, Bastua, and Madwas ranges and even ventured outside the park (Map 5.4 to 5.6), the major herds are observed to primarily utilize the Pondi and Madwas ranges of SDTR.



One of the identified females, along with three other individuals, was photo captured from the Pataur range of Bandhavgarh Tiger Reserve, supporting the long-ranging dispersal of a megaherbivore species traversing through human-dominated landscape and possibly using the identified corridors (Map 5.3).



Map 5.3: Map showing the two potential ecological corridors between BTR and Sanjay-Dubri TR; BTR and Umariya-Dhindori; BTR and Dhindori-Achnakmar WLS (in CG) (Kumar et al., 2021)

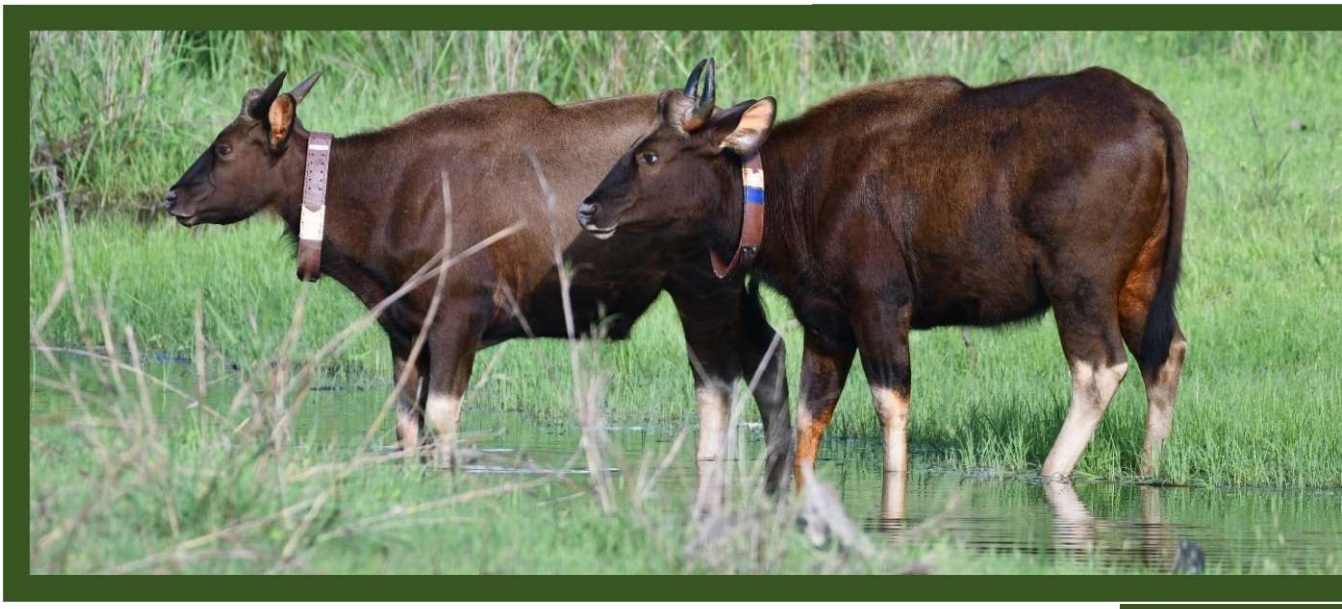
5.3.3 Post-release monitoring

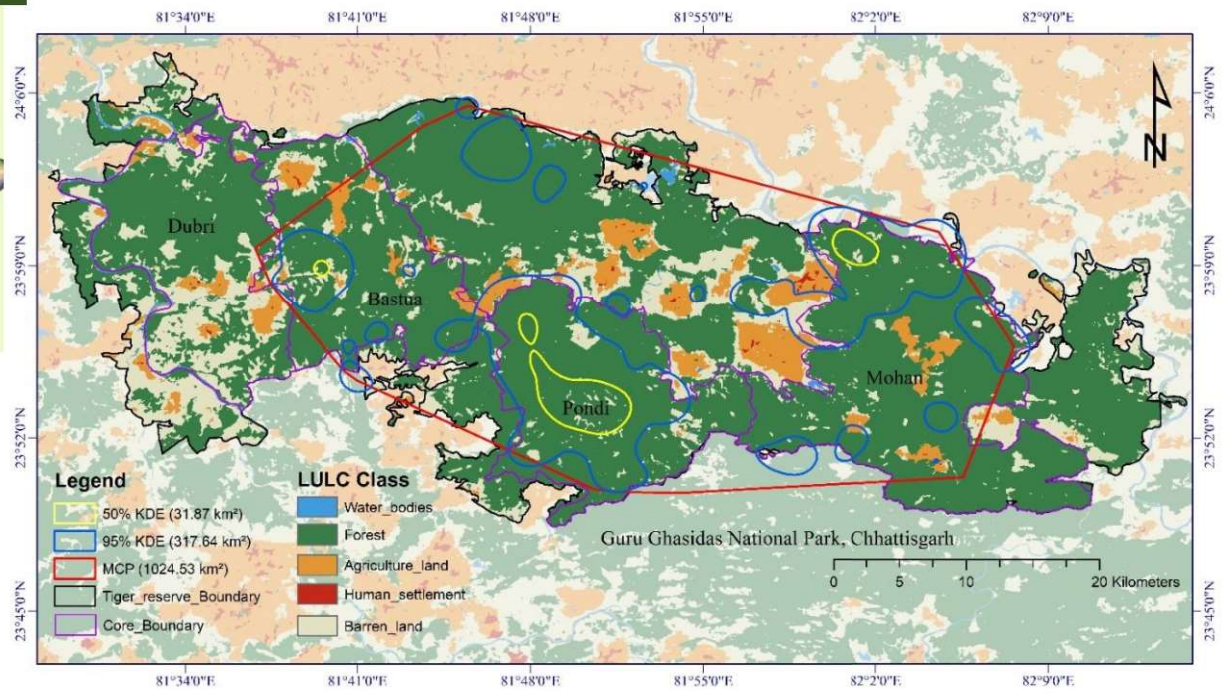
(i) Animal exploration, movement and ranging pattern

In SDTR, the study on ranging patterns of gaur reintroduced during Phase I & Phase II was based on regular tracking of radio-collared (n=18; 12 VHF and six Satellite & VHF) and individuals with colour coded neck bands (n=22). The radio-collared gaurs were monitored periodically through ground tracking using the 'homing in' technique (White & Garrot, 1990). This technique involves the VHF (Very High Frequency) transmitter that emits a radio signal over a long distance, depending on the habitat and terrain, and these radio signals are used to locate the animals visually (Kenward, 1987). Additionally, satellite collars that work on iridium technology were programmed to provide a GPS fix at four-hour intervals and communicate to a satellite every eight-hour intervals. The GPS fixes were downloaded directly from the collar provider company's server. The non-collared individuals were monitored by following their fresh hoofmarks. Once the individuals were located, the information on the number of individuals in the herd, the herd composition, and GPS location were recorded. Observations were obtained between 0600 hrs to 1800 hrs during all seasons. The seasonal home range size by the reintroduced gaur population is provided below (Table 5.5 & Map 8 to 10).

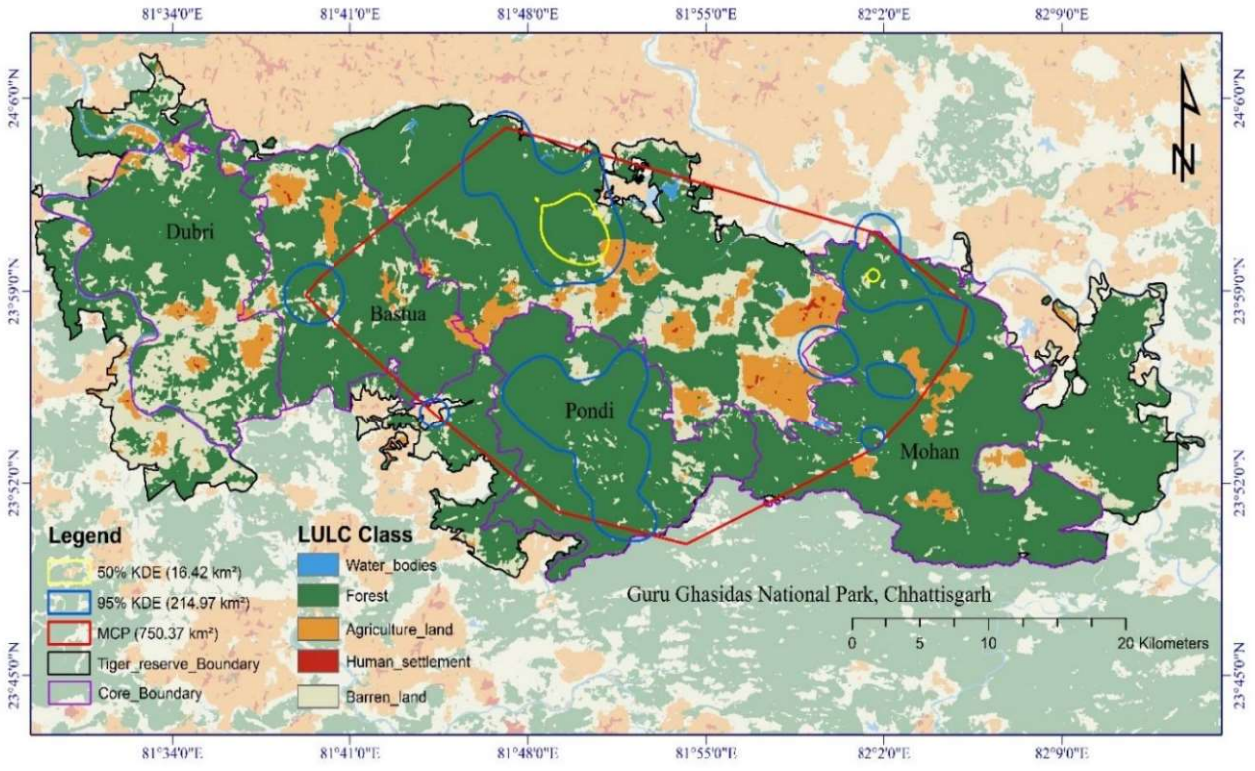
Table 5.5: Details of seasonal home range size by the reintroduced gaur population (June 2023 to June 2024)

Season	100% MCP	95% FKD	50% FKD
Monsoon	1024.53 km²	317.64 km²	31.87 km²
Winter	750.37 km²	214.97 km²	15.42 km²
Summer	504.11 km²	143.63 km²	22.52 km²

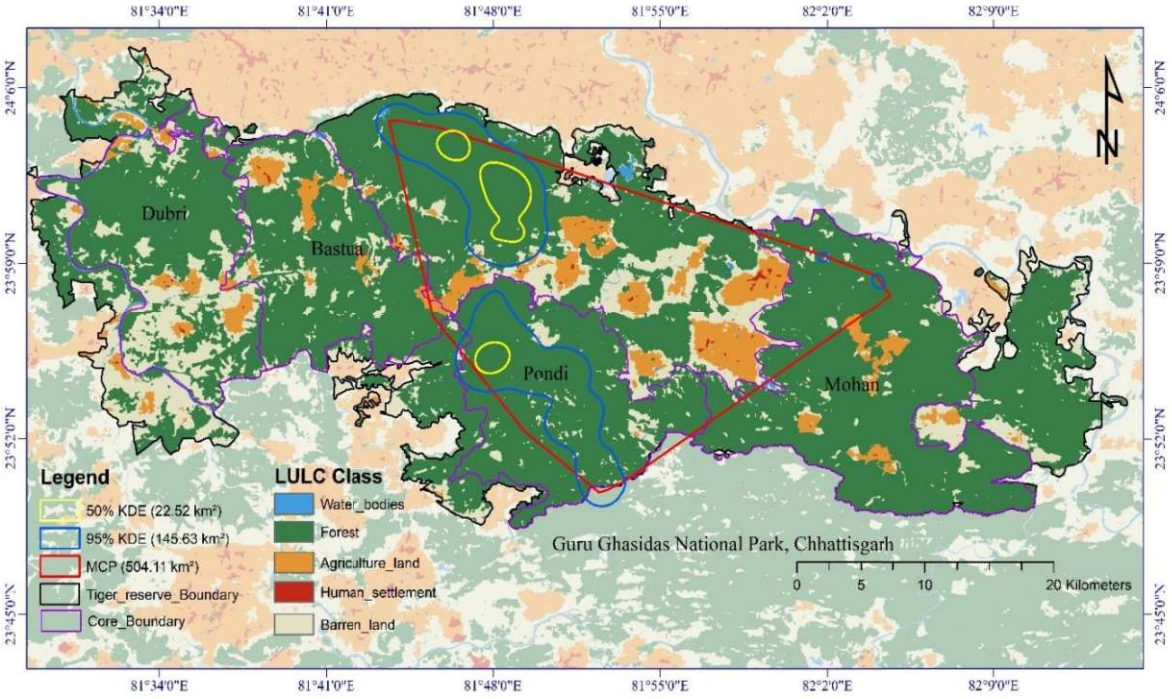




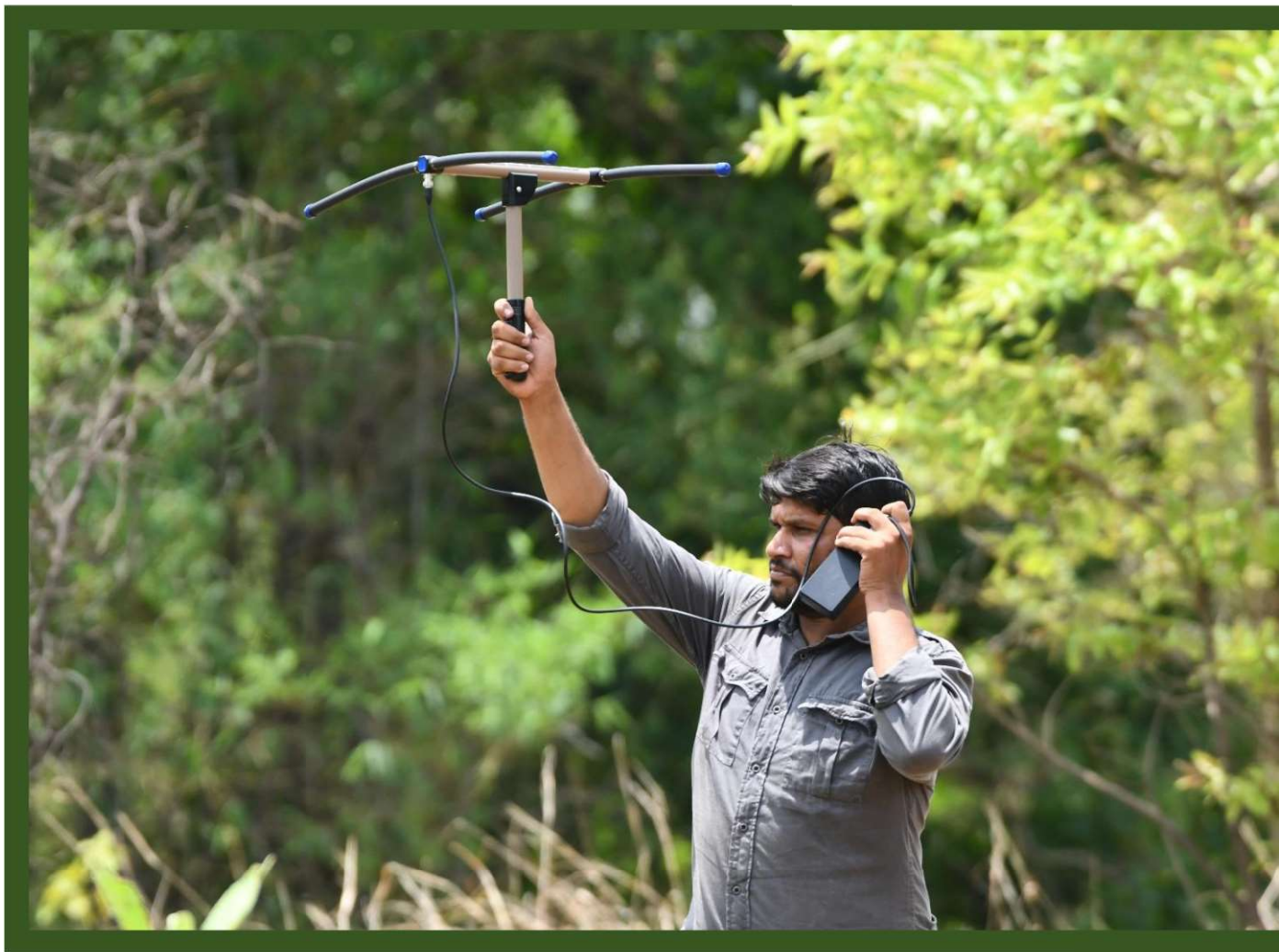
Map 5.4: Home range size of reintroduced gaur during monsoon season



Map 5.5: Home range size of reintroduced gaur during winter season



Map 5.6: Home range size of reintroduced gaur during summer season



(ii) Population Status

In three batches, 50 gaur individuals were translocated from KTR (n=34) and STR (n=16). Mortality of one adult female gaur was reported inside the soft-release enclosure during the reporting period. During the study period, 11 cows (7 from STR and 4 from KTR) calved, and the year witnessed one calf mortality, and two calves were either dead/predated or missing. The overall population of gaur will reach a total of 57 individuals by June 2024. Details of mortality and natality are provided in Table 5.6.

Table 5.6: Details of mortality and natality and current population status.

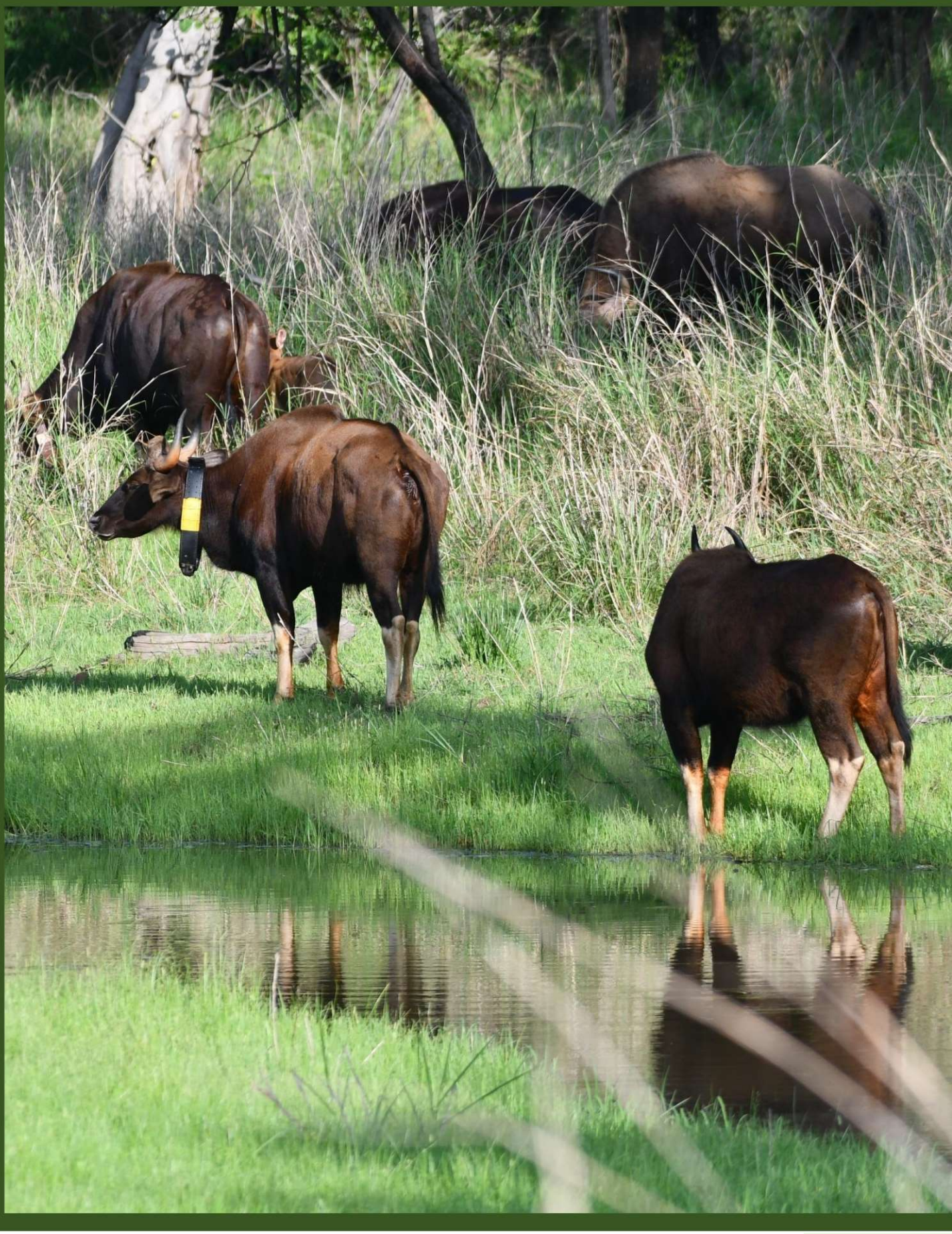
Total Animal Translocated	Adult mortality	No. of new birth	Calf Mortality/ Missing	Total Population
50	01	11	03	57

(iii) Stabilisation of glucocorticoid level (Faecal Cortisol Metabolite Levels)

The study aimed to assess the adaptation of gaurs to a new environment and determine whether they have acclimatised without stress. Faecal cortisol metabolite levels were notably elevated during the transport phase (3035.75a±383.4 pg/ml), indicating increased stress levels. However, the stress was observed to be reduced by the 3rd -day post-release (254.1±73.59 pg/ml), which was correlated with the effects of drugs used during the capture operations, which efficiently managed the level of stress in the initial phases of the post-capture period. Further, a comparatively non-significant increase in FCM level was observed in the samples collected on the 7th day (447.15±274.83 pg/ml) and the 14th day (431.88±114.99 pg/ml) post-release of the animals, which was related to the prolonged captivity of the translocated animals in the enclosure. However, after their release into the bigger enclosure, the stress was observed to be decreasing and reached the baseline data by the 30th day (220.58±66.62 pg/ml). It also suggested a recovery from the initial stress experienced during the capture and transport events. After the release of the animals in the natural habitat inside the SDTR, the FCM level was observed to be maintained at baseline level on the 45th-day post-release (234.86±45.86 pg/ml). This indicated that the animals had adjusted well and started to explore the new place with adequate capacity and a non-significant stress level (Farooqui et al., 2024).

Table: 5.7: The faecal Cortisol Metabolite levels in reintroduced gaur in SDTR

Phase	Faecal Cortisol Metabolite Levels (pg/ml)
During Transportation	3035.75a ± 383.4
3rd day post-release	254.1 ± 73.59
7th day post-release	447.15 ± 274.83
14th day post-release	431.88 ± 114.99
30th day post-release	220.58 ± 66.62
45th day post-release	234.86 ± 45.86



6. Summary

Gaur Reintroduction in Sanjay-Dubri Tiger Reserve (SDTR) has so far been a successful conservation initiative with the successful reintroduction of 50 gaur from Kanha Tiger Reserve (34) and Satpura Tiger Reserve (16) during 2023-24. A total of 18 animals were fitted with collars (12 VHF and six Satellite & VHF) and 22 with colour-coded neck bands and intensively monitored. Seasonal home ranges of reintroduced gaur in SDTR were studied during the year. A total of 11 cows (7 from STR and 4 from KTR) were calved, and the year witnessed one adult mortality, one calf mortality, and two calves were either dead/predated or missing. The overall population of gaur has reached 57 by June 2024.

The salient achievements of the field capture and translocation operation are provided below.

Duly Sensitized and Trained Team

A well-equipped and trained team for capture, animal transportation, and monitoring was key to the successful reintroduction of gaur in SDTR. A duly sensitised and trained team of park managers, wildlife health officers, subject matter specialists, frontline staff, mahouts, and captive elephants executed the entire field operation. These can be good resources for future initiatives.

Standardisation of Procedures

The operation established consistent protocols and guidelines that covered every aspect of the process, from the initial capture of the animals to the monitoring activities post-release. This standardisation ensured that all procedures were carried out uniformly and controlled, thereby enhancing the operation's efficiency and effectiveness.

Safe and Effective Capture

The target species' and capture teams' safety and well-being were prioritised. This was achieved through rigorous planning, training, and execution of the capture operations. Every effort was made to ensure that the capture process was carried out in a manner that was safe, humane, and minimally stressful for the animals while also ensuring the safety of the personnel involved.

Standardisation of Capture Techniques

The field operation followed up with evolving animal capture techniques and adopted the best state-of-art approaches. It involved using scientifically validated methods that had

repeatability and resulted in safe, effective and predictable captures Precise and appropriate drug dosages were used during the capture and translocation operation and minimised the risks and potential adverse effects on the animals, ensuring their well-being throughout the operation.

Post-Release Monitoring

Intensive post-release monitoring was a critical phase in the reintroduction program, and the present project witnessed the enhancement of the SDTR field staff's capacities in monitoring gaur.

The crux of the gaur reintroduction program lies in its inclusive approach, which bolstered active collaboration and coordination between wildlife managers, wildlife health officers, and subject matter specialists at every stage of its execution. For a highly sensitive and logistically challenging field project that involves intrusive approaches like capture and translocation of threatened wild animals, fostering active coordination and involving the right personnel is key to successful field execution.

Animal reintroductions are a long-drawn process. The preliminary efforts to capture and translocate gaur from KTR and STR proved successful. However, to gauge the project's long-term success, monitoring how the population fares over time would be critical. Thus, long-term monitoring of the gaur population, along with its habitats, assumes critical importance.

The Gaur Reintroduction program could be achieved through the generous cooperation and assistance received from individuals and bodies working together, such as the Madhya Pradesh Forest Department, Wildlife Institute of India, School for Wildlife Forensics and Health, Jabalpur, Wildlife & Forestry Services, Ujjain and Ministry of Environment & Forests, Government of India. The coordinated efforts put in by all were extremely important for the entire operation, and without synchronised teamwork, such an operation would not have been possible. Though a lot of people assisted in the planning and execution of the gaur reintroduction program, it is not possible to acknowledge them individually, but their contributions are gratefully acknowledged.

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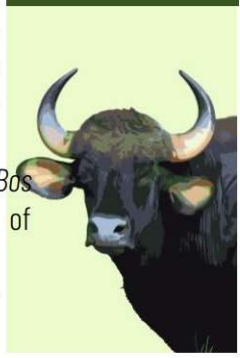

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Annexure. I

(a) Permission for capture and translocation, MOEF&CC (Wildlife Division), GoI, dated:17/11/2021

File No.1-37/2021WL

F. No. 1-37/2021 WL
Government of India
Ministry of Environment, Forest and Climate Change
Wildlife Division

6th Floor, Vayu Wing,
Indira Paryavaran Bhawan,
Jor Bagh Road, Aliganj,
New Delhi-110003.

Dated: 17th November 2021

The Chief Wild Life Warden,
Government of Madhya Pradesh,
Bhopal.

Sub: Re-introduction of Gaur in Sanjay Tiger Reserve.

Sir,

Reference is invited to the letter of the Chief Wild Life Warden, Madhya Pradesh regarding translocation of 50 Gaur (35 Gaur from Kanha Tiger Reserve and 15 Gaur from Satpuda Tiger Reserve) in 1:3 (Male: Female) ratio to Sanjay Tiger Reserve in 2 years.

In this context, the undersigned is directed to convey the approval in accordance with proviso under Section 12(bb) of the Wild Life (Protection) Act, 1972, for translocation of 50 Gaur (35 Gaur from Kanha Tiger Reserve and 15 Gaur from Satpuda Tiger Reserve) in 1:3 (Male: Female) ratio to Sanjay Tiger Reserve in 2 years, subject to the following conditions:

i. The Chief Wild Life Warden shall ensure and satisfy himself that the entire operation is carried out in a safe manner to the animals.

ii. The capturing and translocation of the animals shall be undertaken by qualified veterinarian and strictly under the supervision of the State Forest Department. Adequate veterinary care will also be ensured at all stages.

iii. Due care is to be exercised by the State Government to make the process free from any injury to the animals. It should also be ensured that minimum trauma is caused to the animals during the entire operation.

iv. There would be regular monitoring during and after the process by the Chief Wild Life Warden State Forest Department and regular periodic report will be submitted by the Chief Wild Life Warden to the Ministry.

v. In case of any mis-happening during the process, that endangers or may endanger the safety of the animals, the Ministry may review revoke the permission given.

vi. The Chief Wild Life Warden shall ensure requisite approval, as required, from NTCA.

The Chief Wild Life Warden may take further action in the matter accordingly.

Yours faithfully,

17.11.21

(Rakesh Kumar Jagenia)
Deputy Inspector General of Forests (WL)
E.mail: digwl-mefcc@gov.in

Copy to: Copy to: PSO to the Addl. DGF(WL) & Director Wildlife Preservation, MoEFCC Member Secretary, NTCA, New Delhi Director, WII, Dehradun/PPS to IGF(WL), MoEFCC.

(b) Research proposal permission Letter, MOEF&CC (Wildlife Division), GoI, dated: 04/01/2023

1-37/2021WL

/36946/2023

F. No. 1-37/2021-WL
Government of India
Ministry of Environment, Forest and Climate Change
Wildlife Division

6th Floor, Vayu Wing,
Indira Paryavaran Bhawan,
Jorbagh Road, Aliganj,
New Delhi - 110003.

Dated: 4th January 2023

The Chief Wild Life Warden,
Government of Madhya Pradesh,
Bhopal.

Sub: Permission for research proposal titled " Gaur Re-introduction Plan (2022-27): Establishment of Gaur *(Bos gaurus gaurus)* in Sanjay Tiger Reserve, Madhya Pradesh. - Reg.

Sir,

Kindly refer to the letter of the Chief Wildlife Warden, Madhya Pradesh, No. Ma.Chi-II/Research/9019 dated 14.12.2022 on the above cited subject, seeking this Ministry's permission for collection of blood samples from 50 immobilized Gau (*Bos gaurus gaurus*) and collection of 150-200 opportunistic Dung Samples as part of the research proposal titled " Gaur Re-introduction Plan (2022-27): Establishment of Gaur *(Bos gaurus* gaurus*)* in Sanjay Tiger Reserve, Madhya Pradesh.

This Ministry vide letter of even no. dated 17th November 2021 had communicated approval for translocation of 50 Gaur (35 Gaur from Kanha Tiger Reserve and 15 Gaur from Satpuda Tiger Reserve) in 1:3 (Male:Female) ratio to Sanjay Tiger Reserve in 2 years. One of the condition in the letter was that the Chief Wild Life Warden would submit regular periodic report to the Ministry. In this context, the undersigned is directed to request that a detailed report on action taken in accordance with the said permission and results/observations may kindly be forwarded to this Ministry, for further needful action.

Yours faithfully,

Signed by Rakesh Kumar Jagenia
Date: 04-01-2023 13:16:34

(Rakesh Kumar Jagenia)
Deputy Inspector General of Forests (WL)
Email: digwl-mefcc@gov.in

Copy to: PPS to Addl. DGF(WL) & Director, Wild Life Preservation/PPS to IGF(WL), MoEFCC/PS to JD (WL), MoEFCC.

(c) Project Approval cum Permission for capture, translocation, and post- release monitoring of gaur, PCCF (WL) & CWLW, Govt. of Madhya Pradesh, dated: 08/02/2023

कार्यालय प्रधान मुख्य वन संरक्षक (वन्यप्राणी), मध्यप्रदेश

प्रगति भवन, भोपाल विकास प्राधिकरण, तृतीय तल, एम.पी.नगर, भोपाल
दूरभाष : 0755-2674318, 2674337, फैक्स : 0755-2766315
E-mail : pccfwl@mp.gov.in

क्रमांक/मा.चि.-II/रिसर्च/फ-170/ 1123 भोपाल, दिनांक: 8-2-2023

प्रति,

Dr. Parag Nigam,
Ph.D, Scientist F,
Department of Wildlife Health Management,
Wildlife Institute of India, P.O. 18, Chandrabani,
Dehradun-248001, Uttrakhand

विषय : **Project Proposal Title –"Gaur Reintroduction Plan (2022-27): Establishment of Gaur (Bos gaurus gaurus) in Sanjay Tiger Reserve, Madhya Pradesh":reg.**

संदर्भ : Dr. Ruchi Badola, Registrar, Wildlife Institute of India, Dehradun का पत्र क्रमांक/F.No.WHM/Vet/401/GAUR-STR दिनांक 15.07.2022.

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उपरोक्त विषय में प्राप्त अनुसंधान/अध्ययन प्रस्ताव अनुसार मध्यप्रदेश के संजय टाइगर रिजर्व तथा सीधी एवं उत्तर, दक्षिण शहडोल वनमंडल के अंतर्गत क्षेत्रों में अनुसंधान प्रस्ताव Title - "Gaur Reintroduction Plan (2022-27): Establishment of Gaur (Bos gaurus gaurus) in Sanjay Tiger Reserve, Madhya Pradesh" हेतु फील्ड सर्वे एवं डाटा कलेक्शन के द्वारा अध्ययन कार्य की माह फरवरी-2023 से माह जनवरी-2028 (पांच साल) तक की अवधि के लिए वन्यप्राणी (संरक्षण) अधिनियम, 1972 की धारा 28 (1) (a),(c) एवं मध्यप्रदेश-नियम, 1974 के नियम 35 के अंतर्गत निम्नलिखित शर्तों के अधीन अनुमति प्रदान की जाती है।

अध्ययन हेतु Gaur (Bos gaurus gaurus- 50 Immobilized Animals) के Blood Samples एवं 150-200 Dung Samples एकत्रित करने की अनुमति हेतु भारत सरकार को लेख किया गया है। अत: Blood Samples एवं Dung Samples भारत सरकार से अनुमति प्राप्त होने के पश्चात् ही एकत्रित किये जावेगे। वर्तमान में गौर के किसी भी प्रकार के कोई नमूने एकत्रित नही किये जावेगे।

शर्तों का विवरण:

1. शोध परियोजना को समस्त शुल्कों तथा शासकीय सुविधाओं जैसे भवन, वाहन, हाथी आदि का उपयोग करने पर निर्धारित शुल्क का भुगतान करना होगा।
2. शोधार्थी एवं उसके सहायको द्वारा संरक्षित क्षेत्र के भीतर अपनी सारी गतिविधियों को लॉगबुक में संधारित किया जाएगा तथा उसे प्रत्येक माह संरक्षित क्षेत्र प्रबंधन/क्षेत्र संचालक/वनमंडलाधिकारी को प्रस्तुत किया जाएगा।
3. वन अग्नि अथवा अन्य अवैध गतिविधियों की जानकारी मिलने पर शोधार्थी एवं उसके कर्मचारियों द्वारा स्थानीय अधिकारियों को तत्काल सूचित किया जावेगा।
4. शोधार्थी द्वारा संरक्षित क्षेत्र प्रबंधन के मुद्दो को मीडिया अथवा बाहरी संस्थाओं से विचार-विमर्श नही किया जाएगा। ऐसे किसी भी विषयों पर अपनी राय वह क्षेत्र संचालक/वनमंडलाधिकारी अथवा मुख्य वन्यप्राणी अभिरक्षक को व्यक्तिगत रूप से अथवा लिखित में प्रस्तुत करेगा।
5. क्षेत्र संचालक/वनमंडलाधिकारी द्वारा उप वनक्षेत्रपाल से अनिम्न स्तर के अधिकारी को परियोजना के लिये सम्पर्क अधिकारी नियुक्त किया जाएगा। शोध दल अपनी प्रत्येक गतिविधि/क्रियाकलाप के संबंध में सम्पर्क अधिकारी से चर्चा करेगा एवं सूचना देगा तथा उसे समस्त महत्वपूर्ण घटनाओं एवं प्रगति से अवगत कराएगा।

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6. शोध परियोजना हेतु आने वाले समस्त आगंतुक जिसमें अन्य वैज्ञानिक एवं छात्र भी सम्मिलित है, क्षेत्र संचालक/वनमंडलाधिकारी की अनुमति उपरांत ही परियोजना क्षेत्र का भ्रमण कर पाएंगे।
7. क्षेत्र संचालक/वनमंडलाधिकारी किन्ही स्थानीय परिस्थितियों जैसे मौसम, अध्ययनित क्षेत्र में वन्यप्राणी के घायल होने पर, जनसामान्य को खतरा होने पर आदि परिस्थितियों में मुख्य वन्यप्राणी अभिरक्षक को सूचित करते हुये शोधार्थी की गतिविधियो/क्रियाकलापों पर सीमा बंधन लगा सकेंगे।
8. शोध अनुमति की शर्तो का उल्लंघन किये जाने पर अनुमति निरस्त की जा सकेगी। क्षेत्र संचालक/वनमंडलाधिकारी को यह अधिकार होगा कि विशिष्ट परिस्थितियों में पर्याप्त कारण होने पर वह शोध कार्यो को निलंबित कर सके एवं मुख्य वन्यप्राणी अभिरक्षक से तत्संबंध में मार्गदर्शन प्राप्त कर संशोधन उपरांत शोध की निरंतरता बनाये रख सके।
9. शोध जब तक अन्यथा निर्दिष्ट न किया जाए शोध कार्यो के परिणामस्वरूप बने कोई व्यवसायिक उत्पाद विशेषकर वीडियों एवं चलचित्र मध्यप्रदेश वन विभाग एवं संस्थान की संयुक्त संपत्ति होगी।
10. शोध परियोजना हेतु निर्मित कोई भी स्थाई तथा अचल परिसम्पतियां परियोजना समाप्ति उपरांत वन विभाग को बिना कोई शुल्क लिये हस्तांतरित की जाएगी।
11. मध्यप्रदेश वन विभाग तथा संस्थान के द्वारा संयुक्त रूप से शोध कार्य की प्रगति की मध्यावधि समीक्षा यह ज्ञात करने के लिए की जाएगी कि शोध अनुमति की शर्तो का पालन किया जा रहा है अथवा नही।
12. परस्पर अनुकूल तिथि पर, शोधार्थी एवं मुख्य अन्वेषणकर्ता द्वारा शोध कार्य की प्रगति, इसकी उपलब्धिया, कठिनाइयां एवं भविष्य की रणनीति पर प्रस्तुतीकरण दिया जाएगा।
13. अनुसंधान/अध्ययन में किसी भी वन्यप्राणी को किसी भी प्रकार से पकड़ा (Capture) नही जावेगा।
14. अनुसंधान के दौरान पेड़ पौधों को किसी भी प्रकार से तोड़ा नही जाएगा, कोई क्षति नही पहुंचायी जाएगी तथा किसी भी पेड़ पौधों के किसी भी प्रकार के नमूने एकत्रित नही किये जावेगे।
15. अनुसंधान/अध्ययन कार्यो में किसी भी विदेशी नागरिक को शामिल नही किया जावेगा।
16. अनुसंधान/अध्ययन के परिणामों एवं निष्कर्षों को व्यवसायिक उद्देश्यों (Commercial Purposes) के लिये उपयोग में नही लिया जावेगा तथा अनुसंधान के परिणामों एवं निष्कर्षों को विदेशों में हस्तांतरित नही किया जावेगा।

यह अनुसंधान/अध्ययन कार्य Dr. Parag Nigam, PhD, Scientist F एवं Dr. Bilal Habib, PhD, Scientist E, Wildlife Institute of India, Dehradun के द्वारा क्षेत्र संचालक, संजय टाइगर रिजर्व, सीधी, मध्यप्रदेश के मार्गदर्शन में किया जावेगा।

अनुसंधान/अध्ययन के दौरान वन्यप्राणी (संरक्षण) अधिनियम, 1972 के प्रावधानों एवं शर्तो का कड़ाई से पालन करना सुनिश्चित करें। नियमों का उल्लंघन पाये जाने पर अनुमति निरस्त कर दी जावेगी। उक्त अनुसंधान/अध्ययन अवधि के लिये अध्ययन दल के सदस्यों को क्षेत्र संचालक/वनमंडलाधिकारी परिचय पत्र जारी करेंगे। अध्ययन कार्य समाप्ति के पश्चात् अध्ययन प्रतिवेदन अंतिम रूप से इस कार्यालय को एवं संबंधित क्षेत्र सचालक/वनमंडलाधिकारी को प्रेषित किया जाना सुनिश्चित करें।

08.02.2023

(जसबीर सिंह चौहान)
मुख्य वन्यप्राणी अभिरक्षक एवं
प्रधान मुख्य वन संरक्षक (वन्यप्राणी), म.प्र.

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पृ.क्रमांक/मा.चि.-II/रिसर्च/फ-170/ 1124 भोपाल, दिनांक: 9-2-2023

प्रतिलिपि :

1. अति. वन महानिदेशक (बाघ परियोजना) एवं सदस्य सचिव, राष्ट्रीय बाघ संरक्षण प्राधिकरण, भारत सरकार, पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, बी-1 विंग, सातवां तल, पं. दीनदयाल अंत्योदय भवन, सी.जी.ओ. कॉम्प्लेक्स, लोधी रोड, नई दिल्ली-110003 की ओर सूचनार्थ प्रेषित।
2. प्रधान मुख्य वन संरक्षक (अनुसंधान/विस्तार एवं लोक वानिकी), मध्यप्रदेश, सतपुड़ा भवन, भोपाल की ओर सूचनार्थ प्रेषित।
3. मुख्य वन संरक्षक, वन वृत्त रीवा/शहडोल, मध्यप्रदेश की ओर सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित।
4. क्षेत्र संचालक, संजय टाइगर रिजर्व, सीधी, मध्यप्रदेश की ओर सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित।
5. वनमंडलाधिकारी, सामान्य वनमंडल सीधी/उत्तर शहडोल/दक्षिण शहडोल, मध्यप्रदेश की ओर सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित।

   कृपया अनुमति में अधिरोपित शर्तों का पालन कराया जाना सुनिश्चित करें तथा अध्ययनकर्ता को आवश्यक सहयोग प्रदान करें एवं अध्ययन दल में सम्मिलित रिसर्च फेलो को फोटोयुक्त पहचान पत्र जारी करें।

   अध्ययन के दौरान वन्यप्राणी (संरक्षण) अधिनियम, 1972 के प्रावधानों एवं शर्तों का कड़ाई से पालन कराया जाना सुनिश्चित करें।
6. Dr. Ruchi Badola, Registrar, Wildlife Institute of India, P.O.18, Chandrabani, Dehradun-248001, Uttrakhand की ओर सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित।

मुख्य वन्यप्राणी अभिरक्षक एवं
प्रधान मुख्य वन संरक्षक (वन्यप्राणी), म.प्र.

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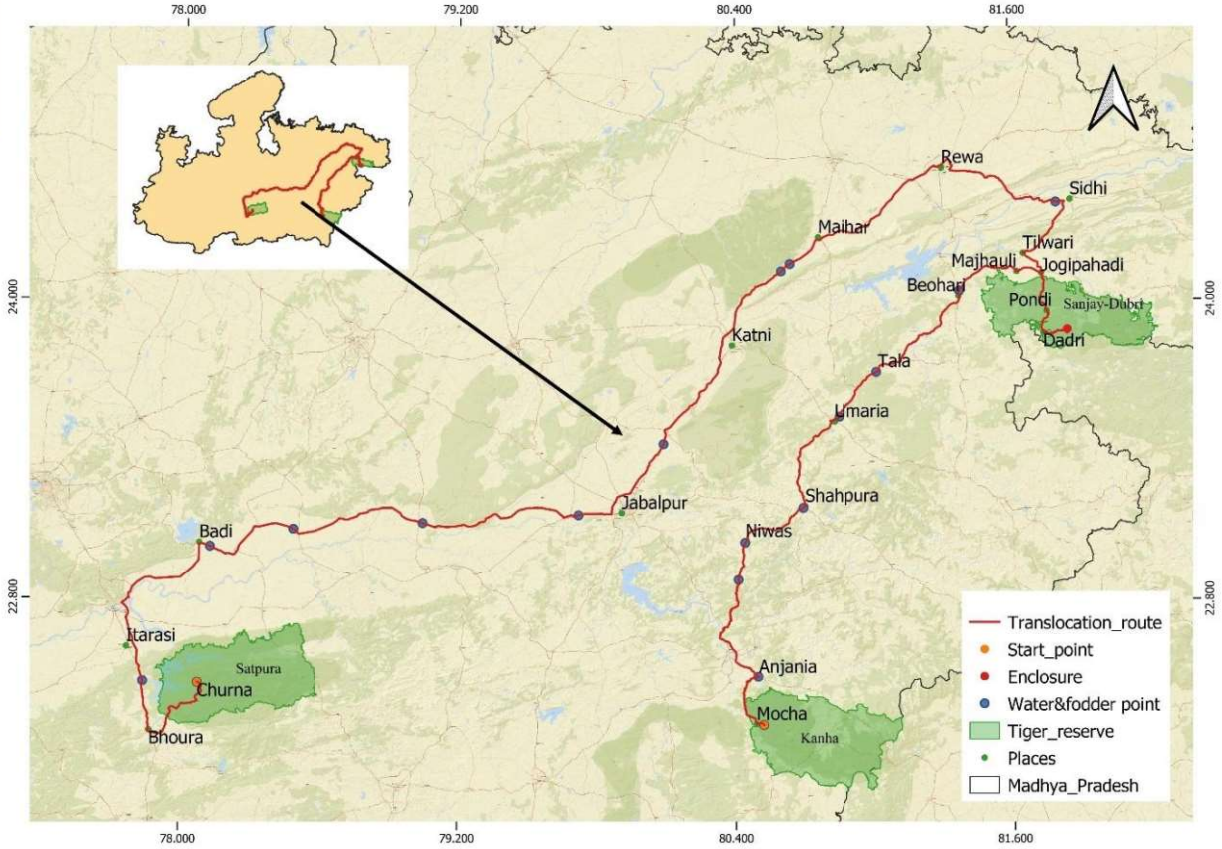
Annexure 2

Transportation route (Kanha Tiger Reserve & Satpura Tiger Reserve to Sanjay Tiger Reserve, Madhya Pradesh)



- Khatia Gate KTR
  - •35.5 km
- Anjania
  - 84.4 km
- Niwas
  - •87.9 km
- Umaria
  - •90.5 km
- Beohari
  - •47 km
- Jogipahadi
  - •36.2 km
- Lurghuti
  - •16 km
- SDTR Enclosure

- Churna Gate, STR
  - •45.6 km
- Bhoura
  - •114 km
- Bari
  - •216 km
- Jabalpur
  - •234 km
- Rewa
  - •70.5 km
- Sidhi
  - •44.1 km
- Jogipahadi
  - •36.2
- Lunghuti
  - •16km
- SDTR Enclosure

Annexure 3

Veterinary Protocol

The summary of the veterinary essentials during the field capture and translocation (Adopted from the Action Plan: Wildlife Institute of India. (2022) Gaur Reintroduction Plan 2022-27: Establishment of Gaur (*Bos gaurus gaurus*) in Sanjay Tiger Reserve, Madhya Pradesh, Action Plan.) is provided below.

Immobilization and Tranquilization Drugs:

The capture of free ranging Gaur is facilitated through use of narcotic agents as they have the advantage of being highly concentrated, require low drug volumes for easy handling and effective delivery; have rapid induction with minimal knock down time and have specific reversal drug that cause rapid recovery.

Opiods in general have been known to possess these qualities and are the drug of choice for immobilizing free ranging Gaur. The ability to have immediate reversal of the immobilization has also proved to be valuable for their use. Etorphine hydrochloride and thiafentanil oxalate have been effectively used during previous captures in Kanha (Nigam, 2014) and were shortlisted for capture. These drugs in appropriate doses produces rapid sternal recumbency with good anesthesia; safe for carrying out all the procedures including collaring, marking, biological sampling and tying up.

The use of short and long-acting tranquilizers to support capture, transport and facilitate adaptation of animal in the new environment have gained importance over the years and have shown positive results (Nigam, 2014). Long-acting tranquilizers have been effectively used in the capture and transport and produce calming in animals by moderating excitement and reducing aggression and motor activity. Based on the published information and experience of their use in South African ungulates as well as during previous capture operation in Kanha; azaperone, haloperidol and perphenazine enanthate were identified to provide tranquilization during captures and subsequent procedure (transport and post release) beisdes helping the animals to settle well at the release site. Beneficial effects include alteration of mood of animal, make the animal indifferent to its surrounding, decrease fear of humans, and decrease self- inflicted trauma (Caulkett and Arnemo, 2015).

The dosages of select drugs are provided at Table A3. However, the choice of drug and the dosage need to be based on due consideration of the animal's health and condition, body weight, level of excitement, physiological status, sex, time of day, ambient temperature, and other parameters as decided by the veterinarian on site. Once the necessary procedures are completed, the animal can be revived with a suitable reversal agent/ antidote (Table A3).

Since the majority of drugs (opioids and neuroleptics) for use in Gaur are not available in India, their procurement and use require administrative clearances, approval, and license. It needs to be carried out on a timely basis so that permissions are received well in advance.

Table A3: Select Immobilization drugs, dosages and action.

Sr. No.	Drug	Dosage	Remarks
1.	Etorphine hydrochloride	(9.8 mg/ml, Captivion^{TM}, Wildlife Pharmaceuticals (Pty) Ltd.) Dose rate of 0.007 to 0.012 mg/kg (mean± SD of 0.009 ± 0.001 mg/kg)	Primary Immobilizing agent
2.	Thiafentanil oxalate	(10mg/ml, Thianil^{TM}, Wildlife Pharmaceuticals (Pty) Ltd.) Dose rate of 0.007 – 0.013 mg/kg (mean± SD of 0.01±0.001 mg/kg)	
REVERSAL			
3.	Naltrexone	1mg Naltexone produces a reversal of immobilizing action of 40-50 mg of etorphine/ 20 X etorphine dose on mg/mg basis and 10X of thiafentanil	Reversal (Antidote for Etorphine and Thiafentanil)
4.	Naloxone	0.04-0.07mg/kg	Reversal (Human antidote for Etorphine)
TRANQULIZERS			
5.	Azaperone	80-100mg (0.1–0.5 mg/kg, IM)	Short-acting tranquilizer (effective for managing the initial excitement phase of drug induction)
6.	Haloperidol	15-20 mg total dose (0.025–0.2 mg/kg, IM)	Intermediate-acting tranquilizer
7.	Perphenazine enanthate	150 – 250 mg total dose (0.1–1.0 mg/kg, IM)	Long-acting tranquilizer
SUPPORTIVE			
8.	Hyaluronidase	4500 IU per dart	Enzymes facilitating drug absorption

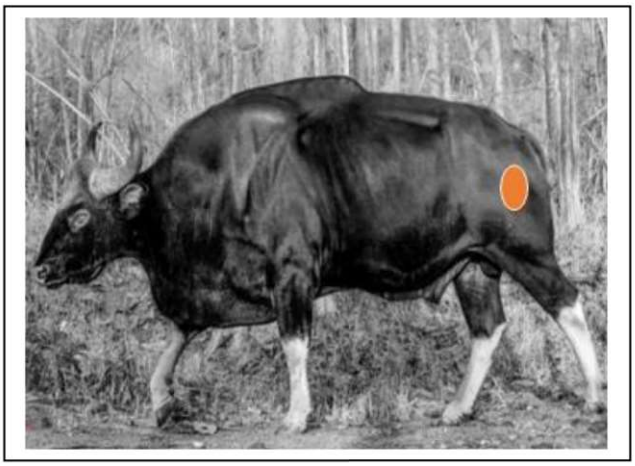
*Wolfe B.A. (2014); Nigam et al. (2014); Caulkett et al. (2015)

Drug delivery: Remote drug delivery is facilitated using all-plastic darts delivered through air- pressurized syringe projector. Selection of the dart projector should be based on proven accuracy, compactness, easy maneuvering on elephant back, being light weight and causing minimal traumatization and negligible disturbance of the animal. Though the effective range of these equipment is up to 60 meters, majority of animals can be darted from a distance of < 30 meters. The animals needs to be darted in the hind quarters as the area provided good muscle mass for efficient drug delivery. Plastic darts of 3 ml capacity with needle length was 40 mm (collared/ plain) is appropriate for darting. The list of the equipment required during the field operation is provided below.

Drug delivery equipment: Syringe Projectors/ Jab stick etc.
Post Immobilization animal monitoring system: Thermometer, Stethoscope, Pulse oximeter with tongue probe.
Other equipment: Electric prodder, suction pump to remove any obstruction in pharyngeal cavity, endo tracheal tubes with inflatable cuffs size 16,18 mm, stomach tube, trochar & cannula, ropes, torches, Swiss tool, water sprayers, binoculars, measuring tapes, communication system.

As per the veterinary protocols, a thorough check of drugs (immobilisation and emergency), accessories, and equipment functioning needs to be done beforehand.

Darting Site: The thigh or rump muscles are good sites for darting due to good muscle mass however other sites have also been used by handlers with mixed results. A wrong site of injection may result in the cannula hitting vital body parts (eyes, vertebral column, penis, bony prominences of the body). The dart needs to be projected perpendicularly as far as possible to facilitate deep intramuscular drug delivery. Angular shots need to be avoided as they tend to inject drug subcutaneously or in fascia/fat leading to improper drug delivery, delayed absorption and unpredictable response resulting in major injury, bouncing or even fracture.



Veterinary emergencies

- Chemical immobilization in uncontrolled environments can be extremely difficult. It may result in hypoxemia, hyperthermia, compromised cardiopulmonary system in immobilized animal (Caulkett and Arnemo, 2015). Every effort should be made to ensure that emergency management (skilled manpower, appropriate emergency drugs, delivery systems, animal support system (oxygen, parentral fluids, water etc.) was in place to manage any eventuality. Care needs to be taken to ensure that the animal is maintained in sternal recumbency following approach. Emergencies like bloat, regurgitation and aspiration pneumonia have been reported in ungulates and needs to be given due concern.

As the risk of anesthetic mortality can be minimized by using proper immobilizing drugs and dosages, proper remote drug delivery systems, and established capture methods and techniques, a skilled, experienced capture team having thorough understanding of the inherent risks associated with animal capture needs to be identified.

Risk associated with capture and translocation:

Chemical capture and anesthesia of free-ranging mammals will always involve some risk of mortality even in healthy animals. Arnemo, 2006 and Spraker,1993 have reported that the mortality rates during chemical immobilization for any large free-ranging mammalian species should be below 2% and anything above would require reevaluation of the anesthetic protocol. Deaths may be directly or indirectly attributable to the anesthetic event itself (e.g. drug overdose, and dart trauma) or may be caused by secondary effects from the capture (e.g. stress, myopathy, etc.) (Arnemo, et al., 2006). Every effort needs to be made to minimize stress and trauma to the animal while capturing.

Emergencies due to faulty drug administration (inaccurate darting, inadequate drug dosage, disturbance during darting etc.) has been reported in literature and necessitates proper planning, training of personnel involved in capture and execution of field capture to ensure minimal stress to the animal while being captured. It is important to ensure that darting is carried out in terrain that is flat as it provides opportunity to observe the animal following darting, easy approach of animal, easy access of the capture team and effective monitoring of immobilized animal and management of emergencies. Efforts should be made to avoid undulating terrain and if required, the animals may be moved/ guided towards open area with the help of captive elephants to facilitate proper darting and further management. Darting in improper terrain may result in animal getting anaesthetised in an area that is difficult to manage. (Arnemo et al. 2006); (Arnemo et al., 2014); (Caulkett et al., 2015)

Critical monitoring of the immobilized animal

The major post immobilization emergencies that can be encountered during the capture operations include development of ruminal tympany, regurgitation, hypoxemia, hyperthermia, hypoglycemia, cardiac depression and capture myopathy. Appropriate veterinary interventions need to be in place.

i. Animal positioning: The best position to maintain a gaur in immobilized state is in sternal recumbency. In case the animal comes on lateral recumbency, effort should be made to push the animal back into sternal recumbency. Aspiration pneumonia is a complication that may arise if the animal is not in proper position.
ii. Bloat: Being ruminant, there is every chance of animal developing bloat during immobilization. It is important to ensure that the animal is properly positioned to facilitate eructation of gases and there is appropriate emergency support system to handle any eventuality.
ii. Respiration function: Majority of drugs produce respiratory depression. It can get further aggravated in case of over dosage, improper position of immobilized animal or obstruction of airway passages. Keeping the head and neck in the straight line with mouth open is beneficial. Respiratory stimulant (Doxapram) has proved to be beneficial in managing emergencies.
iii. Thermoregulation: There is a likelihood of rectal temperatures to increase during immobilization and more so when captures are done during hot periods of the day. These can be managed by spraying water over the body and by provisioning shade/ cover. Antipyretics can be used to medically manage the condition.
iv. Hydration levels: There is a likelihood of immobilized animals to be dehydrated. The

veterinarian needs to properly assess the condition and provide fluid therapy, if necessary

v. Eye care: Eyes may be covered with cloth to avoid exposure keratitis and sensory stimulation.

vi. Physical injuries: Animal may sustain injuries during the capture operation. These injuries can range from small wounds resulting from improper darting and bruises to even fatal ones (falling on a tree stump or hard ground object and damaging internal organs).

Assessment of immobilized animal for level of sedation

Once the animals is darted, they should be left undisturbed for proper drug induction. It takes approximately 3-7 minutes for the drug to produce the desired effect however the animal needs to be approached after ensuring that the levels of sedation safe for handling are achieved.

Health assessment of the captured animal is crucial to the success of any field operation. As immobilizing drugs induce physiological alterations in the captured animal, it was essential to intensively monitor the physiological parameters (pulse, respiration, temperatures, color of mucus membrane, hydration level and oxygen saturation etc.). Any alterations in these parameters need to be adequately addressed by the veterinary team.

Sr No.	Physiological parameters	Range
1.	Temperature	*38.0–39.3° C (100.4–102.8° F)*
2.	Respiration	*10-30/ min*
3.	Pulse	*60-70 beats/min*
4.	Mucus membrane	*Rosy pink*

Normal ranges for physiological parameters in an adult Gaur.

Emergency drugs to support respiratory and cardiac functions needs to be kept handy at all times. Duly equipped and identified veterinary emergency management team should responsible for managing any eventuality. Supportive antibiotics to prevent possible infections secondary to procedures, injectable vitamins, intravenous fluids, eye ointments, tetanus toxoid should be part of the prophylactic treatment provided to the animal at discretion of the veterinarian.

The list of drugs and equipment required during the operation is provided below.

Immobilization drugs: Etorphine/ Thiafentanil and Naltrexone (revival). Tranquilizers: Azaperone, Haloperidol and Perphenazine enanthate.

Antibiotics: Fortified Procaine penicillin, Ampicillin-cloxacillin parental and intra-mammary infusion.

Emergency drugs: Butorphanol tartrate, Doxapram, Atropine sulphate, Hyaluronidase, Haloperidol, Fluphenazine, Epinephrine, Prednisolone, Dexamethasone besides haemostyptics, antiseptics, antipyretics, NSAIDs, vitamin-mineral supplements (Details may be worked out in conjunction with veterinarian).

Medical supplies: Oxygen cylinders, Disposable syringes, tuberculin syringes, gloves, surgical- pads, needles, gauze etc.

Table A4: Emergency drugs

Sr. No.	Drug	Remarks
1.	Doxapram	Analeptic, Effective dose range 0.2-0.5 mg/kg IV/IM for respiratory depression.
2.	Ephedrine	Sympathomimetic, Dose range 0.5 - 1.0 ml of 1:1000 solution IV/IM
3.	Prednisolone	Glucocorticoid, 10 mg/kg IV for circulatory collapse.
4.	Dexamethasone	Glucocorticoid, Dose 1 mg/kg IV for circulatory collapse
5.	Atropine	Anticholinergic 0.02-0.06 mg/kg
6.	Vit E & Selenium	Muscle stabilization to prevent capture myopathy

*Swan G.E. (1993)

The immobilised animal needs to be checked for any visible injuries or disorders. It is important that the animal is positioned in sternal recumbency with the head positioned so that saliva or cud rolls out, the airways are patient, and respiratory and circulatory functions are not compromised. Additionally, the oral cavity should be cleared of any obstruction, cud, or saliva.

Once the animal is stabilized and the parameters are within normal limits, further interventions (collaring, biological sampling, shifting onto a stretcher, lifting, loading onto a transport vehicle, etc.) should be initiated under veterinary supervision. Special emphasis should be given to ensuring that animal welfare concerns are not compromised at any level and that the animal is subjected to minimal stress.

Human safety consideration

Chemical immobilization involves use and handling of dangerous and poisonous chemicals/drugs delivered through sophisticated remote drug delivery systems. Several cases of drug related accidents especially inadvertent injections of capture personnel with drug doses designed for animal capture, improper judgement of immobilization state resulting in injuries that can be even fatal and improper use of drug delivery equipment have been reported. It is essential that the persons involved in capture operation are aware of the dangers associated with chemical immobilization.

Successful immobilization of wild animals is an art as much as science as number of factors determines the success of the procedure. It is not only important that the person carrying out the operation has clear understanding of the immobilizing drugs and equipment, but also has adequate knowledge and understanding of the species being handled and procedures involved; besides personal ability to carry out such operation. Skill and experience are prerequisite for successful immobilization.

Field immobilisation of gaur is always a challenge, as most operations must be carried out in tough surroundings. In general, the chances of inflicting self-injuries, miscalculating/ misjudging drug dosages, drug spillage and accidents are high. The individual may be exposed to various threats during capture operation that may include physical injuries, chemical/ drug poisoning or getting exposed to infectious diseases and parasites during handling. Though accidental exposures have occurred, there is limited information

available on these incidents. At times, these exposures can even be fatal; hence, human safety should be the foremost consideration when carrying out any field immobilisation.

Prevention and Management

Accidents during field immobilisation can be effectively avoided by having a thorough knowledge of the drug protocol and the procedures, awareness on hazards associated with drug immobilisation and undertaking preventive measures for personal protection (eye and hands) and during handling (drugs, loaded darts, immobilised animal). A first aid kit is an important component of any immobilisation operation to meet any eventuality. Effective communication, transport and medical support aids in responding to any emergencies.

In the event of any accident, the basic principles of management include keeping the patient calm and comfortable, arranging for medical support, limiting drug absorption by washing any contact surface with large quantities of water or application of tourniquet, administering antidotes if symptoms of poisoning are noted, proper positioning of the patient (horizontal sideways position to prevent choking in case the patient vomits or on his back to provide cardiopulmonary resuscitation CPR). A person needs to be trained in providing CPR before hand. Morkel, 1993 suggested mnemonic HAD- ABC as a sequence for responding in case of emergency.

First Aid Kit

Emergency drugs: When narcotics are used atleast 20 mg Naloxone and Naltrexone should be part of the first aid kit besides 250 mg hydrocortisone, 40 mg diazepam (VALIUM), 5 mg atropine, 20 mg adrenalin.

Other medical supplies: Stethoscope, thermometer, intravenous saline (0.9%) solution-2 litres, IV drip set -2, disposable syringes-2,5 & 10 ml, hypodermic needle, 18g & 21g, adhesive plaster and scissors, sterile bandage/gauge 2"& 4", antiseptic lotion and haemostyptics

Medical supplies to meet respiratory depression Portable Oxygen cylinders with mask, Doxapram HCL (CAROPRAM/ DOPRAM) - 4vials and muscle relaxants.

H	Help	Immediately call for help
A	Absorption/Antidote	Limit absorption and give antidote if required
D	Drip	Establish drip as soon as possible if indicated
A	Airway	Establish and maintain adequate airway
B	Breathing	Monitor breathing and apply artificial respiration if needed
C	Circulation	Administer cardiac massage if there is heart failure.

Field immobilisation is as much an art as a science. A thorough understanding and knowledge of the animal being immobilised, drug protocols and procedures, hazards associated with the use of drugs and management of any eventuality are important.

Annexure 4

Data Sheet for Recording and Monitoring Immobilized Animal (Gaur)

Area Details Date ……..

Location …….. GPS Lat…….. Long……..

Purpose of capture ……

Collar Frequency/make/color ……

Ambient temperature …….. Day (cloudy, bright) ……..

Animal Details

Species …….. Physical condition ……..

Emotional state before drugging …….. Sex ……..

Approximate age …….. Breeding status ……..

Weight (kg) Estimated ……..Actual……..

Immobilisation Details

Name of Immobilizing Drug/ Concentration	Time of Injection	Total volume	Mg used	Route & site
1.				
2.				
3.				

Behaviour at the time of darting (running, walking, standing, excited)

Induction time Ataxia……min, dropping of head……min, Incoordination and Sternal recumbency…… Min (Right/left), Salivation (present/ absent), Any other observation……

The sequence of events following darting till the animal is approached (Sequence of the event)……
……
……

Animal Monitoring

Time	Observations following Immobilization	Respiration	Rectal temp. (°F)	Pulse (rate)	Oxygen saturation/ Capillary filling time/ Mucus membrane
		Shallow/ deep/ irregular & rate			

Name of reversal Drug(s)	Time of Injection	Mg used and & volume	Route	Site

Details about recovery event till animal regains consciousness /shows signs of recovery

.....

.....

.....

Name of other supportive Drug(s)/antibiotic(s) etc. given	Volume used	mg used	Route & site

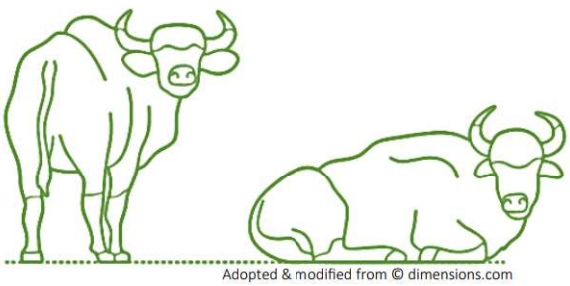
Biological sampling

Name of sample	Preservative used	Examination required	Handed over to	Remarks

Team

Comments

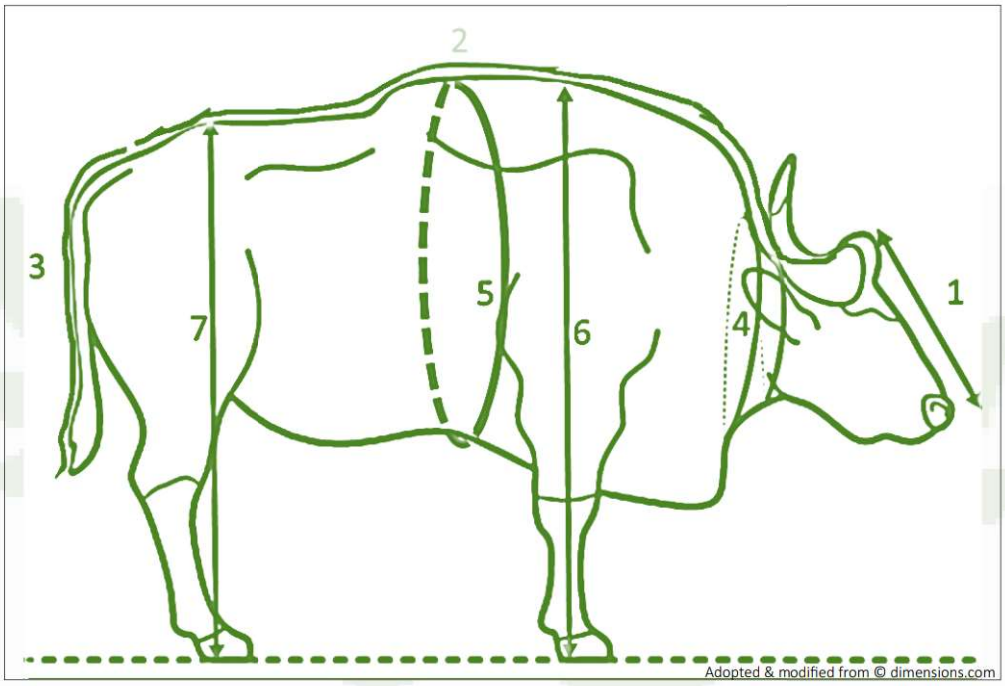
Signature



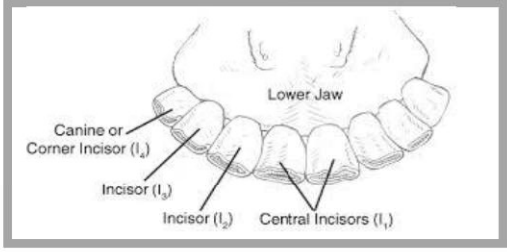
Adopted & modified from © dimensions.com

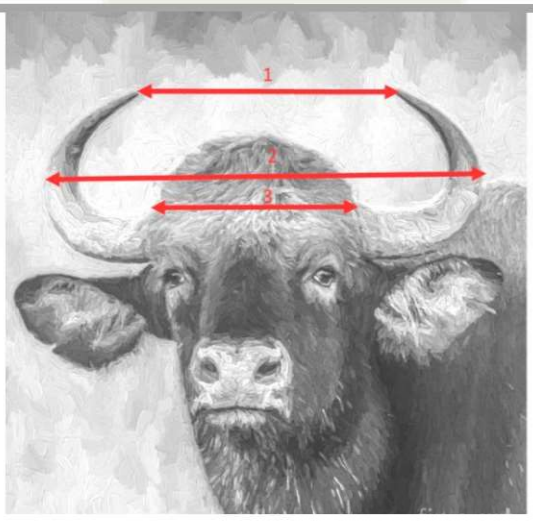
Body Measurements

1. Nose tip to Base of Occiput……2. Base of Occiput to base of tail ……..
3. Tail length…… 4. Neck girth (U)……M)……(L)……..
5. Chest girth ……6. Height (Shoulder blade to heel) ……..
7. Hind limb length ……



8. Horn length (R) ……(L)…… 9. Horn spread: (b)…… (m)……(t)……
10. Testicular Dimensions……11. Hoof condition
……
12. Skin condition…… 13. Dentition/wear & tear I ---, C ---, PM ---, M ---
10. Identification marks: Scar and location/ Ear tear/etc. ……
……





Annexure 5

List of officials involved in gaur reintroduction

Sr. No.	Name	Designation
Madhya Pradesh Forest Department		
1	Sh. Aseem Shrivastav	PCCF & HoFF, Govt of MP
2	Dr. Atul Kumar Shrivastav	PCCF (WL) & CWLW, Govt of MP
3	Sh. Subharanjan Sen	PCCF (HRD), Govt. of MP
4	Sh. Satyanand	Director SFRI, Jabalpur
5	Sh. Jasbir Singh Chauhan	Former PCCF & CWLW, Govt. of MP
6	Sh. L. Krishnamoorthy	APCCF & Field Director, Satpura Tiger Reserve, MP
7	Sh. S.K. Singh	CCF & Field Director, Kanha Tiger Reserve, MP
8	Sh. Amit Kumar Dubey	CCF & Field Director, Sanjay Tiger Reserve, MP
9	Sh. Naresh Singh Yadav	CF & Joint Director, Kanha Tiger Reserve, MP
10	Sh. Sandeep Fellows	Deputy Director, Satpura Tiger Reserve, MP
11	Sh. Punit Goyal	Deputy Director, Kanha Tiger Reserve, MP
12	Sh. Hariom	Divisional Forest Officer, Dindori (Production) Forest Division, MP
13	Sh. Rajesh T. Kanna	Deputy Director, Sanjay Tiger Reserve, MP
14	Sh. Rajnish Kumar Singh	Deputy Director, Pench Tiger Reserve, MP
15	Ms. Amita	Deputy Director, Kanha-Buffer, MP
16	Dr. Akhilesh Mishra	WHO, Pench Tiger Reserve
17	Dr. Sanjeev Gupta	WHO, Panna Tiger Reserve
18	Dr. Sandeep Agarwal	WHO, Kanha Tiger Reserve
19	Dr. Atul Gupta	WHO, Van Vihar National Park
20	Dr. Nitin Gupta	WHO, Bandhavgarh National Park
21	Dr. Gurudutt Sharma	WHO, Satpura Tiger Reserve
22	Dr. Rajesh Tomar	WHO, MMSJ White Tiger Safari and Zoo
23	Dr. Abhay Sengar	WHO, Sanjay Tiger Reserve
24	Dr. Amit Oad	Veterinary Officer, Ratapani Wildlife Sanctuary
25	Sh. Sanjeev Sharma	Assistant Director, Kisli, Kanha Tiger Reserve
26	Sh. Vidhyabhushan Singh	Assistant Director, Banjar, Kanha Tiger Reserve
27	Sh. Ajay Thakur	Assistant Director, Halon Malajkhand, Kanha Tiger Reserve
28	Sh. Mukesh Kumar Jamor	Assistant Director, Phen, Kanha Tiger Reserve
29	Sh. Mitendra Chichkhede	Assistant Director, Sijhora, Kanha tiger Reserve
30	Sh. Rajeev Shrivastav	SDO, Churna, Satpura Tiger Reserve
31	Sh. Ashish Kumar Pandey	SDO, Kurai, Pench Tiger Reserve
32	Sh. Ashish Khobragadhe	SDO, Pachmarhi/Pipariya, Satpura Tiger Reserve
33	Sh. Rahul Raghuvanshi	SDO, Dubri, Sanjay Tiger Reserve
34	Ms. Vinita Phulwe	SDO, Sidhi, Sanjay Tiger Reserve
35	Sh. Sudhir Mishra	SDO, Sidhi, Sanjay Tiger Reserve
36	Sh. Nikunj Pandey	SDO, Son Gariyal, Snajay Tiger Reserve
37	Sh. Rameshwar Tekam	SDO, Kushmi, Sanjay Tiger Reserve
38	Sh. Sitaram Rajurkar	Range Officer, Sitaram, Kanha Tiger Reserve
39	Sh. Jitendra Awase	Range Officer, Kisli, Kanha Tiger Reserve
40	Sh. Vijay Bharaskar	Range Officer, Satpura Tiger Reserve

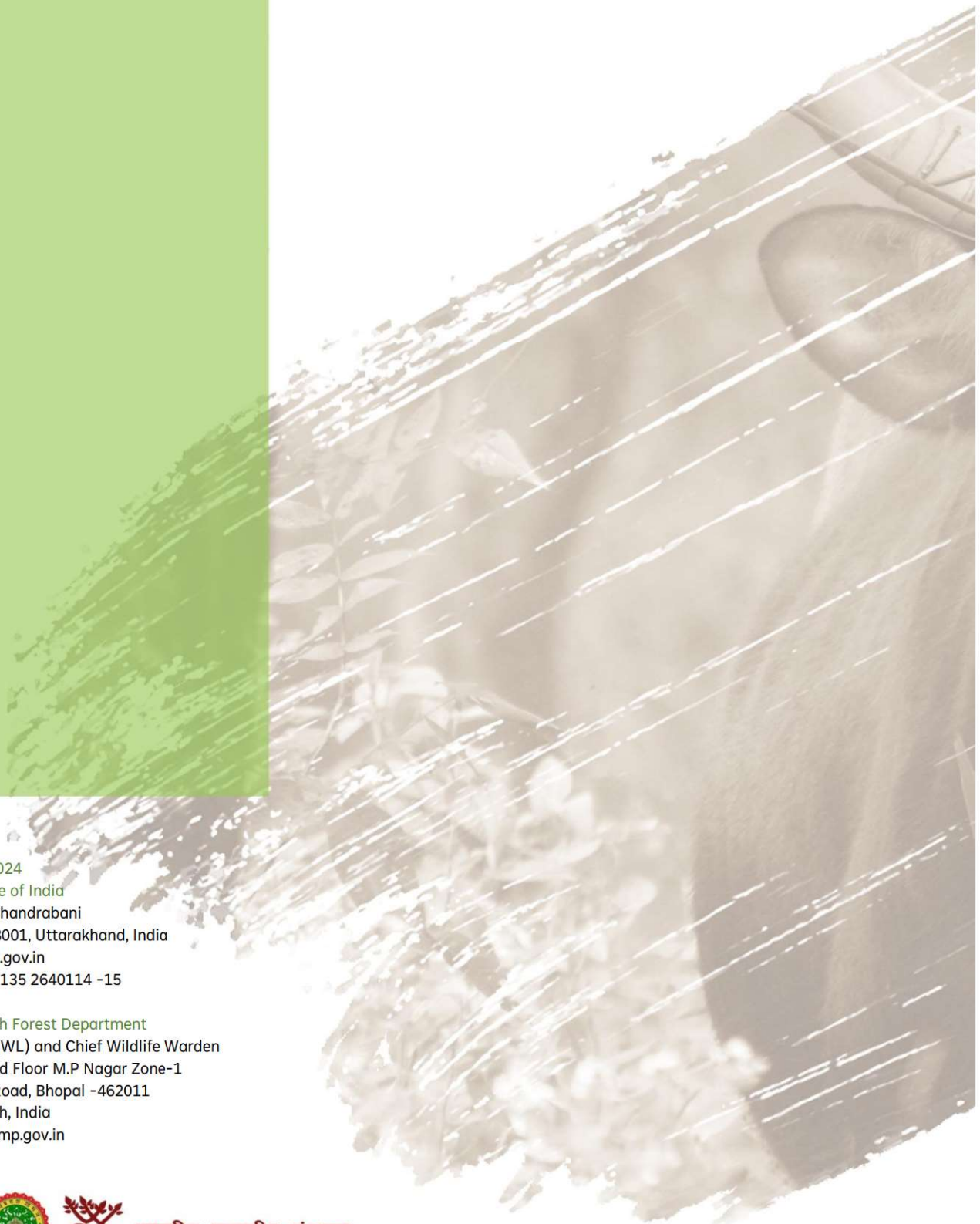
Sr. No.	Name	Designation
41	Sh. Abhay Tomar	Range Officer, Kanha, Kanha Tiger Reserve
42	Sh. Virendra Jamod	Range Officer, Mukki, Kanha Tiger Reserve
43	Sh. Rambharosh Patakh	Range Officer, Churna, Satpura Tiger Reserve
44	Sh. Naval Singh Chauhan	Range Officer, Bori, Satpura Tiger Reserve
45	Sh. Nishant Doshi	Range Officer, Satpura Tiger Reserve
46	Sh. Martand Singh Marawi	Range Officer, Khamarpani, Pench Tiger Reserve
47	Sh. Virendra Jyotshi	Range Officer, Khatiya, Kanha Tiger Reserve
48	Sh. Mahavir Pandey	Range Officer, Bastua, Sanjay Tiger Reserve
49	Sh. Aseem Bhuriya	Range Officer, Tamsar, Sanjay Tiger Reserve
50	Sh. Subham Khare	Range Officer, Beohari, Sanjay Tiger Reserve
51	Mrs. Kavita Rawat	Range Officer, Pondi, Sanjay Tiger Reserve
52	Sh. Akash Paroha	Range Officer, Dubri, Sanjay Tiger Reserve
53	Sh. Sanjeev Ranjan	Range Officer, Madwas, Sanjay Tiger Reserve
54	Sh. Ajinkya Deshmukh	Field Biologist, Kanha Tiger Reserve
55	Sh. Sangeeta Kewat	Field Biologist, Sanjay Tiger Reserve
Wildlife Institute of India, Dehradun		
1	Sh. Virendra Tiwari	Director, WII
1	Dr. Parag Nigam	Scientist G & Head, Dept. of Wildlife Health and Management
2	Dr. S. Sathyakumar	Scientist G & Registrar
3	Dr. Bilal Habib	Scientist F, Dept. of Animal Ecology and Conservation Biology
4	Sh. Ritesh Vishwakarma	Senior Project Associate (Gaur Project -SDTR)
5	Sh. Bhaskar Bhandari	Project Associate -II (Gaur Project-SDTR)
6	Sh. Bharat Sharma	Driver, WII
7	Sh. Deepak Yadav	Office Assitant, WII
School of Wildlife Forensic and Health, NDVSU, Jabalpur		
1	Dr. Shobha Jawre	Director, SWFH
2	Dr. Nidhi Rajput	Ast. Professor, SWFH
3	Dr. Amol Rokade	Ast. Professor, SWFH
4	Dr. Kajal Jatav	Ast. Professor, SWFH
5	Dr. K.P. Singh	Wildlife Biologist, SWFH
6	Dr. Hamza Farooqui	Veterinary Scholar, SWFH
7	Sh. Ravi Kewat	Driver, SWFH
External Professionals		
1	Dr. A.B. Shrivastav	Foremer Director, SWFH
2	Mr. Kartikey Singh Chauhan	Founder, Wildlife and Forestry Services
2	Dr. Chatturvedi	Health Professional, Mandla District (MP)
3	Dr. Saurabh Rathore	Health Professional, Mandla District (MP)
Kanha Tiger Reserve (Field Staff)		
1	Sh. Dinesh Patel	Assistant Health Staff
2	Sh.Sandeep Singor	Computer opp.
3	Sh.Sundar Lal	Cook
4	Sh.Ramesh Maravi	Cook
5	Sh.Santosh singh Thakur	Driver
6	Sh.Chandrabhan Singh	Driver
7	Sh.Sugriv Das Tandiya	Driver

Sr. No.	Name	Designation
8	Sh.Alum Parte	Field Staff
9	Sh.sukchain Maravi	Field Staff
10	Sh.Dilip Yadav	Field Staff
11	Sh.Bheemsen Rajput	Field Staff
12	Sh.Chetram Parte	Field Staff
13	Sh.Lal Singh	Field Staff
14	Sh.dharam Singh Gurve	Field Staff
15	Sh.Santosh Neti	Field Staff
16	Sh.Mahesh markaam	Field Staff
17	Sh.Amar Lal Maravi	Field Staff
18	Sh.Chhabi Lal Maravi	Field Staff
19	Sh.Rajkumar Gurve	Field Staff
20	Sh.Shiv Prasad Gond	Field Staff
21	Sh.Kamlesh Markaam	Field Staff
22	Sh.Saddam Markaam	Field Staff
23	Sh.Ram Prasad Maravi	Field Staff
24	Sh.Vishram Singh	Field Staff
25	Sh.Manoj Singh	Field Staff
26	Sh.Rajju Lal Markaam	Field Staff
27	Sh.Lalla Yadav	Field Staff
28	Sh.Sukhchain Maravi	Field Staff
29	Sh.Deepesh Gaekwad	Forest Guard
30	Sh.Mahesh markaam	Forest Guard
31	Sh.Kamta Prashad	Forest Guard
32	Sh.Ramesh Rahangdale	Forest Guard
33	Sh.Ramesh Katre	Forest Guard
34	Sh.Matuk Singh Maravi	Mahaout
35	Sh.Netram Sarote	Mahaout
36	Sh.Malsingh Yadav	Mahaout
37	Sh.Santosh Bhalavi	Mahaout
38	Sh.Hemraj Yadav	Mahaout
39	Sh.Rambhrosh Maravi	Mahaout
40	Sh.Mahipal Maravi	Mahaout
41	Sh.Deepak Saiyyam	Mahaout
42	Sh.Dharam Singh Parte	Mahaout
43	Sh.Ramprasad Maravi	Mahaout
44	Sh.Mahendra Bohat	Sweeper
45	Sh.Sukhchand Kushram	T.P.F.
46	Sh.Santosh Yadav	T.P.F.
47	Sh.Tularam Yadav	T.P.F.
48	Sh.Sukkal Markaam	T.P.F.
49	Sh.Ayodhya Yadav	T.P.F.
50	Sh.Govind seyam	T.P.F.
51	Sh.Hans Lal Yadav	T.P.F.
52	Sh.Mahesh Gurve	T.P.F.
53	Sh.Sukkhu Singh Maravi	T.P.F.

Sr. No.	Name	Designation
54	Sh.Naval Singh Gurve	T.P.F.
55	Sh.Lakhan Vishwakarma	T.P.F.
56	Sh.Umendra Gurve	T.P.F.
57	Sh.Sanjay Gurve	T.P.F.
58	Sh.Ramcharan Yadav	T.P.F.
59	Sh.Omprakash	T.P.F.
60	Sh.Ravindra Uike	T.P.F.
61	Sh.Tikaram Yadav	T.P.F.
62	Sh.Gopal Shrivastava	T.P.F.
63	Sh.Ramprasad Ayam	T.P.F.
64	Sh.Gend Lal Yadav	T.P.F.
65	Sh.Dhup Singh Markaam	T.P.F.
66	Sh.Chetram Maravi	T.P.F.
67	Sh.Bhujbal	Waiter
68	Sh.Satayavan Yadav	Waiter
69	Sh.Nand Kishor	Washerman
Sanjay Tiger Reserve (Field Staff)		
1	Sh. Diwakar Singh Kushram	Beat Guard
2	Sh. Anil Sahoo	Field Staff
3	Sh. Dashrath Yadav	Field Staff
4	Sh. Mohan Singh	Field Staff
5	Sh. Indrajeet Singh	Field Staff
6	Sh. Kamlesh Yadav	Field Staff
7	Sh. Sanjay Yadav	Field Staff
8	Sh. Devswaroop Yadav	Field Staff
9	Sh. Lalbahadur Singh	Field Staff
Satpura Tiger Reserve (Field Staff)		
1	Sh. Narpat Singh Alawa	Beat Guard
2	Sh. Chandrapal Gurve	Beat Guard
3	Sh. Dinesh Gurve	Beat Guard
4	Sh. Anil Kumar Sakkya	Beat Guard
5	Sh. Sumit Saha	Field Biologist
6	Sh. Umesh Yadav	Driver
7	Sh. Jagdish	Driver
8	Sh. Mukesh	Driver
9	Sh. Vinod Tiwari	Driver
10	Sh. Madhu	Driver
11	Sh. Vinod Kahar	Driver
12	Sh. Ram Singh	Driver
13	Sh. Nitin	Driver
14	Sh. Manish	Driver
15	Sh. Ramesh	Driver
16	Sh. Manoj Patel	Driver
17	Sh. Jagdish	Driver
18	Sh. Chiman Bathare	Driver
19	Sh. Mahesh	Driver

Sr. No.	Name	Designation
20	Sh. Pradeep Sharama	Driver
21	Sh. Sushil Thakare	Driver
22	Sh. Sher Singh Bhallavi	Field Staff
23	Sh. Ishwar Das Yadav	Field Staff
24	Sh. Jagdish Yadav	Field Staff
25	Sh. Fulchandra Markaam	Field Staff
26	Sh. Seetaram Uike	Field Staff
27	Sh. Rajkumar	Field Staff
28	Sh. Chhoteveer	Field Staff
29	Sh. Sangram Singh	Field Staff
30	Sh. Madan	Field Staff
31	Sh. Sarvan	Field Staff
32	Sh. Jai Singh	Field Staff
33	Sh. Mehtar	Field Staff
34	Sh. Gannu	Field Staff
35	Sh. Ashok	Field Staff
36	Sh. Rewaram	Field Staff
37	Sh. Mehtu	Field Staff
38	Sh. Anil	Field Staff
39	Sh. Dassu	Field Staff
40	Sh. Ramdas	Field Staff
41	Sh. Kanhaiya	Field Staff
42	Sh. Shivsankar	Field Staff
43	Sh. Bali	Field Staff
44	Sh. Omprakash	Field Staff
45	Sh. Rajesh	Field Staff
46	Sh. Makhan	Field Staff
47	Sh. Vijay	Field Staff
48	Sh. Mahesh Uike	Mahaout
49	Sh. Anil Bhusare	Mahaout
50	Sh. Lakhan Alap	Mahaout
53	Sh. Preetam	T.P.F.
54	Sh. Rohit	T.P.F.
55	Sh. Guljaar	T.P.F.
Pench Tiger Reserve (Field Staff)		
1	Sh. Nand Kishor Birhole	Driver
2	Sh. Ravi Uike	Driver
Bandhavgarh Tiger Reserve (Field Staff)		
1	Sh. Sanjay Pandey	Driver
2	Shiv Kumar	Driver
3	Sh. Shivbhan	Field Staff
4	Sh. Shikari Yadav	Field Staff
5	Sh. Shrilal Yadav	Driver
Captive Elephants, Madhya Pradesh Forest Department		
1	Vanraj	Captive Elephant
2	Mansi	Captive Elephant

Sr. No.	Name	Designation
3	Kanha	Captive Elephant
4	Pawan	Captive Elephant
5	Chanchalkali	Captive Elephant
6	Himalaya	Captive Elephant
7	Vijay Bahadur	Captive Elephant
8	Ranapratap	Captive Elephant
9	Shiva	Captive Elephant
10	Shivani	Captive Elephant
11	Tara	Captive Elephant
12	Smita	Captive Elephant
13	Priya	Captive Elephant
14	Vikram	Captive Elephant
15	Anjuman	Captive Elephant



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