Ministry of Forests and Environment

STATUS OF TIGERS AND PREY IN NEPAL 2022

Department of National Parks and Wildlife Conservation

Department of Forests and Soil Conservation

STATUS OF TIGERS AND PREY IN NEPAL 2022

Government of Nepal
Ministry of Forests and Environment
Department of National Parks and Wildlife Conservation
and
Department of Forests and Soil Conservation
Kathmandu, Nepal
2022

TECHNICAL TASK FORCE

Hem Raj Acharya, Assistant Ecologist, Department of National Parks and Wildlife Conservation
Ashim Thapa, Assistant Ecologist, Department of National Parks and Wildlife Conservation
Babu Ram Lamichhane, PhD, Senior Conservation Officer, National Trust for Nature Conservation
Samundra Ambuhang Subba, Research Officer, WWF Nepal
Gokarna Jung Thapa, PhD, Head of GIS/RS, WWF Nepal
Rabin Kadariya, PhD, Senior Conservation Officer, National Trust for Nature Conservation
Laxmi Raj Joshi, Conservation Officer, National Trust for Nature Conservation

FIELD COORDINATORS

Haribhadra Acharya, Chief Conservation Officer, Chitwan National Park
Manoj Kumar Shah, Chief Conservation Officer, Parsa National Park
Shyam Kumar Shah, Chief Conservation Officer, Banke National Park
Bishnu Prasad Shrestha, Chief Conservation Officer, Bardia National Park
Kishor Kumar Mehta, Chief Conservation Officer, Shuklaphanta National Park

TECHNICAL COMMITTEE

Ganesh Pant, PhD, Ecologist, Department of National Parks and Wildlife Conservation
Sabnam Pathak, Assistant Forest Officer, Department of Forests and Soil Conservation
Naresh Subedi, PhD, Program Manager, National Trust for Nature Conservation
Chiranjibi Prasad Pokheral, PhD, Program Manager, National Trust for Nature Conservation
Kanchan Thapa, PhD, Head of Wildlife Programs, WWF Nepal
Bhagawan Raj Dahal, PhD, Deputy-Country Representative, ZSL Nepal

ADVISORS

Ram Chandra Kandel, PhD, Director General, Department of National Parks and Wildlife Conservation
Rajendra K.C., PhD, Director General, Department of Forests and Soil Conservation
Dhananjaya Paudyal, Chief, Biodiversity and Environment Division, Ministry of Forests and Environment
Himanshu Khadka, Director, National Parks and Wildlife Reserve Directorate
Bed Kumar Dhakal, Deputy Director General, Department of National Parks and Wildlife Conservation
Ajay Karki, Deputy Director General, Department of National Parks and Wildlife Conservation
Sharad Chandra Adhikari, Member Secretary, National Trust for Nature Conservation
Ghana Shyam Gurung, PhD, Country Representative, WWF Nepal
Hem Sagar Baral, PhD, Country Representative, ZSL Nepal

CITATION

DNPWC and DFSC. (2022). Status of Tigers and Prey in Nepal 2022. Department of National Parks and Wildlife Conservation and Department of Forests and Soil Conservation. Ministry of Forests and Environment, Kathmandu, Nepal.

The Prime Minister

KATHMANDU
NEPAL

Message

Nepal is endowed with rich biological diversity, and it has tremendous potential in reshaping people's livelihood and economic base of the country. The Government of Nepal is committed to the conservation of biodiversity on a sustainable basis for the benefit of Nepal's present and future generations and for the global community as a whole, in accordance with the principles of the Convention on Biological Diversity.

Over the last few decades, we have made an impressive progress in establishing and managing 23.39% of our land under protected areas system- a key strategy for biodiversity conservation. Moreover, Nepal has made a significant achievement in the recovery of key wildlife species including tiger, rhinoceros, and gharial. Tiger is an indicator species of healthy ecosystem, and we are benefited from tiger conservation in several ways mostly through the maintenance of ecosystem services, promotion of nature-based tourism and livelihood.

In 2010, the International community made a strong commitment to double the World's wild tigers in the Saint Petersburg Tiger Summit. During the Summit, all 13 tiger range governments agreed to the global goal of doubling the tiger population by 2022, based on the baseline population of 2010. I am happy to learn that Nepal has become the first country to double the tiger population, which is a matter of national pride. In this context, I wish to extend my sincere thanks to the Ministry of Forests and Environment, security forces involved in conservation, conservation partners and the local communities for their untiring efforts and support in achieving this ambitious target.

The increase in number of tigers calls for arranging adequate habitation and ensuring sufficient moving areas for tigers. Equally important is minimizing the risk of human-wildlife conflict through adequate safety measures. In view of this, development and implementation of a practical plan would be critically important to preserve both human beings and tigers.

I take this opportunity to reiterate the commitment of the Government of Nepal towards conserving tiger and other key wildlife species that eventually contribute for the prosperity of people and the nation. Finally, I would like to mention that our future actions and strategies will focus on managing tiger population and promoting human-tiger coexistence.

Sher Bahadur Deuba

Kathmandu, Nepal
17 July 2022

Government of Nepal

Ministry of Forests and Environment

Singhadurbar, Kathmandu

Message

The tiger is an apex predator, dominating the ecological food chain and playing a key role in maintaining the balance of natural ecosystems, safeguarding water regimes and aiding in climate security. Yet, globally, habitat shrinkage, poaching, unplanned infrastructure development and industrialization among other threats have endangered the species' survival, with a 93 percent habitat decline reported in the past century.

Nepal has been tirelessly working to reverse this declining trend. In 2010, along with other range countries, Nepal endorsed the St Petersburg declaration committing to double the tiger population by 2022. Guided by strategic policies and with effective grassroots implementation, key threats to the species were effectively and holistically addressed. To evaluate efficacy of the tiger conservation efforts, systematic and robust scientific monitoring was carried out in Nepal every four years.

In 2022, the Department of National Parks and Wildlife Conservation (DNPWC) and the Department of Forest and Soil Conservation (DFSC) conducted the fourth National Tiger and Prey Survey with the support from National Trust for Nature Conservation, WWF Nepal and ZSL Nepal. I am happy to note that the results prove that Nepal has successfully achieved its goal of doubling its tigers.

In line with this achievement, our future strategic goal will be to maintain these populations by facilitating human-tiger coexistence through enhancing frontline staff capacity, community stewardship, and effectively coordinating with stakeholders. Nepal will continue to further improve protection for tigers and their habitats, manage conflicts, develop wildlife-friendly infrastructures, and address other emerging challenges while balancing the country's development aspirations.

Finally, I would like to acknowledge the roles of DNPWC and DFSC in leading this responsibility. Likewise, I appreciate the great support from the local communities, conservation partners, and security forces in this initiative. With the continued support from key stakeholders, Nepal will continue to strive towards a better future for its tigers as well as people.

Kathmandu, Nepal
17 July 2022

Pradeep Yadav
Minister

Government of Nepal

Ministry of Forests and Environment

Singhadurbar, Kathmandu

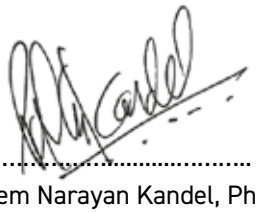
Foreword

Tiger is a flagship species that inhabits a wide range of interconnected habitats, conservation of which ensures the health of the ecosystem. Historically, tigers were distributed throughout the Asia, extending from Turkey in the west to the eastern coast of Russia. In the past century, the tiger's range shrunk by 93%, with its global population reduced to about 3,200 individuals in just 13 range countries in 2010. Habitat loss and degradation, poaching and illegal trade of body parts, and human-tiger conflicts, were the major reasons for the decline.

Considering the rapid plunge of tiger population in the past decades, it has been listed as 'Endangered' in the IUCN's Red List and under Appendix I in Convention on International Trade in Endangered Species of Wild Fauna and Flora. As one of the tiger range countries, Nepal has also listed the species under Schedule I in its National Parks and Wildlife Conservation Act, 1973.

Nepal is committed to achieve its international pledge of doubling the tiger population by 2022. Over the past decades, major focus areas have included addressing key threats such as poaching, habitat loss and human-wildlife conflicts. To manage tiger meta-population at the landscape level, investments were also made to secure core breeding sites by establishing new protected area, extending existing areas, and restoring corridor functionality, within and between protected areas of Nepal and India. The Government of Nepal is working closely with local communities under the framework of community-based conservation, benefiting communities by ploughing back up to 50% of protected area's revenue to improve livelihoods and well-being, for greater stewardship.

Every four years, Nepal conducts national survey of tiger and prey to evaluate effectiveness of conservation interventions. Accordingly, the fourth national survey was carried out between December 2021 and April 2022. I would like to express my sincere thanks to all the government and partner organizations including the National Tiger Survey 2022 Advisory Committee, Technical Committee, Technical Task Force, Field Implementation Committees, protection units, frontline staff, citizen scientists and volunteers for their contributions and hard work in this national initiative. I specially thank the Department of National Parks and Wildlife Conservation and Department of Forests and Soil Conservation for leading the survey; and WWF Nepal, ZSL Nepal and National Trust for Nature Conservation for financial and technical support. I would also like to specially thank the local communities and all relevant stakeholders who have contributed towards the long-term survival of this magnificent species.



Kathmandu, Nepal
17 July 2022

.....
Pem Narayan Kandel, PhD
Secretary

Government of Nepal
Ministry of Forests and Environment

Department of Forests and Soil Conservation

Department of National Parks and Wildlife Conservation

Acknowledgement

Nepal, among the 13 range states, is committed to doubling the tiger by 2022 as per St Petersburg Declaration 2010. National surveys are conducted every four years to update the status of tigers and prey, based on tiger monitoring protocol. The fourth nationwide Tiger and Prey Survey 2022 has revealed impressive increase in the status of tigers, making Nepal the first country globally to succeed in doubling its tiger population. This gives us pride and encouragement to continue our tireless efforts to save this magnificent species.

The survey was conducted by the Government of Nepal with the support from National Trust for Nature Conservation, Zoological Society of London-Nepal office, and World Wildlife Fund-Nepal office. We would like to thank Dhananjaya Paudyal - Joint Secretary, Ministry of Forests and Environment, Himanshu Khadka, Director, National Parks and Wildlife Reserve Directorate, Bed Kumar Dhakal and Ajay Karki, Deputy Director Generals of DNPWC, Sharad Chandra Adhikari - Member Secretary, NTNC, Hem Sagar Baral - Country Representative, ZSL Nepal and Ghana Shyam Gurung - Country Representative, WWF Nepal, for their support and advice in making this national survey a success.

We extend our thanks to the technical committee members - Ganesh Pant, Sabnam Pathak, Kanchan Thapa, Naresh Subedi, Chiranjibi Prasad Pokheral, and Bhagawan Raj Dahal for their untiring work throughout the survey and report preparation. Our special thanks go to Chief Conservation Officers and staff of Parsa, Chitwan, Banke, Bardia, and Shuklaphanta National Parks, Divisional Forest Offices (Dadeldhura, Kanchanpur, Kailali, Bardia, Surkhet, Banke, Salyan, Dang, Arghakhanchi, Kapilvastu, Rupendehi, Palpa, Nawalparasi–Bardaghat Susta East, Nawalparasi–Bardaghat Susta West, Chitwan, Parsa, Makwanpur, Bara and Rautahat) as well as Nepali Army and staff of NTNC, ZSL Nepal, WWF Nepal and TAL field offices for their participation and support in the field survey implementations.

We would also like to thank the technical task force members - Hem Raj Acharya, Ashim Thapa, Babu Ram Lamichhane, Samundra Ambuhang Subba, Gokarna Jung Thapa, Rabin Kadariya, Laxmi Raj Joshi, for their active envolvement in implementing the field surveys and analysis. Special thanks to Ashish Gurung, Umesh Paudel, Bishnu Prasad Thapaliya, Sunjeep Pun, Suman Malla, Bishnu Lama, Harka Man Lama, Kritana Bhandari, Prawesh Poudel, Rabin Bahadur K.C., and Sagar Chaudhary for their outstanding contribution in field survey and data management. Many thanks to Ashok Kumar Ram and Sheren Shrestha for helping with editing the report. We would like to thank Chungba Sherpa for providing selected tiger photos for this report. Additionally, our special thanks to all elephant staff involved during the survey, buffer zone user committees, community forest user groups, Community Based Anti-poaching Units, citizen scientists, students and volunteers for their role and participation in the survey.

We hope this technical report will be useful to all policy makers, managers, conservationists, academia, and general readers nationally and internationally. Finally, we reiterate our sincere thanks to every individual and institution who contributed to this initiative in Nepal's tiger conservation.

Rajendra K.C., PhD
Director General
Department of Forests and Soil Conservation

Ram Chandra Kandel, PhD
Director General
Department of National Parks and Wildlife Conservation

ACRONYMS

AIC	Akaike Information Criterion
BaNP	Banke National Park
BNP	Bardia National Park
CBD	Convention on Biological Diversity
CFUG	Community Forest User Group
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CNP	Chitwan National Park
CV	Coefficient of Variation
DFO	Division Forest Office
DFSC	Department of Forests and Soil Conservation
DNPWC	Department of National Parks and Wildlife Conservation
ESA	Effective Sampling Area
GoN	Government of Nepal
GPS	Global Positioning System
GTRP	Global Tiger Recovery Program
HTC	Human Tiger Conflict
IAP	Invasive Alien Species
IUCN	International Union for Conservation of Nature
MCMC	Markov Chain Monte Carlo
MCP	Minimum Convex Polygon
MFSC	Ministry of Forests and Soil Conservation
ML	Maximum Likelihood
MMDM	Mean Maximum Distance Moved
MSL	Mean Sea Level
NTNC	National Trust for Nature Conservation
PA	Protected Area
PNP	Parsa National Park
RRT	Rapid Response Team
SD	Standard Deviation
SE	Standard Error
SECR	Spatially Explicit Capture Recapture
ShNP	Shuklaphanta National Park
SMART	Spatial Monitoring and Reporting Tool
SSB	Seema Suraksha Bal
TAL	Terai Arc Landscape
UNESCO	United National Education, Scientific and Cultural Organization
WCCB	Wildlife Crime Control Bureau
WWF	World Wildlife Fund for Nature
ZSL	Zoological Society of London

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Tiger (*Panthera tigris*) is an endangered umbrella species, and indicator of healthy ecosystems. The tiger's distribution declined drastically in the last century and is now confined in 13 Asian countries. However, implementation of strategic conservation interventions has revived tiger populations in most range countries. In 2010, Nepal along with other range countries endorsed the St. Petersburg declaration to double the tiger population by 2022. In this regard, Nepal prepared periodic tiger conservation action plans and effectively implemented them on ground. Nepal has adopted the landscape conservation modality declaring Terai Arc Landscape as a transboundary tiger conservation landscape. During this period, establishment of Banke National Park, extension of Parsa National Park and restoration of critical corridors were major milestones in terms of securing habitats for the species.

Nepal has conducted periodic assessments of tigers at intervals of four years since 2009. The first, second and third nationwide assessments carried out in 2009, 2013, 2018 estimated 121, 198, and 235 tigers, respectively. This report synthesizes the findings of the fourth nationwide tigers and prey survey, led by the Department of National Parks and Wildlife Conservation and Department of Forests and Soil Conservation with support from conservation partners including National Trust for Nature Conservation, WWF Nepal and ZSL Nepal. Frontline staff, wildlife technicians, community-based citizen scientists and volunteers from various institutions supported this nationwide survey. The survey was conducted in all potential tiger habitats between December 2021 and April 2022 following 'Tiger and Prey Base Monitoring Protocol' of Nepal. The objectives of the survey were to assess: i) habitat occupancy of tigers, ii) tiger abundance and density, and iii) prey density.

To conduct this survey, an advisory committee and a technical committee were formed at central level and implementation committees at protected area level. Orientation trainings were provided to field survey teams prior to the field survey. Habitat occupancy was carried out in 137 (15 km × 15 km) grid cells covering 18,928 km^2 of forested habitats to estimate tiger distribution across the country. Camera-trap survey was carried out in 1,843 (2 km × 2 km) grid cells encompassing - a) sampling area: 7,372 km^2, b) effective sampling area (total sampling area plus buffer): 20,747 km^2 (protected areas, buffer zones, corridors, and adjoining forests) to estimate tiger abundance and density. Overall effective sampling effort was 31,422 trap days. Survey of 778 line transects, with a total sampling effort of 1,438 km, provided the prey density estimates. An extensive effort of 13,065 person-days and 655 elephant-days was invested to complete the field work for the nationwide survey.

Tiger occupancy was estimated using the program - PRESENCE; tiger abundance and density were estimated using spatial capture-recapture models in *'secr'* and '*SPACECAP*' package in R environment. Similarly, prey density was estimated using distance sampling framework in DISTANCE software. Combining both sign and capture locations in camera trap, tigers were recorded in 16 districts (Rautahat, Bara, Parsa, Makwanpur, Chitwan, Nawalparasi-Bardhaghat Susta East, Nawalparasi-Bardhaghat Susta West, Dang, Banke, Salyan, Bardia, Surkhet, Kailali, Doti, Kanchanpur and Dadeldhura) of 24 districts surveyed across the country. Altogether, 692 unique tiger signs were detected, with the occupancy estimate of ~0.51 - the area occupied by tigers is 9,653 km^2 of the total potential habitat of 18,928 km^2 - across the landscape. Segregating further, habitat occupied by tigers in protected areas was found to be as high as ~0.86 (5,426 km^2), as against ~0.38 (4,624 km^2) outside protected areas. Findings suggest opportunities for further occupancy increase through management interventions.

Tigers were photo-captured in 647 grids (35%) of the total 1,843 grids. From a total of 5,746 tiger photographs generated, 316 individuals were identified, including 35 in Parsa National Park, 113 in Chitwan National Park, 23 in Banke National Park, 117 in Bardia National Park and 28 in Shuklaphanta National Park. Independent detections (1,996) of identified individuals were analyzed to estimate protected area-wise tiger populations. Based on

spatial capture-recapture estimate, 41 tigers were estimated in Parsa National Park and adjoining forests, 128 tigers in Chitwan National Park and adjoining forests, 25 tigers in Banke National Park and adjoining forests, 125 tigers in Bardia National Park and adjoining forests and 36 tigers in Shuklaphanta National Park and adjoining forests. A naïve comparison indicates an approximate increase in the national tiger population by 51% since 2018. The total number of tigers in Nepal currently is 355 individuals. With these findings, Nepal has successfully achieved its commitment to double its tiger population.

Tiger density (per 100 km^2) in protected areas and adjoining forests, was estimated to be 1.74 (SD 0.17), 4.06 (SD 0.22), 0.97 (SD 0.12), 7.15 (SD 0.38), and 1.99 (SD 0.27) in Parsa, Chitwan, Banke, Bardia and Shuklaphanta National Parks, respectively. Wild prey species detected during line transect survey included four deer species (spotted deer, sambar, hog deer, barking deer), two antelopes (blue bull and four-horned antelope), wild boar, gaur, and two primate species (rhesus monkey and langur). Combined prey density (per km^2) in Protected Areas and adjoining forests were 75 (SE 11.4), 100 (SE 9.1), 33 (SE 6.6), 90 (SE 11.2) and 146 (SE 19) in Parsa, Chitwan, Banke, Bardia and Shuklaphanta National Parks, respectively.

The overall positive trends in habitat occupancy, tiger abundance and prey density in Nepal relates to positive outcomes of improved protection and management measures, better connectivity as well as greater support towards conservation by communities. With this, Nepal has achieved the St. Peterburg's target to doubling the tiger population by 2022. Strategic interventions in future are necessary to maintain these tiger populations. Adequate protection to tigers outside protected areas, managing human-tiger conflicts, and increasing prey density particularly larger species like gaur, swamp deer, sambar, nilgai and wild buffalo. These will need to be supported by further improvements in protection and management interventions, research on human–tiger conflict and tiger ecology as well as greater engagement with communities.

1 INTRODUCTION

The tiger (*Panthera tigris*) is an iconic species, and an apex predator of terrestrial ecosystems. The species is currently distributed in 13 range countries (Bangladesh, Bhutan, Cambodia, China, India, Indonesia, Lao PDR, Malaysia, Myanmar, Nepal, Russia, Thailand, and Vietnam) with an estimated global population of 3,900 individuals in the wild (Associated Press, 2016). Over the past century, global tiger range is found to have been reduced by 95% (Wolf and Ripple, 2017), while its population declined from an estimated 100,000 individuals. Acknowledging this sharp decline in tiger population and its habitat, the global community united with a commitment to double the world's wild tiger population by 2022, adopting the Global Tiger Recovery Program (GTRP) in 2010 (GTRP, 2010). Nepal is one of the 13 tiger range countries that committed to double the tiger population, against its 2010 baseline of 121 to 250 individual tigers by 2022.

The historic low in Nepal's tiger conservation was the early 1970s, with an estimated national population of ~50 individuals in the wild. Prior decades had seen large wildlife hunting processions organized by the then Rana rulers and Shah dynasty for state guests. For instance, 120 tigers were hunted in a single hunting trip during 1939.

The 1970 also served as a turning point in Nepal's conservation chronology. Tiger conservation was formally initiated with the establishment of Chitwan National Park (CNP), the first national park (NP) of Nepal, and launch of the tiger ecology project in 1972 (McDougal, 1977; Smith, 1993). Subsequently, the Government of Nepal (GoN) has established four other protected areas (PAs) viz. Parsa National Park (PNP), Banke National Park (BaNP), Bardia National Park (BNP) and Shuklaphanta National Park (ShNP) for the conservation of tigers in lowland areas of the country. Conservation perspectives, and thereby approaches, have evolved over time, globally. Being a signatory to diverse global conventions (RAMSAR 1971, CITES 1973, UNESCO 1984, CBD 1992), conservation priorities in Nepal has accordingly evolved, from protecting species in isolated PAs to landscape level thinking for initiating tiger conservation with a metapopulation approach (Wikramanayake *et al.*, 1998).

Poaching and illegal trade, habitat loss and fragmentation, decline of prey and human-tiger conflicts (HTC) have added extra challenges in conserving this charismatic creature, in recent decades. Increase in human population, rapid urbanization and large infrastructure development have also triggered land-use changes in the landscape, further aggravating the threats. The Terai Arc Landscape (TAL) was accordingly conceptualized as the first transboundary conservation landscape in Nepal and India to facilitate tiger dispersal, with larger goal of mainstreaming species and forest restoration into the rural development agenda. Almost two decades of landscape level conservation coupled with law enforcement efforts began paying dividends with increasing tiger numbers and distribution, illustrating restoration of habitats facilitating tiger dispersal is conceivable while enhancing local livelihoods (Chanchani *et al.*, 2014; Thapa *et al.*, 2018).

The Government of Nepal has been conducting nationwide assessment of the status of tigers and prey, every four years, since 2009, following the national 'Tiger and Prey Base Monitoring Protocol' (DNPWC, 2008 and 2017). Three nationwide tiger surveys carried out in 2009, 2013, and 2018 indicated a steady trend with 121, 198, and 235 tigers respectively (Karki *et al.*, 2009, Dhakal *et al.*, 2014; DNPWC and DFSC, 2018). The first survey result provided the baseline, and the second assessment recorded a 63% increase in the country's tiger population, with an estimated population of 198 tigers. It also provided better insights of tigers along the transboundary Landscape with empirical evidence of tiger movement across the

international borders (Chanchani *et al.*, 2014). The third assessment estimated 235 tigers – an increase of ~19% within the four-year period.

Each of these assessments identified site-specific management and conservation gaps, recommending appropriate measures and guiding strategic investments to address them. Policy documents such as National Forest Policy (2019), National Biodiversity Strategy and Action Plan (2014-2020), President Chure Terai-Madhesh Conservation and Management Master Plan (2017), Terai Arc Landscape Strategy and Action Plan (2015-2025), Chitwan Annapurna Landscape Strategy and Action Plan (2015-2025) and Tiger Conservation Action Plan (2016-2020) adopted these recommendations and helped guide holistic tiger conservation in Nepal. Strengthening protection, improving habitats, reducing human-tiger conflicts and strengthening transboundary conservation were the key strategies adopted.

The fourth Nationwide Tiger and Prey Survey, 2022, was conducted by the Department of National Parks and Wildlife Conservation (DNPWC) and Department of Forests and Soil Conservation (DFSC) in partnership with the National Trust for Nature Conservation (NTNC), WWF Nepal and ZSL Nepal. This report presents the findings of the latest survey and recommends a road map for management of Nepal's tiger populations in the future.

2 OBJECTIVES

The objective of the fourth Nationwide Tiger and Prey Survey was to update the status of the tiger and prey in Nepal. The specific objectives include:

i The habitat occupied by tigers at the landscape level;

ii The tiger population abundance and density in PAs and adjoining forests; and,

iii The prey density in PAs and adjoining forests.

3 STUDY AREA

The study area for the fourth nationwide Tiger and Prey Survey covered potential tiger habitats within as well as beyond the Terai Arc Landscape (TAL) - Nepal. The TAL is a global priority transboundary conservation landscape for tigers, extending from Bagmati River, Nepal in the east to Yamuna River in Uttarakhand, India in the west, with an area of 51,002 km^2 (Wikramanayake *et al.*, 1998). TAL-Nepal accounts for 24,710 km^2, in 19 districts (Dadeldhura, Kanchanpur, Kailali, Bardia, Salyan, Surkhet, Banke, Dang, Arghakhanchi, Kapilvastu, Rupendehi, Palpa, Nawalparasi (Bardaghat Susta East), Nawalparasi (Bardaghat Susta West), Chitwan, Makwanpur, Bara, Parsa and Rautahat) in six provinces (Sudurpashchim, Karnali, Lumbini, Gandaki, Bagmati, and Madhesh). Within TAL-Nepal, ShNP, BNP, BaNP, CNP and PNP are prime tiger habitats and PAs; biological corridors (Brahmadev, Laljhadi, Basanta, Karnali, Khata, Kamdi, Lamahi, Barandabhar and Shikaribas) provide habitat connectivity among these PAs of Nepal and with transboundary PAs in India (Chanchani *et al.*, 2014). In addition to these areas falling in TAL-Nepal, five districts towards the east (Sarlahi, Dhanusa, Sindhuli, Siraha and Udaypur) were included for tiger occupancy assessment in the fourth national survey, with effective sampling area extending to a total of 18,928 km^2.

The survey area represents sub-tropical monsoonal climate with three distinct seasons: cool-dry (November-February), hot-dry (March-June) and monsoon (July-October). The average temperature in the cool season drops to 5°C in January and rises to 40°C in the hot dry season (MFSC, 2015). These climatic variations support a mosaic of early successional tall grasslands established in the alluvial floodplains to climax stage Sal forests at lower elevations, and broad-leaved forests in the Chure range. Major habitat types include Sal forests, riverine forests, mixed hardwood forests and alluvial grasslands (MFSC, 2015). The highly productive alluvial grasslands and riverine forests of TAL are the key habitats for tigers. These habitats also support 85 species of mammals, 565 species of birds, 47 species of herpeto-fauna and more than 125 species of fish (MFSC, 2015), including other imperiled species such as the greater one-horned rhinoceros *(Rhinoceros unicornis),* swamp deer *(Rucervus duvaucelii),* Asian elephant *(Elephas maximus),* Gangetic dolphin *(Platanista gangetica),* Bengal florican *(Houbaropsis bengalensis),* Gyps vulture (Gyps spp), and gharial *(Gavialis gangeticus).*

Table 1. Tiger bearing protected areas in Nepal

Protected Area	IUCN Category	Core Area (km^2)	Buffer Zone (km^2)	Year of establishment	Elevation
Parsa NP	II	627	285	1984 as WR; upgraded to NP in 2017	435-950
Chitwan NP	II	952	729	1973	150-815
Banke NP	II	550	343	2010	153-1,247
Bardia NP	II	968	327	1976	150-1,441
Shuklaphanta NP	II	305	243	1976 as WR; upgraded to NP in 2017	174-1,386

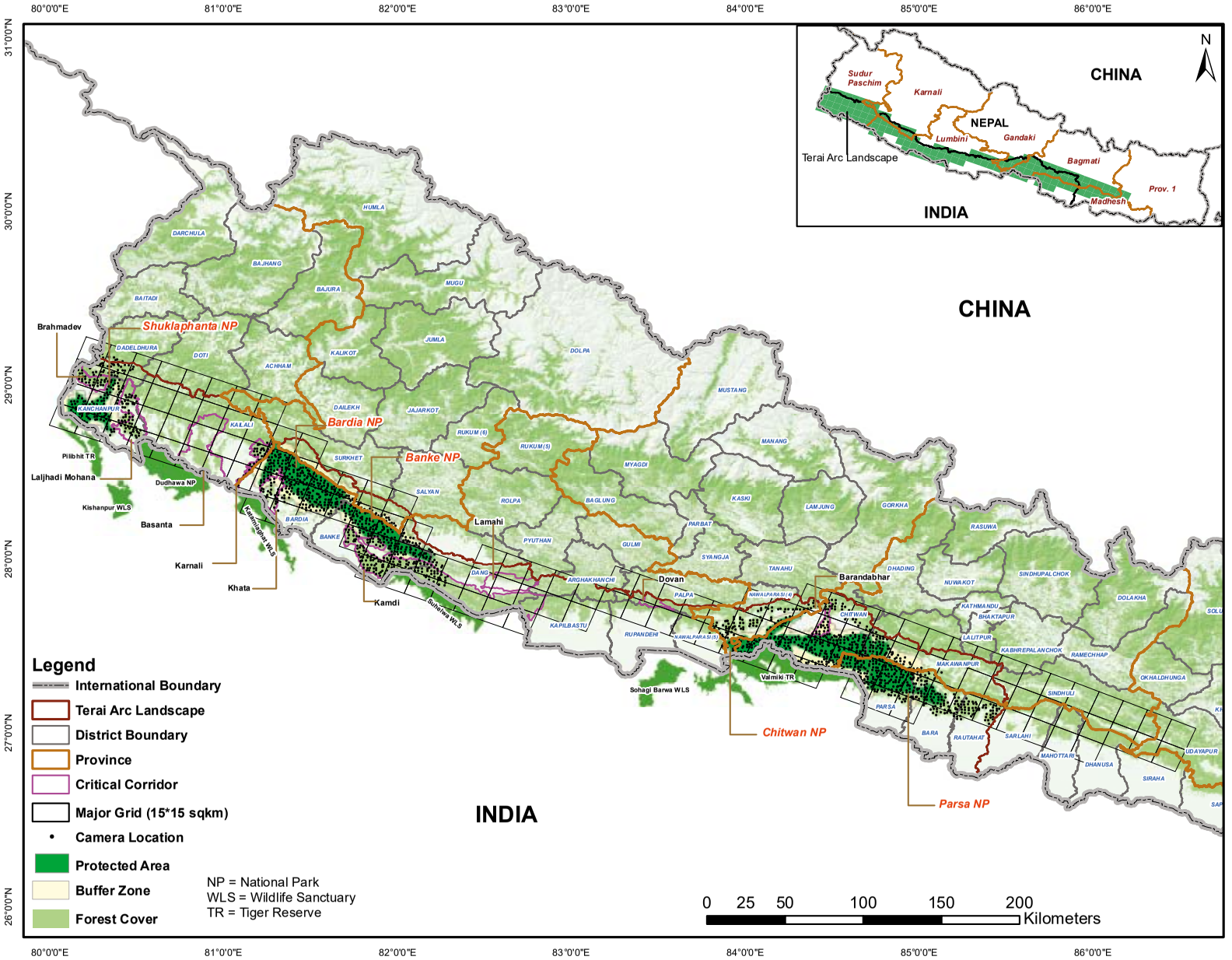


Figure 1. Location of TAL – Nepal showing tiger-bearing PAs and corridors with camera trap locations (black dots) and habitat occupancy grid cells (15 km x15 km)

4 MATERIALS AND METHODS

The national tiger survey was based on the revised version (DNPWC, 2017) of Nepal Government's 'Tiger and Prey Base Monitoring Protocol, 2008'. This involved standard procedures for monitoring tigers and their prey in their potential habitats within Nepal. Details are presented in the following sections.

4.1 Survey team organization

The fourth nationwide survey was guided and implemented by a multi-dimensional team with a National Tiger Survey Advisory Committee, a Technical Committee and Field Implementation Committees. The Advisory Committee was chaired by the Director General, DNPWC, with members including Director General, DFSC, Deputy Director Generals DNPWC Member Secretary - NTNC, Country Representative - WWF Nepal, and Country Representative – ZSL Nepal, for overall guidance and leadership. The Technical Committee was chaired by the Ecologist, DNPWC and supported by representatives of DFSC, WWF Nepal, ZSL Nepal and NTNC for overall technical coordination and supervision. Field Implementation Committees were formed in Parsa, Chitwan, Banke, Bardia, and Shuklaphanta National Parks, under the chairmanship of respective Chief Conservation Officers, with members including respective Divisional Forest Officers, Officers-in-Charge of NTNC field offices, Manager of TAL, Field Officers from ZSL Nepal and other relevant stakeholders. The details of the personnel involved are provided in Annex-10. A Technical Task Force led by Assistant Ecologist of DNPWC and comprising representatives from WWF Nepal and NTNC was created for data processing and analysis.

4.2 Field methods

4.2.1 Field training

The field work began with detailed orientation trainings on occupancy, camera trap and line transect surveys to the field team members who were involved in the tiger and prey survey, in CNP (for Chitwan-Parsa complex), BNP (for Banke-Bardia Complex), and ShNP (for Shuklaphanta-Laljhadi Jogbuda Complex). The trained personnel were strategically deployed in groups of 7-13 across the study area, to conduct the surveys.

4.2.2 Time frame and human resources

The field survey was conducted from December 2021 to April 2022 (Annex-9). It was initiated from CNP following formal inauguration by Honorable Minister, Ram Sahay Prasad Yadav, Ministry of Forests and Environment. An extensive effort of 13,065 person-days and 655 elephant-days was invested to complete the nationwide survey (Annex-9).

4.2.3 Tiger occupancy surveys

Standardized method was followed for tiger occupancy survey (DNPWC, 2017), covering 137 grid cells (15 km X 15 km each) spread across 18,928 km^2 of potential tiger habitat (forests and grasslands) in TAL (Figure 1). Each grid cell was divided into 16 sub-grid cells (3.75 km x 3.75 km). One sub-grid cell was randomly selected to include an element of randomness in spatial distribution of survey routes (Karanth *et al.*, 2008; Barber-Meyer *et al.*, 2012). The number of spatial replicates (i.e., km walked) per grid cell was proportional to the percentage of tiger habitat (Karanth *et al.*, 2008; Barber-Meyer *et al.*, 2012). For grid cells with 100% tiger habitat, 40 km was sampled by traversing random grid in every survey route. The grid cells with less than 10% habitat cover were discarded. Each contiguous 1 km segment was considered a 'spatial replicate' (Hines *et al.*, 2010; Barber-Meyer *et al.*, 2012). Each replicate comprised 10 segments of 100 m each and the data was recorded at every 100 m, avoiding spatial autocorrelation by

accounting single records for each unique species per segment.

The trained personnel walked along high probability tiger sign areas such as forest trails, fire lines, ridge lines, riverbeds and streams recording signs of tiger (scats, pugmarks, scrapes, kills and urination), prey signs (dung/pellets, footprints, sightings and calls) and human disturbances (tree cutting, lopping, grazing, human presence and signs of poaching).

4.2.4 Camera trap surveys for abundance estimation of tigers

The camera trap locations were selected based on extensive field surveys for signs of tiger such as pugmarks, scats, scrape marks, and urination. Due to limited numbers of cameras available for the survey, the trapping was carried out in shifting blocks in CNP-PNP complex (3 blocks) and BNP-BaNP complex (4 blocks), and in a single block in ShNP-Laljhadi-Jogbuda complex (Karanth and Nichols, 2003). Cuddeback (C1) and Panthera (V5 and V6) automated cameras were used. These were systematically placed in pairs in strategic locations (fire lines, trails, riverbanks, ridge lines, etc.) in 1,843 of the total 2,045 grid cells (2 km x 2 km) covering the entire tiger-bearing PAs and adjoining forests (Figure 2). The cameras were programmed to take three pictures per trigger with no delay (FAP mode) using white flash. The camera traps were deployed for 15-20 nights in each of the grid cells. The images along with their metadata were retrieved on weekly basis and stored safely for final analysis.

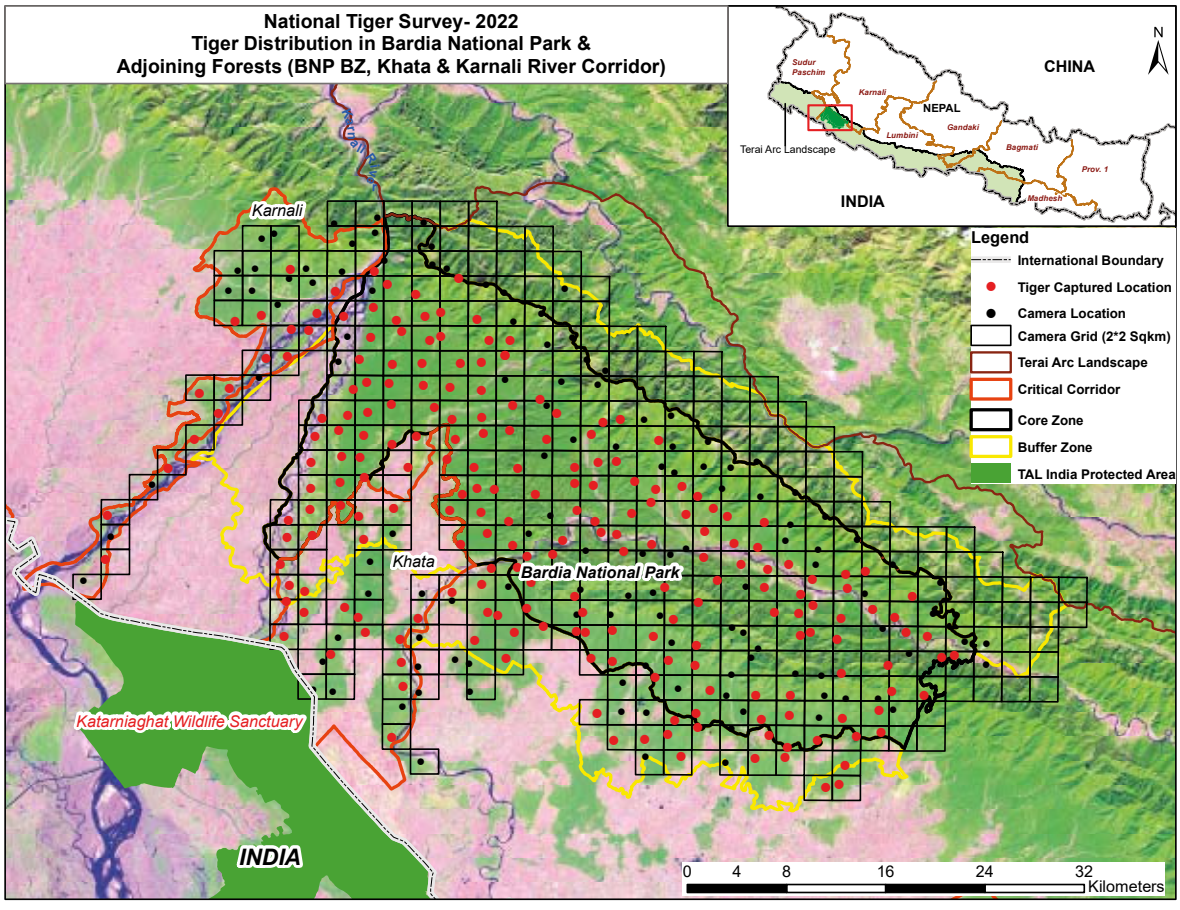


Figure 2. Camera trap layout for Bardia National Park (similar design was implemented in all other survey sites).

4.2.5 Line transect surveys for prey density estimation

Distance sampling framework was used for estimating prey densities (Buckland *et al.*, 2001). Line transects of 1.5-3 km lengths were systematically placed on 2 km x 2 km camera trap grid cells in national parks, buffer zones and adjoining forests; areas falling in hilly terrains were avoided to adhere to the assumption of distance sampling (Figure 3). Global Positioning System (GPS) locations of the start and end points of each of the transects were uploaded onto GPS receivers prior to the survey and the straight line was navigated following the bearing using Suunto compass and GPS receiver.

Line transect survey was conducted mostly on foot and on elephant back (in tall floodplain grasslands and riverine forests). Each transect was traversed, by two people, between 1500 hours and 1830 hours. To increase detection, the survey was carried out in dry season when visibility was high, following burning of grasslands and forest floor.

Bearings of transects and animal sightings, the species sighted, group size, age composition, radial distance to the animal (or the center of groups), GPS locations and habitat type of each sighting were recorded. Range finders and Suunto compass were used to measure radial distance and animal bearings (DNPWC, 2017).

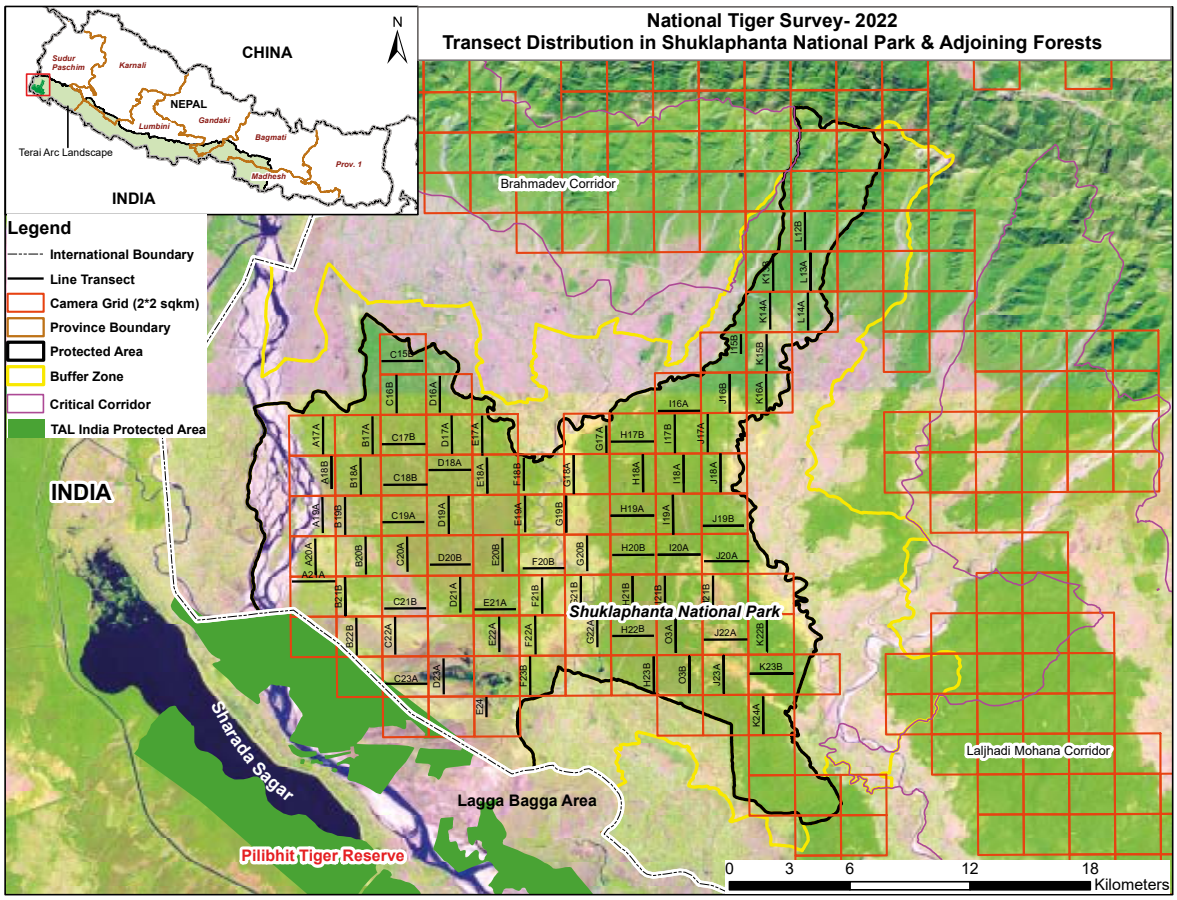


Figure 3. Distribution of line transects in Shuklaphanta National Park (similar design was implemented in all other survey sites).

5 DATA ANALYSIS

5.1 Tiger occupancy modelling

Occupancy modelling framework (MacKenzie *et al.,* 2002) was used to estimate occupancy (*Psi*) and detection probabilities (*p*). Detection history matrix was generated and imported into the program PRESENCE 12.7 (Hines, 2013) for further analysis. Single season single species co-detection model (Hines *et al.,* 2010) was used for modeling occupancy and detection probability. Multiple season model was also used to estimate occupancy dynamics across the landscape both spatially and temporally (Hines *et al.,* 2014). Occupancy change was compared based on the 2018 survey data.

5.2 Tiger population abundance estimation

Camera trap survey is a well-established technique for density and abundance estimation of elusive carnivores (Karanth *et al.,* 1998; Kelly and Holub, 2008). Recent development of spatial capture-recapture methods has led to greater clarity in abundance estimation by integrating spatial or "location" information of animal captures. This involves identification of tigers based on their unique stripe patterns, developing a capture history matrix detailing tiger ID, capture locations and sampling occasions over the sampling period (Karanth and Nichols, 2003), and analysis of capture history data using spatial capture-recapture framework that uses maximum likelihood (Efford and Fewster, 2012; Efford, 2021) and/or Bayesian framework (Royle *et al.,* 2009; Gopalaswamy *et al.,* 2012). The data is also amenable to analysis in a non-spatial framework and can be used for conventional mark-recapture analysis (White and Burnham, 1999).

Individual tigers were visually identified by field technicians and trained biologists at three levels (i.*e.* field technicians, wildlife biologists and Technical Committee members) by thoroughly examining all the images obtained. Individual tigers were identified using stripe patterns of all available 'both flank' pictures and either 'right or left flank pictures' for each of the study sites. Only adult tigers (animals captured independently without mother) were used in the analysis (Karanth and Nichols, 1998). Juveniles and cubs captured were not included in the analysis.

Each individual tiger was given a unique ID, after comparing in the 2018 archives. The tiger images were also segregated based on sex; images that didn't allow detection of sex were classified as 'unknown'. Tiger images from protected areas with shared boundary were also compared and common tigers were identified; for analysis, the common tigers were assigned to the PA with higher detection of these respective animals.

Tiger abundance was estimated using Maximum Likelihood (Efford and Fewster, 2012) and density estimate using Bayesian based spatially explicit capture-recapture (SECR) (Royle *et al.*, 2009). The spatial capture history matrix, trap layout matrix, habitat mask excluding non-habitat areas were prepared as input files. The data was analyzed using '*secr*' package (version 4.4.7, Efford, 2021) for Maximum Likelihood and SPACECAP for Bayesian analysis in the R statistical environment (version 4.2, R Development Core Team, 2022).

A range of standard models on detection probability (g0) and space range (sigma) were considered. The effects of time factor (t), time trend (T), animal's learned response (b), transient response (B), animal x site learned response (bk), animal x site transient response (Bk), and two-class mixtures (h2) were specified and modelled for both detection and distribution. All models were ranked based on Akaike's Information Criterion (AICc) and model-averaging was done with models having delta AIC<2 (w, weightage, >95%) to determine population estimates for each site.

Since the PAs surveyed are contiguous (e.g., BaNP shares its boundary with BNP, and PNP with CNP), taking population size ($\hat{N}$) of PAs buffer would overestimate the population. Therefore, SECR models were fitted using the stable buffer size first and then population estimates were exclusively derived for the effectively sampled area or the ellipse that contained all the detectors (camera traps).

Abundance estimates between 2018 and 2022 were also compared using results from DNPWC and DFSC (2018) for all the study sites in TAL following similar approach in *secr*.

5.3 Tiger population density estimation

SECR models under Bayesian framework using Markov-Chain Monte Carlo (MCMC) calculation process was used to estimate site-specific tiger densities in SPACECAP (version 1.1.0) (Gopalaswamy *et al.*, 2012) in R 3.4.0 (R Core Team, 2017). Three input files - "animal capture" file detailing trap location, animal ID and sampling occasion, "trap flag" file, and "habitat mask" were prepared. Trap flag was created and included in the model to specify active days of each camera trap station. This incorporated the block sampling design and explicitly accounted for dysfunctional cameras on account of theft, wildlife damage or malfunction. Habitat mask was created for area that included camera trap array (MCP: minimum convex polygon) surrounded by a buffer of half mean maximum distance moved (1/2 MMDM) by the tigers as range beyond this were all dominated by human settlements. Pixelated habitat mesh size of 0.3364 km^2 was used (Karanth *et al.*, 2008). Models with two different combinations - trap response - present and absent, with half normal detection function were used to fit the data.

MCMC simulations with 60,000- 1,50,000 iterations, burn-in of 40,000-60,000 and thinning rate of 1 and data augmentation value of 5-6 times the number of animals captured was set for running the site-specific analysis. Geweke diagnostic scores (-1.64 to 1.64) was used to check the convergence of chains and data fit (Gopalaswamy *et al.*, 2012). Pixelated map showing tiger density was produced for each of the sites in ArcGIS (Ver. 10.8). Output file contained posterior estimate on population density (number of tigers/km^2, which was later changed to numbers/100 km^2) including estimate on sigma value and their corresponding standard deviation. Density estimates between 2018 and 2022 were also compared using results from DNPWC and DFSC (2018) for all the study sites in TAL following similar approach in SPACECAP.

Tiger abundance was also estimated by multiplying the estimated density from Bayesian SECR models with the respective effective sampled areas (Srivathsa *et al.*, 2015). Effective sample area was calculated by adding a buffer of estimated sigma (σ) x sqrt (5.99) to the camera trap array (Thapa and Kelly, 2017) excluding non-habitat (settlement and agriculture) areas.

5.4 Tiger prey density estimation

Line transect data were analyzed using the program DISTANCE version 7.2 to obtain density estimates of prey species (Buckland *et al.*, 2001; Thomas *et al.*, 2010). These yielded estimates of the density of principal prey species for each site. Observation of all the species was pooled for fitting global detection function. For species with sufficient detections (>30), detection function was fitted at the species level. Chi square goodness of fit test was used to assess the fit of the model, and the best model from the subset of models was selected using lowest AIC value. Output file contained estimate on population density (number of prey/km^2) and corresponding standard error. Prey estimates between 2018 and 2022 were also compared using results from DNPWC and DFSC (2018) for all the study sites in TAL following similar approach in DISTANCE.

6 RESULTS

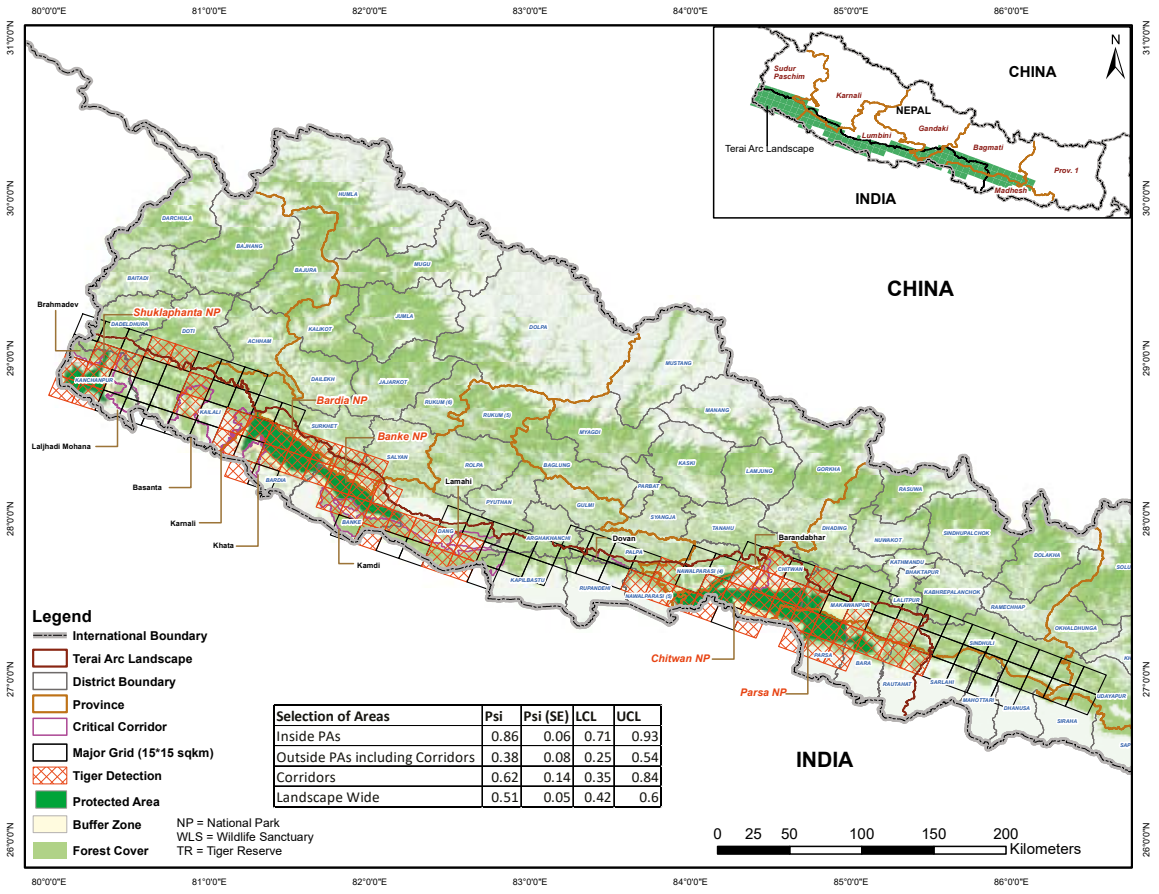
6.1 Tiger habitat occupancy

6.1.1 Sampling effort and tiger sign detection

The team surveyed 130 (of the total 137) grid cells (Fig 4) with a realized sampling effort of 3,165 km of search path, spread across 24 districts. A total of 692 unique tiger signs were detected. Of these, 89% unique signs were recorded within PAs and Buffer Zones, and 11% signs were recorded outside PAs. Overall, tiger signs were detected in 15 districts (Rautahat, Bara, Parsa, Makwanpur, Chitwan, Nawalparasi Bardhaghat Susta East, Nawalparasi Bardhaghat Susta West, Dang, Banke, Salyan, Bardia, Surkhet, Kailali, Doti and Kanchanpur). In Dadeldhura, tiger was captured in camera, but no signs were detected during the occupancy survey, and therefore excluded from the occupancy analysis.

6.1.2 Tiger occupancy and detection probability

The naïve tiger occupancy was 0.47 with tiger signs detected in 61 out of 130 grid cells. The modelled occupancy probability in the landscape was 0.51 (SE 0.05) with detection probability estimated at 0.83 (SE 0.02). Of the total potential habitat of tigers (18,928 km^2) in the landscape, an estimated 9653.4 km^2 (SE 895.3 km^2) was occupied by tigers.



Selection of Areas	Psi	Psi (SE)	LCL	UCL
Inside PAs	0.86	0.06	0.71	0.93
Outside PAs including Corridors	0.38	0.08	0.25	0.54
Corridors	0.62	0.14	0.35	0.84
Landscape Wide	0.51	0.05	0.42	0.6

Figure 4. Tiger occupancy in TAL-Nepal, 2022

In addition, the modelled occupancy inside the PAs was 0.86 (SE 0.05) covering 5,425.8 km^2 and 0.38 (SE 0.08) 4623.6 km^2 outside PAs. The detection probability inside PAs was 0.88 (SE 0.03) and was 0.6 (SE 0.12) outside PAs. Based on comparison with 2018 survey grids, the model occupancy probability in the landscape was 0.58 (SE 0.05) with detection probability estimated at 0.84 (SE 0.02).

6.2 Tiger abundance

6.2.1 Sampling effort and tiger captures

A pair of cameras were deployed in each of the 1,843 grid cells (2 km x 2 km) across five tiger bearing PAs and their adjoining forests, with a total effort amounting to 31,422 trap days. A total of 5,746 tiger images were recorded in 1,996 independent occasions, with average tiger trap rate of 0.06 per trap day (6.4%). Tigers were captured in 647 (35%) grid cells (Table 2). Total effective sampling area (ESA) was estimated at 20,747 km^2.

A total of 316 individual tigers were identified, including 123 males, 178 females and 15 of unknown sex (Table 3).

6.2.2 Tiger population abundance estimates

The estimated abundance of tigers in PNP and adjoining forests is 41 (SE 2.8), CNP and adjoining forests is 128 (SE 4.5), BaNP and adjoining forests is 25 (SE 1.4), BNP and adjoining forests is 125 (SE 3.1) and ShNP and adjoining forests is 36 (SE 4.1)

Table 2. Number of grid cells surveyed and number of grid cells with tiger captures in each site

Site	Number of surveyed camera trap grid cells	Number of grid cells with tiger captures
PNP and adjoining forests	364	103 (28%)
CNP and adjoining forests	505	205 (41%)
BaNP and adjoining forests	344	69 (20%)
BNP and adjoining forests	375	219 (58%)
ShNP and adjoining forests	255	51 (20%)
Total	**1,843**	**647 (35%)**

Table 3. Survey effort and number of tigers captured

Site	Survey effort (trap days)	Effective sampling area (km^2)	Number of tiger photos	Number of independent detections	Number of individual tigers captured (M_{t+1})	Adult males	Adult females	Adult unknown sex	Cubs
PNP and adjoining forests	5,376	4,060.6	650	236	35	14	19	2	4
CNP and adjoining forests	8,529	5,382.9	2,267	680	113	48	57	8	7
BaNP and adjoining forests	7,058	4,727.7	505	130	23	9	12	2	5
BNP and adjoining forests	6,307	3,433.6	1,893	807	117	40	74	3	17
ShNP and adjoining forests	4,152	3,142.7	431	143	28	12	16	-	2
Total	**31,422**	**20,747.4**	**5,746**	**1,996**	**316**	**123**	**178**	**15**	**35**

Table 4. Site-wise tiger population estimates in Nepal, 2022

Site	M_{t+1}	Model	Detection Function	RN	SE	95% Confidence interval
PNP and adjoining forests	35	g0~h2 sigma~h2	EX	41	2.8	38-50
CNP and adjoining forests	113	g0~h2 sigma~h2	EX	128	4.5	121-140
BaNP and adjoining forests	23	g0~h2 sigma~h2	EX	25	1.4	23-30
BNP and adjoining forests	117	g0~h2 sigma~h2	EX	125	3.1	121-134
ShNP and adjoining forests	28	g0~h2 sigma~1	EX	36	4.1	31-49
TOTAL	**316**			**355**		

RN: Realized Number which refers to the number of tigers detected (N) plus a model-based estimate of tigers in the study area of interest that remain undetected; g0: detection probability; Sigma: space range; h2: two-class mixtures; EX: Negative exponential

(Table 4). Summing up the site-wise estimates, the total tiger population for Nepal is 355 individuals. The details of the model used, and the real parameters are provided in Annex-1.

Tiger population estimates generated using other programs have been provided in Annex-2 for better comparison with the earlier surveys.

6.3 Tiger density estimates

Using the Bayesian-SECR, the mean posterior density of tigers per 100 km^2 was estimated at 1.74 (SD 0.17) in PNP and adjoining forests, 4.06 (SD 0.22) in CNP and adjoining forests, 0.97 (SD 0.12) in BaNP and adjoining forests, 7.2 (SD 0.4) in BNP and adjoining forests and 1.99 (SD 0.27) in ShNP and adjoining forests (Table 5). The data convergence was achieved for results of all the study sites, accounting Geweke diagnostic score with other real parameters. The pixelated tiger density map produced by combining site-wise pixel values generated by program SPACECAP is provided in Figure 5. The summaries of real parameters for each of the sites are provided in Annex-3.

Table 5. Tiger density estimates for the tiger-bearing protected areas including buffer zones, adjoining forests and corridors

Site	Mean	SD	95% CI
PNP and adjoining forests	1.74	0.17	1.40-2.04
CNP and adjoining forests	4.06	0.22	3.61-4.47
BaNP and adjoining forests	0.97	0.12	0.79-1.23
BNP and adjoining forests	7.15	0.38	6.47-7.94
ShNP and adjoining forests	1.99	0.27	1.50-2.51

SD: Standard Deviation.

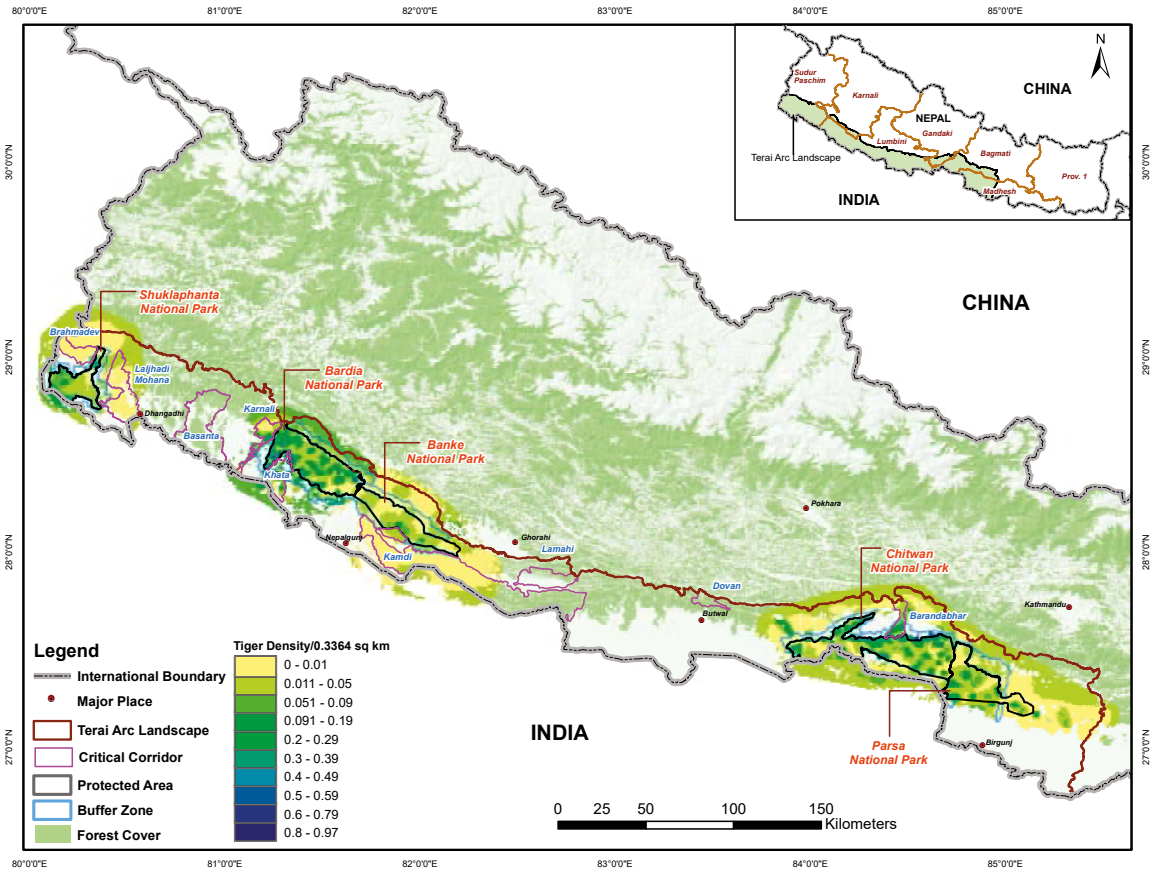


Figure 5. Tiger density within the Terai Arc Landscape, Nepal. The density map is composed of pixels (0.336 km^2) representing potential activity centers of individual tigers

6.4 Prey density estimates

A total of 778 transects, covering 1,438 km, were surveyed. Major prey species recorded were spotted deer (*Axis axis*), sambar (*Rusa unicolor*), hog deer (*Axis porcinus*), barking deer (*Muntiacus muntjak*), blue bull (*Boselaphus tragocamelus*), four-horned antelope (*Tetracerus quadricornis*), wild boar (*Sus scrofa*), and gaur (*Bos grunniens*). Rhesus macaque (*Macaca mulatta*) and langur (*Semnopithecus entellus*) were also sighted.

Combined prey density (all prey/km^2) varied between 32.6 and 146.2 animals/km^2 (Table 6). Site-wise combined prey density was 75.1 (SE 11.4) in PNP and adjoining forests, 99.7 (SE 9.1) in CNP and adjoining forests, 32.6 (SE 6.6) in BaNP and adjoining forests, 90.2 (SE 11.2) in BNP and adjoining forests and 146.2 (SE 19) in ShNP and adjoining forests. Among the major prey, species level density estimates revealed highest density of spotted deer (PNP- 26, SE 9.2; CNP- 74.5, SE 12.1;

BNP- 44.1, SE 6.3; ShNP- 114.6, SE 17.2) followed by sambar in PNP, and wild boar in ShNP (Annex - 7). High primate density was recorded in CNP and BNP.

6.5 Habitat use of tigers outside PAs

Altogether, 49 individual tigers were recorded outside PAs. Of these, 29 tigers were recorded in biological corridors (Barandabhar, Kamdi, Karnali, Khata and Laljhadi) (Table 7). Habitat use of tigers outside PAs was found to be 7% of M_{t+1} in both CNP and ShNP, while these were comparatively higher in BaNP (35% of M_{t+1}), PNP (29% of M_{t+1}) and BNP (18% of M_{t+1}). (See maps in Annex 8).

Table 6. Combined site-wise prey density estimates

Site	Effort (km)	Number of Transects	No. of Obs.	Density (Per Km^2)	SE	CV (%)	95 % CI
PNP and adjoining forests	226	109	148	75.1	11.4	15.13	55.9-101.0
CNP and adjoining forests	415	200	501	99.7	9.1	9.13	83.4-119.3
BaNP and adjoining forests	248	163	101	32.6	6.6	20.23	22.0-48.4
BNP and adjoining forests	267	151	320	90.2	11.2	12.41	70.7-114.9
ShNP and adjoining forests	282	155	325	146.2*	19.0	13	113.4-188.6

** denotes density estimates of all prey excluding swamp deer that was not included during the line transect survey in Shuklaphanta National Park; SE: Standard Error of Mean; CI: Confidence Interval; CV: Coefficient of Variation (SD/Mean)*

Table 7. Number of tigers captured outside PAs

S.N	Site	Male	Female	Unknown Sex	Total
1	Parsa Collaborative Forest* and PNP Core	3	3	-	6
2	Parsa Collaborative Forest (exclusive)*	-	1	-	1
3	Rautahat forest (exclusive)	-	2	-	2
4	Rautahat forest, Bara Forest and PNP Core	1	-	-	1
5	Barandabhar corridor (exclusive)	2	-	-	2
6	Nawalparasi (exclusive)	4	1	-	5
7	Nawalparasi and CNP BZ	1	-	-	1
8	Dang forest (exclusive)	1	-	-	1
9	Kamdi corridor (exclusively)	1	-	1	2
10	Kamdi corridor and BaNP Core, BZ	4	1	-	5
11	Karnali river corridor (exclusive)	1	6	1	8
12	Karnali river corridor, BNP Core	1	1	-	2
13	Khata corridor (exclusive)	2	1	-	3
14	Khata corridor, BNP Core, BZ	3	1	-	4
15	Khata corridor, BNP BZ	2	-	-	2
16	Bardia forest, BNP BZ	-	2	-	2
17	ShNP core and Laljhadi corridor	1	-	-	1
18	Jogbuda forest (exclusive)	-	1	-	1
	Total	**27**	**20**	**2**	**49**

** Collaborative forest: A forest jointly managed by national government, local government and local communities*

7 DISCUSSION

7.1. Tiger distribution, habitat usage and occupancy

Altogether 692 unique tiger signs were recorded by habitat occupancy survey carried out across TAL. Maximum tiger signs were recorded within PAs (83%), while 17% were detected outside PAs, in TAL. Similarly, tigers were captured in 647 out of 1,843 grid cells, which is ~35% of the total area surveyed. Combining both signs and capture locations in camera traps, tigers were recorded in 16 districts. However, majority (92%) of the photo-captured tigers (M_{t+1}=291) were within PAs and 25 tigers (8%) were exclusively captured in forests outside PAs in TAL. A total of 24 individual tigers that used core and buffer zones also had their territorial range extended to forests outside PAs. In case of corridors, 29 tigers were photo-captured in Laljhadi (1), Khata (9), Karnali (10), Kamdi (7) and north of highway in Barandabhar (2), while only 1 sign each were recorded from Basanta and Brahmadev. The presence of tigers in all these biological corridors indicate their functionality in facilitating tiger dispersal. Moreover, capture of tigers in Jogbuda (Dadeldhura district) in the west and Gujara and Chapur (Rautahat district) in the east during this survey, as well as recent records from higher elevations within Dadeldhura (2,511 m) and Ilam district (3,165 m), indicates that the tigers are dispersing into their extant range, possibly facilitated by restoration efforts and high breeding performance in source populations. Changing climatic conditions may also have impacted such dispersal into climate refugia at higher altitudes (Thapa *et al.*, 2016).

Modelled tiger occupancy in the landscape shows an increasing trend between 2009 and 2022. The likely reason for the increase in occupancy for the last 13 years can be attributed to greater tiger dispersal facilitated by the ongoing habitat restoration efforts in bottlenecks and corridors as well as improved wildlife enforcement. Between 2009 and 2013, there was a 47% (λ=1.47) increase in occupancy. Similarly, between 2013 and 2018 there was a 12% (λ=1.12) increase in occupancy across for the landscape. However, between 2018 and 2022, the occupancy appears to be stabilizing, with marginal decrease by 4% (λ=0.96). This may be due to differences in survey season, forest fires and other human-mediated disturbances in forests outside PAs. Analysis using additional covariates could further validate the comparisons.

In totality, tigers occupied 9,653 km^2 (*Psi* = 0.51) of the available habitat (18,928 km^2) of the landscape. Within PAs, tigers occupied 5,426 km^2 (*Psi* = 0.86) of the available habitat. However, tigers occupied only 4,624 km^2 (*Psi* = 0.38) of the available habitat outside the PAs. Large tracts of forests exist outside the PAs in TAL and beyond, but majority of these forest patches face high anthropogenic pressure. The ground forest cover is literally non-existent with high cattle grazing, and prey base is extremely low to support resident tigers. Unlike PAs, these forested habitats have minimal protection, and therefore face risk of becoming sink for tigers. Thus, the existing limited use of forests by tigers outside PAs can be enhanced through protection and other management interventions. To make the habitat outside PAs more conducive for tigers and to facilitate their safe dispersal, measures should be focused towards improving habitat quality, increasing prey population and minimizing human disturbances. Replicating success of community forestry as seen in Khata corridor could provide a potential solution that benefits both tigers and people.

7.2 Tiger abundance and density

7.2.1 Methods used, and the Extent of Areas covered

SECR-ML and SECR-B are commonly used techniques in deriving population and density estimates (Gopalaswamy *et al.*, 2012; Royle *et al.*, 2009; Elliot and Gopalaswamy, 2017; Alexander *et al.*, 2017). In the present survey, tiger population estimates were derived using SECR-ML while density estimates were derived using SECR-B, as was done in prior national surveys. These results helped address the overlap issues (between adjoining PAs in CNP-PNP and BaNP-BNP) and the estimates derived from both estimators were similar with 95% CI overlap (Table 8).

In estimating PA wise abundance coefficient of variation (CV %, Table 8) is relatively lower for SECR-ML as compared to SECR-B. Therefore, PA-wise abundance estimates have been reported using SECR-ML. Similarly, as program CAPTURE and Mark were used in all past three surveys (2009, 2013 and 2018), the results obtained from these programs have also been reported for readers knowledge. For density estimates, the results from both SECR-ML and SECR-B have been reported (Annex-6).

The 2022 survey extensively covered potential tiger habitat of TAL-Nepal. The sampling effort in this survey was maximized by covering most of the known records of tiger distribution based on findings of annual tiger surveys since 2013-2018 (Dhakal *et al.*, 2014; DNPWC and DFSC, 2018); the extent of the area covered by camera traps was increased from 1,643 grid cells in 2018 survey to 1,843 grid cells in 2022 (12%). However, the number of planned grid cells were similar to 2018 (n=1,961). Tiger captures were recorded in 35% (647) of the 1,843 grids.

7.2.2 Trend in minimum population based on individual tiger captures

This study reports a minimum population of 316 individual adult tigers - 123 males, 178 females and 15 unknown sexes, from across the study sites (PNP and adjoining forests - 35, CNP and adjoining forests - 113, BaNP and adjoining forests - 23, BNP and adjoining forests - 117 and ShNP and adjoining forests - 28) compared to 209 individuals (80 males, 119 Female) in 2018 (DNPWC and DFSC, 2018).

In all PAs minimum population of tigers has increased significantly against 2009 baseline (2013 of BaNP) (Figure 6). In ShNP, M_{t+1} has remained stable between 2013 to 2018, largely because of the male biased sex ratio (2018 survey-1.5:1), and recorded poaching (N=2) (DNPWC and DFSC, 2018). However, in 2022, M_{t+1} has doubled since 2013 with improved sex ratio (0.75:1) suggesting effective management interventions of improved protection and habitat management programs in the last four years.

Table 8. Comparison of Population Estimates using SECR-ML and SECR-B

Site	SECR-ML					SECR-B			
	M_{t+1}	Population Estimate	SE	95% CI	CV (in %)	Population Estimate	SE	95% CI	CV (in %)
PNP and adjoining forests	35	41	3	38-50	6.9	37	3.6	30 - 44	9.8
CNP and adjoining forests	113	128	5	121-140	3.5	120	6.6	107-132	5.5
BaNP and adjoining forests	23	25	1.4	23-30	5.6	26	3.2	21 - 33	12.2
BNP and adjoining forests	117	125	3.1	121-134	2.5	138	7.4	125-153	5.4
ShNP and adjoining forests	28	36	4.1	31-49	11.2	37	5.0	28 - 47	13.6
Total	**316**	**355**				**358**			

CV: Coefficient of Variation, M_{t+1}: Minimum individuals identified, SE: Standard error of Mean, SECR: Spatially Explicit Capture Recapture, ML: Maximum Likelihood, B: Bayesian

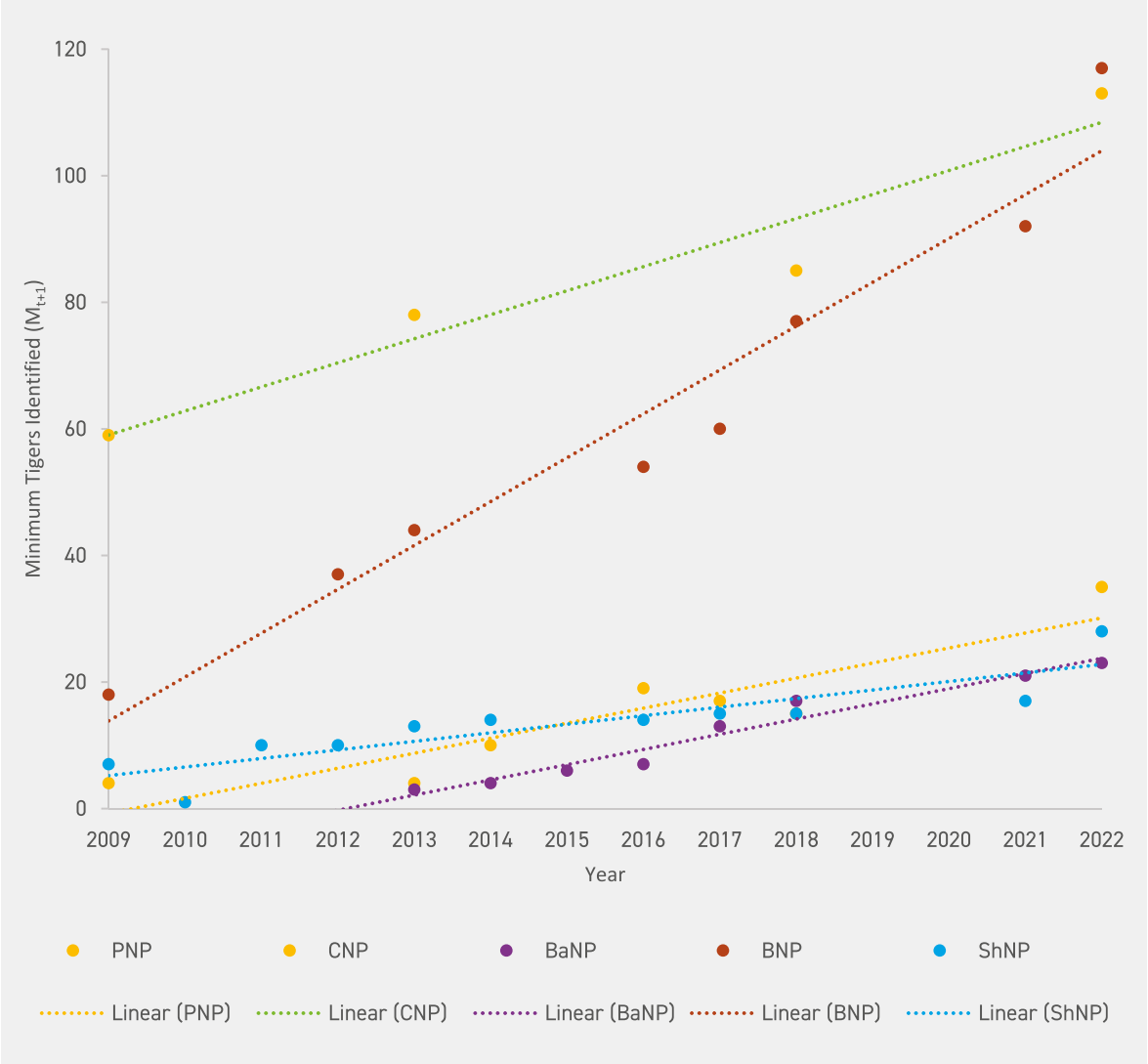


Figure 6: Trend in tiger population (2009-2022) based on M_{t+1}

7.2.3. Tiger abundance estimates

Status of tigers in Nepal is estimated at 355 individuals in 2022 which is simply a summation of PAs and their adjoining forests-wise estimation, without accounting for estimated variance and confidence intervals.

Population increase is observed in all PAs and adjoining forests in comparison with the previous nationwide survey (DNPWC and DFSC, 2018) (Figure 7).

In BaNP, the population has slightly increased from 21 (18-30) in 2018 to 25 (23-30) in 2022. Naïve comparison estimates since park establishment in 2010 has revealed a considerable increase from 4 (3-7) in 2013. Bardia's tiger population showed the highest growth among PAs in Nepal from 18 in 2009 to 125 (121-134). Similarly, in PNP and adjoining forests, the tiger population progressively increased from 4 (4-4) in 2009 to 41 (28-50) tigers in 2022. CNP's tiger population also gradually increased from 91 (71-147) in 2009 to 128 (121-140) in 2022. The latest tiger population in CNP is well-within the estimated carrying capacity of 136 individuals (DNPWC, 2020). Likewise, ShNP population also saw a sharp increase from 8 (8-14) in 2009 to 36 (31-49) in 2022.

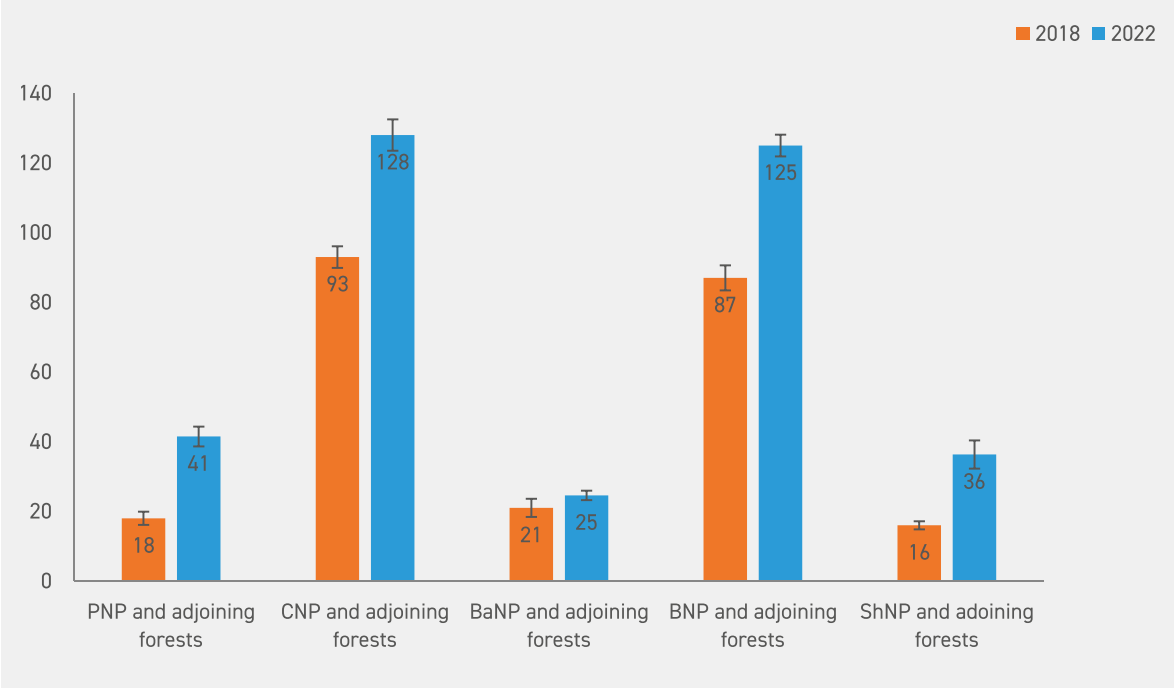


Figure 7. Site-level tiger population estimates with respective standard error bars for 2018 and 2022

7.2.4. Tiger density

Tiger density (no of tigers/100 km^2) ranged from 0.9 in BaNP (lowest) to 7.2 in BNP (highest). Compared to 2018 survey, apart from BaNP, tiger density estimates increased significantly in all PAs (Figure 8). Site-level tiger densities from 2018 to 2022 increased from 0.92 (SD 0.15) to 1.74 (SD 0.17) in PNP, 3.28 (SD 0.19) to 4.06 (SD 0.22) in CNP, 4.74 (SD 0.28) to 7.15 (0.38) in BNP and 0.96 (SD 0.14) to 1.99 (SD 0.27) in ShNP. The tiger density estimates for BaNP remained stable with ~1/100 km^2 in 2018 as well as 2022.

These densities might be underestimates for PA-specific information, considering that this assessment included tiger-capture areas outside these PAs. In 2018, tigers were mostly confined within the boundaries of protected areas and associated buffer zones; in 2022, some of the PAs such as BNP, CNP and PNP had tiger spatial density distributed over Karnali corridor, Khata corridor, Nawalparasi-Chormara area, Sahajnath area of Bara and in Gujara and Chandrapur areas of Rautahat. A separate analysis focusing solely on the data from PAs might give a more robust PA-specific density estimate.

Detailed outputs from SECR-B analysis for 2018 and 2022 are provided in Annex 4. The pixelated tiger density maps for 2018 and 2022 produced by combining site-wise pixel values generated by program SPACECAP are provided in Annex 5.

7.2.5. Factors governing tiger population abundance and density

The conservation of tigers is dependent on appropriate protection measures, prey densities, habitat connectivity, habitat management of the critical habitats, park-people relationship and human-tiger interactions across the country. The reported increase could be due to holistic conservation efforts: i) tiger habitat extension (establishment of BaNP and extension of PNP); ii) significant investment in grassland and wetland management; iii) restoration of critical corridors and bottlenecks; iv) improved wildlife enforcement; v) strengthened capacity of frontline staff; and vi) effective stakeholders' engagement, including local communities. Prioritization and allocation of investments were made to address the site-specific challenges and issues.

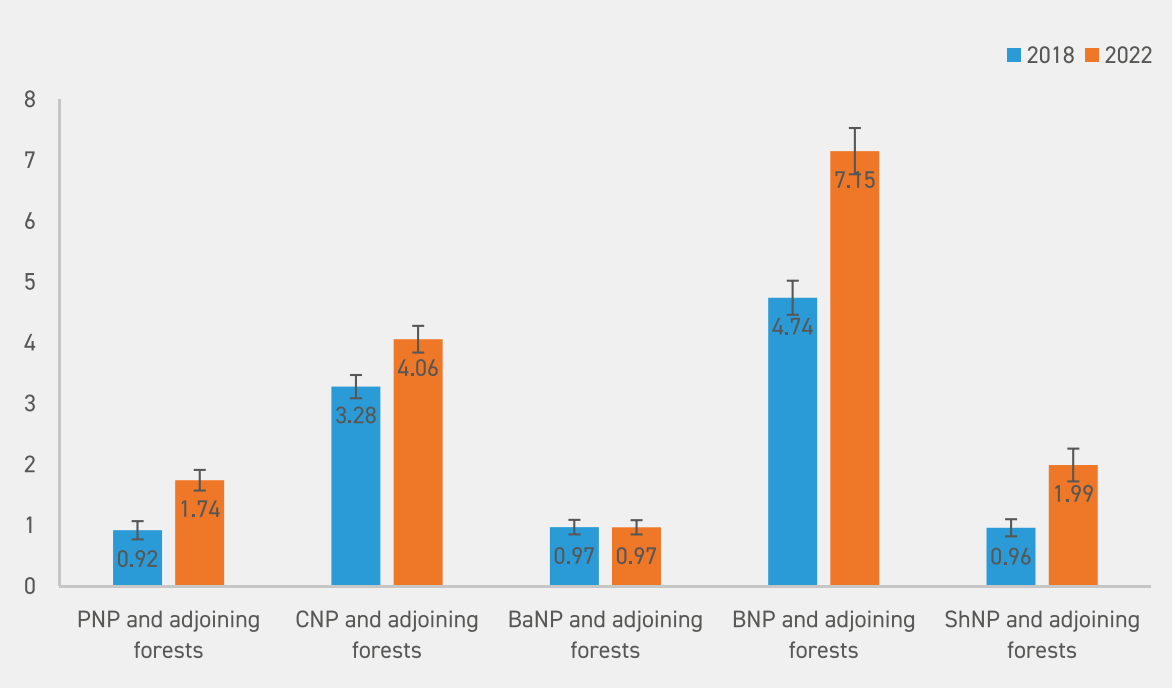


Figure 8. Site-level tiger density estimates with respective standard error bars for 2018 and 2022

7.3. Prey Density

Prey density is the primary factor to determine the carrying capacity of tiger and other carnivores. The increase in prey density estimates within PAs across the study area compared to earlier surveys is a positive sign for tiger conservation. The highest density of prey (146/km^2, SE 19.0, p=0.2) was estimated in ShNP. The highest increase in prey densities per km^2 from previous survey (2018) was documented in PNP from 22 to 75 (SE 3.8, p=0.2) and BaNP from 8 to 33 (SE 6.6, p=0.4). In CNP and BNP, prey density increased from 71 to 100 (SE 9.8, P=0.2) and 78 to 90 (SE 11.2, p=0.3) respectively.

As with tiger numbers, prey density increases could also be attributed to better and intensive conservation measures. Enhanced protection as well as intensive habitat management efforts in the PAs in recent years may have contributed in increasing the prey density. The prey survey was also conducted in appropriate season (April–May) this year based on experience of previous survey which was conducted during winter (December–February). In winter, there were lower detections of the prey species due to high vegetation cover. Improved detections this year may have contributed to provide a more robust estimate.

The density of medium and small-sized (spotted deer, wild boar) prey were relatively high in all PAs, while the density of large prey species (sambar, nilgai, wild buffalo, gaur) were found to be low. Tiger is an apex predator and prefers larger size prey. With lower density of the large sized prey, tigers switch to smaller prey, particularly the most abundant prey spotted deer contributing nearly 50% of the diet (Upadhyaya *et al.*, 2018, Lamichhane *et al.*, 2019). Thus, focusing on increasing densities of large prey species should be a strategy to sustain the tigers in higher densities (Karanth, 2003).

We estimated the prey density using distance sampling framework which is the most widely used method for estimating the prey density across the tiger range. However, in areas with thick vegetation and lower visibility this method may not perform well. To increase the detections, we surveyed transects on elephant back during the dry season after annual burning of the grasslands. This method also has limitation to survey in the rugged terrains like Churia hills as it violates the straight-line assumptions. This method also misses the species such as gaur and swamp deer which occur in large groups and confined in certain habitats. Thus, we should consider to adopt other methods including the by-catch data from camera traps to provide better estimates of prey densities in the future (Rowcliffe *et al.*, 2008, Kafley *et al.* 2019, Pal *et al.*, 2020).

8 MANAGEMENT IMPLICATIONS AND TOWARDS HUMAN-TIGER COEXISTENCE

Nepal has successfully achieved its global commitment to double the tiger population within its range. This was made possible through continued political commitment from the Government of Nepal, and consistent and coordinated efforts by diverse conservation stakeholders, facilitating strategic long-term recovery programs and investing significant resources.

Considering this increase in tiger population, the country cannot afford to let its guard down. Additional resources must be strategically invested to maintain the populations by monitoring and addressing current risks as well as emerging threats driven by global as well as local circumstances.

Management interventions are needed and therefore, recommended, at national, landscape, and site levels. These include policy initiatives, enhancing security for wildlife, habitat extension, protection and improvements for metapopulation management, managing conflicts and safeguarding communities, wildlife-friendly infrastructure development and ensuring a balance between nature preservation and country's development aspirations.

Specific recommended actions are provided below.

8.1. Strengthening protection

Poaching continues to be a threat to tigers in Nepal. Genetic studies of seized tiger parts in Nepal have traced their origins to ShNP, BNP and CNP. Detailed security assessment may be required on the ground to guide appropriate site-specific protection measures in vulnerable sites. For instance, ShNP could benefit from additional anti-poaching measures such as construction of guard posts, particularly along the southern parts, and facilitation of real-time SMART adaptive patrolling

With improved protection inside PAs, non-protected forests beyond PA boundaries are becoming sinks for tigers. For protection of tigers outside PAs, Division Forest Officials/staff should be capacitated and equipped for anti-poaching measures. Local communities need to be further capacitated through the institutionalization of CBAPUs. Coordination among Wildlife Crime Control Bureau (WCCB) cells, particularly in districts surrounding tiger-bearing PAs, is crucial in curbing the illegal wildlife trade. Improved coordination, joint patrolling and information sharing between border security force - *Seema Suraksha Bal* (SSB) in India and, Armed Police Force, Nepal and Nepali Army in Nepal will additionally help strengthen illegal wildlife trade control.

8.2. Increasing prey biomass within PAs

Prey biomass plays a key role in improving or maintaining tiger densities. Recommended measures include intensive grassland management to maintain grazing lawns, removal of invasive alien plant species (IAPs), and ensuring year-round water availability by creating/restoring wetlands. In CNP and ShNP immediate intervention is required to address siltation and drying up of wetlands, reducing productivity.

It is also recommended to intensify patrolling efforts (Real time SMART and other cutting-edge technology) and monitoring changes of prey over time to keep track of the health of the ecosystem. Analysis of bycatch data (prey) is recommended for estimating prey density based on camera trap data, to optimize resources.

Increasing prey densities, particularly large prey, will benefit tiger conservation. Accordingly, exploring reintroductions of large prey such as gaur (Chitwan to Babai valley), arna (Koshi to Chitwan), swamp deer (Shuklaphanta to Chitwan, Bardia and even Koshi) is recommended.

8.3 Enhancing landscape functionality focusing in corridors and forests outside PAs.

A combination of efforts will be required to address the limited habitat use by tigers and prey in forests outside PAs (National Forests, Protection Forests and identified biological corridors). Engagement

with local communities should be scaled up with a focus on reducing their dependence on forests. Feasibility of providing legal protection to biological corridors and remaining forests outside PAs in TAL and beyond should be explored, to prevent encroachment and fragmentation.

Improving these habitats by reducing anthropogenic pressures, preventing further fragmentation and enhancing prey densities will provide additional dispersal grounds for tigers. This will also aid in sustaining the meta-population of tigers in TAL. Initiating a long-term forest monitoring program to track land use - land cover changes will help evaluate changes and inform management and policy makers.

8.4 Managing tiger habitat in other potential areas including high altitude forests

Beyond the scope of this survey, tiger has been recorded from high altitude locations in Ilam (3,165 m) and Dadeldhura (2,511 m). Eastern Terai including Koshi Tappu WR and Trijuga forest, Mahabharat range, Chure range and high-altitude large forest patches identified as climate refugia, are potential habitats for tiger dispersal. Securing these will ensure greater survival prospects for tigers in Nepal. Further research and monitoring will help guide relevant habitat management interventions in these areas. Interventions in these newer habitats must be done in close coordination with community and representatives of provincial and local governments.

8.5 Addressing the impact of linear infrastructures

The number and extent of infrastructure are likely to increase within TAL-Nepal and beyond, further fragmenting fragile forested habitats. Efforts need to continue to ensure the right balance between conservation and development through: i) effective implementation of Wildlife-friendly Infrastructure Construction Directives, 2022, focusing on tiger potential habitats; ii) engagement with policy makers to avoid inviolate zones (critical tiger habitats); iii) engagement with developmental agencies to promote wildlife-friendly infrastructures, and integration of effective mitigation measures in the infrastructural planning process; and, iv) developing appropriate mitigative measures in existing linear infrastructures (for example - automated barriers to maintain speed limits, digital tracking of passing vehicles, and construction of over/underpasses or guiding fences in vulnerable sites to provide safe routes for wildlife).

8.6 Enhancing transboundary co-operation

Nepal shares open borders with India, presenting its set of challenges, but also opportunities for the two countries to collaborate closely for conservation. Joint tiger monitoring by the two countries in 2013 identified at least 10 tigers sharing habitats across the borders. Cooperation and coordination for wildlife crime control (through joint patrols and intelligence sharing), habitat restoration (transboundary corridor), joint wildlife monitoring and data sharing, and addressing infrastructure challenges, will aid in transboundary metapopulation conservation benefiting tiger conservation efforts of both countries.

It is also recommended to update the 'Tigers of the Transboundary Terai Arc Landscape' report with latest survey datasets, in coordination with the Government of India.

8.7 Creating a safe environment for people and wildlife

At the national level, tigers contribute only around 6% of the total human-wildlife conflict compared to 44%, 34% and 6% caused by elephants, common leopards and rhinos respectively (unpublished data set, DNPWC 2022). Tiger attacks on humans have substantially increased in the past few years, especially around Bardia and Chitwan National Parks. With increasing density and abundance in their source sites, tigers have been occupying wider areas. Regular tiger presence in forest fringes where people also visit frequently for fodder, fuelwood and other NTFP collection collection has increased the chances of encounters, sometimes leading to fatal attacks. With increasing tiger population, territorial fights among tigers is also increasing as space available for them is limited. Dispersing tigers are also using these marginal areas increasing the chances of human-tiger conflict. To effectively manage conflicts, it is pertinent to understand overall conflict dynamics and consequently devise strategies to

create a safe environment for both people and wildlife. The survival of these species will depend upon increasing the tolerance level of the local communities, which in turn, is determined by how well conflict is managed, and ownership by the communities.

Wildlife Damage Relief Guidelines (2069 BS, third amendment, 2075) has provisioned for providing monetary relief to victims of conflicts. Simplifying claiming processes, reducing delays, enhancing transparency and efficiency at all levels is recommended. However, relying heavily on the relief guidelines can turn this into a financial liability for the government. The GoN's Guidelines can be supported by additional relief schemes in place, such as the national relief scheme managed by NTNC. Promoting professional market-based insurance schemes (human, livestock, property and crops) can also potentially help reduce the pressure on the government coffers, while providing better returns to the community for their losses. These have been piloted in the buffer zone of CNP and BNP and could be scaled up for wider community.

For effective long-term management, specific focus must be made on understanding conflicts (both social and ecological dimensions) better. Awareness generation, effective monitoring, and strengthening Rapid Response Teams (RRTs) can aid in pre-emptively preventing conflicts. Improved communication and coordination between stakeholders will be crucial to diffuse conflict situations. The country also must be better prepared for rescue and rehabilitation (as the last resort for managing) of conflict animals, by establishing necessary mechanisms, and capacitating and strategically placing expert teams for timely response.

8.8 Strengthening annual tiger, prey and habitat monitoring programs

Annual monitoring will help keep a close track on core populations and trends, and guide adaptations in conservation. Data on survivorship, reproduction and social structure in tiger populations is possible only through standardized long-term monitoring programs. The management is therefore recommended to establish long-term monitoring programs in the respective PAs to keep constant surveillance of respective tiger populations-increase (through new births or immigration) and losses (due to natural death, poaching or emigration). For better ecological insights and to address the issue of overlap, such long-term monitoring can also be done at complex level for Banke-Bardia and Chitwan-Parsa ecological units.

Similarly, prey monitoring is recommended during high visibility seasons in stratified sampling blocks as per the habitat types for robust estimates. This is also recommended in areas that are subject to annual habitat management investments, for monitoring the impacts. Increasing the potential of existing habitats by increasing forage productivity would have direct relevance to increasing and sustaining the growing tiger population. Therefore, research and monitoring programs such as estimating ecological carrying capacity could provide crucial scientific inputs for preparation of site-specific habitat management plans, and their implementation.

8.9. Establishing a national pride program for tiger conservation

With Nepal's globally acclaimed achievement in tiger conservation, sustaining this success becomes a key priority for the country. A 'Tiger Conservation Special Program' under the leadership of the Prime Minister is recommended to help holistically address existing and emerging challenges for tiger conservation. These will include managing human-tiger conflicts, improving habitats, rescue and rehabilitation, building capacity of frontline staff as well as enhancing awareness and livelihood of local communities. This program can be projected as the National Pride Program of Nepal. Such a program would add a huge communication leverage to Nepal's commitment to nature conservation globally. This would also provide leverage for improved coordination and communication between different stakeholders including various levels of government for improved prospects for tiger conservation and community well-being.

9 REFERENCES

Alexander, J.S., Gopalaswamy, A.M., Shi, K., Riordan, P. (2015). Face Value: Towards Robust Estimates of Snow Leopard Densities. *PLoS ONE* 10(8): e0134815.

Associated Press. (2016). Number of tigers in the wild rises for first time in more than 100 years [WWW Document]. The Guardian. https://www.theguardian.com/environment/2016/apr/11/number -of-tigers-in-the-wild-rises-for-first-time-in-over-100-years. [Accessed on 20 July 2022].

Barber-Meyer, S, Jnawali, S., Karki, J., Khanal, P., Lohani, S., Long, B., MacKenzie, D., Pandav, B., Pradhan, N., Shrestha, R., Subedi, N., Thapa, K., Wikramanayake E. (2012). "Influence of prey depletion and human disturbance on tiger occupancy in Nepal." *Journal of Zoology* 289 (1): 10–18.

Buckland, S.T. (2001). Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, USA.

Chanchani P., Lamichhane B. R., Malla S., Maurya K., Bista A., Warrier R., Nair S., Almeida M., Ravi R., Sharma R., Dhakal M., Yadav S. P., Thapa M., Jnawali S. R., Pradhan N. M. B., Subedi N., Thapa G. J., Yadav H., Jhala Y. V., Qureshi Q., Vattakaven J. and Borah J. (2014). Tigers of the Transboundary Terai Arc Landscape: Status, distribution and movement in the Terai of India and Nepal. National Tiger Conservation Authority, Government of India, and Department of National Park and Wildlife Conservation, Government of Nepal.

Department of National Parks and Wildlife Conservation (DNPWC). (2017). Tiger and Prey Base Monitoring Protocol (Nepal). Government of Nepal, Ministry of Forests and Soil Conservation, Department of National Parks and Wildlife Conservation, Babarmahal, Kathmandu, Nepal.

DNPWC and DFSC. (2018). Status of Tigers and Prey in Nepal. Department of National Parks and Wildlife Conservation & Department of Forests and Soil Conservation. Ministry of Forests and Environment, Kathmandu, Nepal.

DNPWC. (2020). Assessment of Ecological Carrying Capacity of Royal Bengal Tiger in Chitwan-Parsa Complex, Nepal. Department of National Parks and Wildlife Conservation, Babarmahal, Kathmandu.

Dhakal, M., Karki, M., Jnawali, S. R., Subedi, N., Pradhan, N.M.B., Malla, S., Lamichhane, B.R., Pokheral, C.P., Thapa, G.J., Oglethorpe, J., Subba, S.A., Bajracharya, P., Y, H. (2014). Status of Tigers and Prey in Nepal. Department of National Parks and Wildlife Conservation, Kathmandu, Nepal.

Efford, M.G., Fewster, R.M. (2012). Estimating population size by spatially explicit capture-recapture. *Oikos* 122: 918-928.

Efford, M.G. (2021). Package 'secr'. University of Otago, New Zealand.

Elliot, N.B., Gopalaswamy, A.M. (2017). Toward accurate and precise estimates of lion density. *Conservation Biology* 31(4): 934-943.

Gopalaswamy, A.M., Royle, J.A., Hines, J.E., Singh, P., Jathana, D., Kumar, N.S., Karanth, K.U. (2012). Program SPACECAP: software for estimating animal density using spatially explicit capture-recapture studies. *Methods in Ecology and Evolution* 3: 1067-1072.

GTRP (2010). Global Tiger Recovery Program (Executive Volume – September 20, 2010). St. Petersburg Declaration on Tiger Conservation at the International Tiger Forum ('Tiger Summit'), held in St. Petersburg, Russia, November 21–24, 2010.

Hines, J.E., Nichols, J.D., Royle, J.A., MacKenzie, D.I., Gopalaswamy, A.M., Kumar, N.S. and Karanth, K.U. (2010). Tigers on trails: occupancy modeling for cluster sampling. *Ecological Applications* 20: 1456–1466.

Hines, J. E. (2013). PRESENCE 6.2: Software to estimate patch occupancy and related parameters. United States Geological Service, Patuxent Wildlife Research Center, Laurel, Maryland, USA.

Hines, J.E., Nichols, J.D., Collazo, J.A. (2014). Multiseason occupancy models for correlated replicate surveys. *Methods in Ecology and Evolution* 5: 583-591.

Kafley, H., Lamichhane, B. R., Maharjan, R., Thapaliya, B., Bhattarai, N., Khadka, M., & Gompper, M. E. (2019). Estimating prey abundance and distribution from camera trap data using binomial mixture models. *European Journal of Wildlife Research 65*(5): 1-14.

Karanth, K.U., Nichols, J.D. (1998). Estimation of tiger densities in India using photographic captures and recaptures. *Ecology* 79(8): 2852-2862.

Karanth, K.U., Nichols, J.D. (2003). Monitoring tigers and their prey: A manual for wildlife researchers, managers and conservationists in tropical Asia. Bangalore: Centre for Wildlife studies.

Karanth, K.U. (2003). Tiger ecology and conservation in the Indian subcontinent. *Journal Bombay Natural History Society*, 100 (2&3).

Karanth, K.U., Kumar, N.S., Srinivas, V., Gopalaswamy, A. (2008). Revised monitoring framework for Tigers Forever: Panthera sites. Technical Support Team, Tigers Forever. Bangalore, India: WCS India.

Karki, J.B., Jnawali, S.R., Shrestha, R., Pandey, M.B., Gurung, G., Thapa, (Karki) M. (2009). Tiger and their prey base abundance in Terai Arc Landscape, Nepal. Department of National Parks and Wildlife Conservation and Department of Forests, Kathmandu, Nepal.

Kelly, M.J., Holub, E.L. (2008). Camera trapping of carnivores: trap success among camera types and across species and habitat selection by species, on salt pond mountains, Giles County, Virginia, *Northeastern Naturalist*, 15(2): 249-262.

Lamichhane, B. R., Leirs, H., Persoon, G. A., Subedi, N., Dhakal, M., Oli, B. N., ... & De Iongh, H. H. (2019). Factors associated with co-occurrence of large carnivores in a human-dominated landscape. *Biodiversity and Conservation 28*(6): 1473-1491.

MacKenzie, D.I., Nichols, J.D., Lachman, G.B., Droege, S., Andrew R. J., Langtimm, C.A. (2002). Estimating site occupancy rates when detection probabilities are less than one. *Ecology* 83: 2248-2255.

McDougal, C. (1977). The Face of the Tiger. Rivington Books, London, UK.

Ministry of Forests and Soil Conservation (MFSC). (2015). Strategy and Action Plan 2015-2025, Terai Arc Landscape, Nepal. Ministry of Forests and Soil Conservation, Singha Durbar, Kathmandu, Nepal.

Pal, R., Bhattacharya, T., Qureshi, Q., Buckland, S.T., Sathyakumar, S. (2020). Using distance sampling with camera traps to estimate the density of group-living and solitary mountain ungulates. *Oryx* 55(5): 668-676.

Royle J.A., Nichols J.D., Karanth K.U., Gopalaswamy, M. (2009). A hierarchical model for estimating density in camera trap studies. *Journal of Applied Ecology* 46: 118-127.

Rowcliffe, J.M., Field, J., Turvey, S.T., Carbone, C. (2008). Estimating animal density using camera traps without the need for individual recognition. *Journal of Applied Ecology* 45: 1228-1236.

Smith, J.L.D. (1993). The Role of Dispersal in Structuring the Chitwan Tiger Population. *Behavior* 124: 165-195.

Srivathsa, A., Parameshwaran, R., Sharma, S., Karanth, K.U. (2015). Estimating population sizes of leopard cats in the Western Ghats using camera surveys. *Journal of Mammalogy* 96 (4): 742-750.

Thapa, G.J., Wikramanayake, E., Jnawali, S.R., Oglethorpe, J., Adhikari, R. (2016). Assessing climate change impacts on forest ecosystems for landscape-scale spatial planning in Nepal. *Current Science* 110(3): 345:352.

Thapa, K., Manandhar, S., Bista, M., Shakya, J., Sah, G., Dhakal, M., Sharma, N., Llewellyn, B., Wultsch, C., Waits, L.P., Kelly, M.J., Hero, J., Huges, J., Karmacharya, D. (2018). Assessment of genetic diversity, population structure, and gene flow of tigers (*Panthera tigris tigris*) across Nepal's Terai Arc Landscape. *PLoS ONE* 13 (3): 1-25.

Thapa, K., Kelly, M.J. (2017). Density and carrying capacity in the forgotten tigerland: tigers in the understudied Nepalese Churia. *Integrative Zoology* 12:211–227.

Thomas, L., Buckland, S.T., Rexstad, E.A., Laake, J.L., Strindberg, S., Hedley, S.L., Bishop, J.R.B., Marques, T.A. (2010). Distance software: design and analysis of distance sampling surveys for estimating population size. *Journal of Applied Ecology* 47: 5-14.

Upadhyaya, S. K., Musters, C. J. M., Lamichhane, B. R., de Snoo, G. R., Thapa, P., Dhakal, M., ... & de Iongh, H. H. (2018). An insight into the diet and prey preference of tigers in Bardia National Park, Nepal. *Tropical Conservation Science*, *11*.

White, G.C., Burnham, K.P. (1999). Program MARK: survival estimation from populations of marked animals. *Bird Study* 46: 120-139.

Wikramanayake, E.D., Dinerstein, E., Robinson, J.G., Karanth, K.U., Rabinowitz, A., Olson, D., Mathew, T., Hedao, P., Conner, M., Hemley, G., Bolze, D. (1998). An ecology-based method for defining priorities for large mammal conservation: the tiger as case study. *Conservation Biology* 12 (4): 865-878.

Wolf, C., Ripple, W.J. (2017). Range contractions of the world's large carnivores. *Royal Society Open Science* 4 (7): 170052.

10 ANNEXURES

Annex 1. Summary of Spatially Explicit Capture Recapture (SECR) models for population estimation at site level. Only the top models are presented

Protected Area	Model	DETECTFN	PAR	LOGLIK	AIC	dAIC	AICc	AICcWT	g0	sigma
PNP	g0~h2 sigma~h2	Exponential	5	-595.655	1201.311	0	1203.38	1	0.11	3486.08
PNP	g0~h2 sigma~1	Exponential	4	-610.693	1229.387	27.34	1230.72	0		
CNP	g0~h2 sigma~h2	Exponential	5	-1462.414	2934.827	0	2935.388	1	0.302	1863.29
	g0~h2 sigma~1	Exponential	4	-1480.031	2968.062	33.044	2968.432	0		
BaNP	g0~h2 sigma~h2	Exponential	5	-412.898	835.796	0	839.325	1	0.19	3721.82
BaNP	g0~h2 sigma~1	Exponential	4	-442.158	892.315	55.212	894.537	0		
BNP	g0~h2 sigma~h2	Exponential	5	-1567.474	3144.948	0	3145.489	1	0.19	1880.69
BNP	g0~h2 sigma~1	Exponential	4	-1617.075	3242.15	97.018	3242.507	0		
ShNP	g0~h2 sigma~1	Exponential	4	-353.554	715.107	0	716.846	1	0.87	1593.83

g0: detection probability, Sigma: space range,bk: animal x site learned response, and h2: two-class mixtures

Annex 2. Population abundance estimates with standard errors and 95% confidence intervals and detection probability estimates using program Capture and Mark

Protected Area	CAPTURE Program						MARK Program					
	Number	CI (Lower)	CI (Higher)	SE	P-hat	Selection Criteria Value	Number	SE	CI (Lower)	CI (Higher)	P-hat	Model
Parsa NP	37	36	44	2.0	0.2	M(th) = 1.00	38	3.2	36	51	0.2	{MbRE}
Chitwan NP	124	118	142	5.8	0.1	M(b) = 0.87	156	19.2	119	194	1.0	{Mbh2}+{MbRE}
Banke NP	26	24	41	3.5	0.2	M(h) = 0.98	29	6.1	17	41	0.1	{M0RE}+{MbRE}
Bardia NP	131	124	149	6.4	0.2	M(h) = 1.00	127	5.8	116	138	0.2	{Mbh2}+{MbRE}+{Mh2}
Shukla NP	37	31	58	6.1	0.1	M(h) = 0.74	43	13.6	16	69	0.1	{M0RE}+{Mh2}+{MbRE}
Total	**355**											

CI: Confidence Interval, SE: Standard Error, P-hat: detection probability, M(th): model containing time x heterogeneity, M(b): Model containing behavioral response, M(h): Model containing heterogeneity, MbRE: Model containing behavior x random effects, M0RE: Model containing Random Effects, Mbh2: Model containing behavior x heterogeneity, Mh2: Model containing heterogeneity.

Annex 3. Bayesian spatially explicit capture-recapture (SECR) analysis summary outputs from program SPACECAP. Density is presented as per 100 km^2

SITES	MODEL	PARAMETER	POSTERIOR MEAN	POSTERIOR SD	95% LOWER HPD LEVEL	95% UPPER HPD LEVEL	BAYESIAN VALUE	GEWEKE DIAGNOSTIC SCORE
PNP	Half normal	Sigma	3628.3	168.5	3270.7	3935.4	1.00	0.167
		Lam0	0.024	0.002	0.019	0.029		0.048
		Psi	0.250	0.038	0.178	0.326		-0.136
		N	51.9	5.1	42.0	61.0		0.666
		P	0.024	0.002	0.019	0.028		
		D	1.74	0.17	1.40	2.04		
CNP	Half normal	Sigma	2530.4	61.7	2407.3	2652.9	1.00	0.457
		Lam0	0.041	0.003	0.036	0.047		0.569
		Psi	0.251	0.022	0.209	0.294		1.481
		N	169.6	9.4	151.0	187.0		1.623
		P	0.040	0.003	0.036	0.046		
		D	4.06	0.22	3.61	4.47		
BaNP	Half normal	Sigma	5433.3	376.6	4730.2	6186.0	0.94	0.364
		Lam0	0.008	0.001	0.005	0.010		-0.770
		Psi	0.243	0.046	0.155	0.335		0.107
		N	33.0	4.0	25.0	40.0		0.689
		P	0.038	0.006	0.026	0.051		
		D	0.97	0.12	0.79	1.23		
BNP	Half normal	Sigma	2361.7	55.0	2252.1	2462.8	1.00	-0.368
		Lam0	0.043	0.003	0.038	0.048		0.474
		Psi	0.251	0.021	0.210	0.292		0.987
		N	175.7	9.4	157.0	193.0		1.180
		P	0.042	0.002	0.038	0.047		
		D	7.15	0.38	6.47	7.94		
ShNP	Half normal	Sigma	3854.7	343.8	3259.1	4535.7	0.98	-0.932
		Lam0	0.013	0.002	0.008	0.018		0.435
		Psi	0.231	0.043	0.150	0.315		0.599
		N	45.2	6.1	34.0	57.0		0.322
		P	0.067	0.010	0.048	0.086		
		D	1.99	0.27	1.50	2.51		

Annex 4. Site-level tiger density estimates per 100 km². Sites in bold show significant difference in density between 2018 and 2022

	National Tiger Survey 2018				National Tiger Survey 2022			
SITES	Density	SD	95% LCL	95% UCL	Density	SD	95% LCL	95% UCL
PNP	0.92	0.15	0.64	1.2	1.74	0.17	1.4	2.04
CNP	3.28	0.19	2.92	3.63	4.06	0.22	3.61	4.47
BaNP	0.97	0.12	0.75	1.18	0.97	0.12	0.79	1.23
BNP	4.74	0.28	4.2	5.28	7.15	0.38	6.47	7.94
ShNP	0.96	0.14	0.72	1.21	1.99	0.27	1.5	2.51

Annex 5. A comparative assessment of change in spatial density between 2018 and 2022 for each protected area

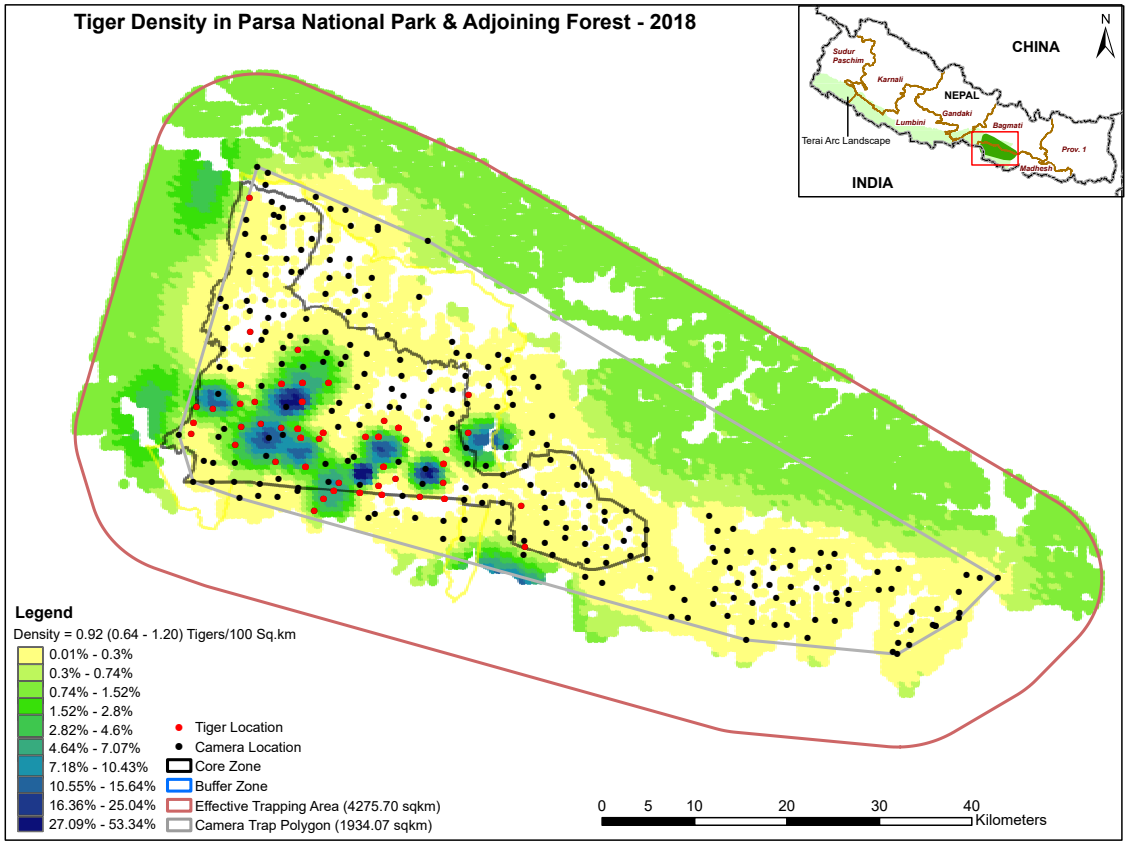


Figure 5.1. Pixelated tiger density map of Parsa National Park, adjoining forests and corridors, 2018

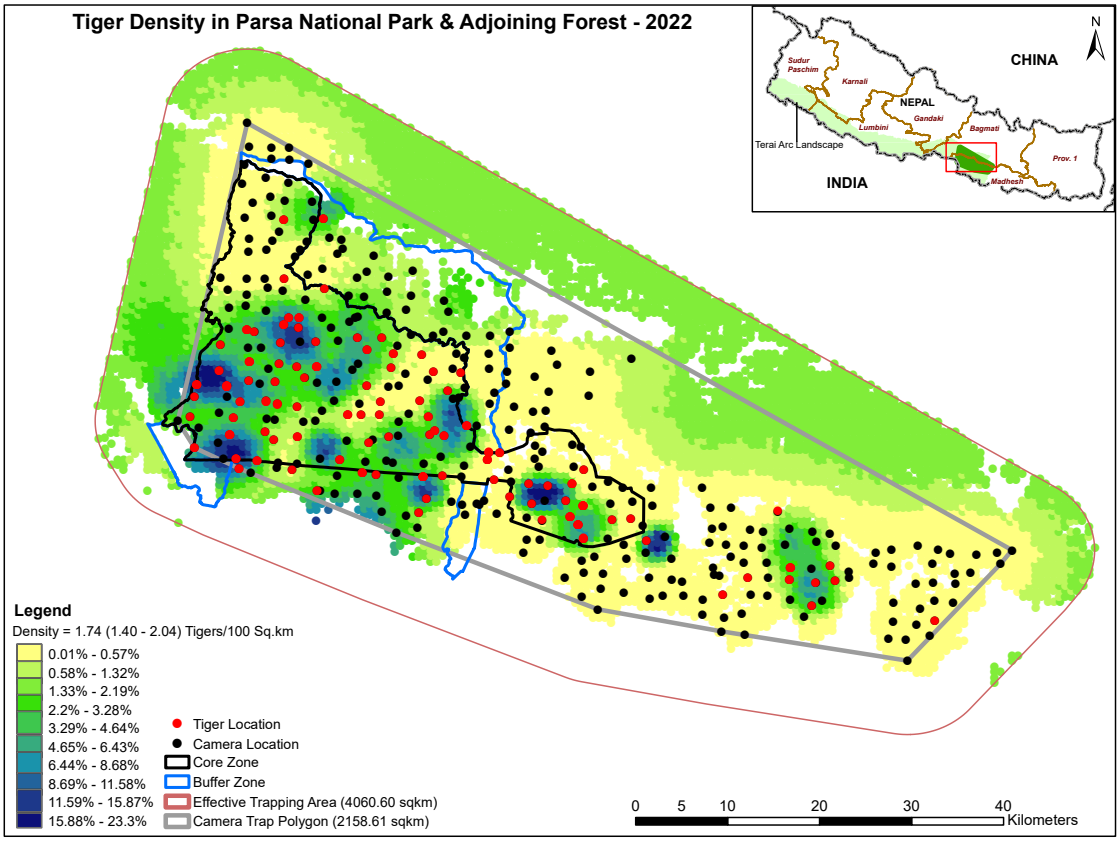


Figure 5.2. Pixelated tiger density map of Parsa National Park, adjoining forests and corridors, 2022

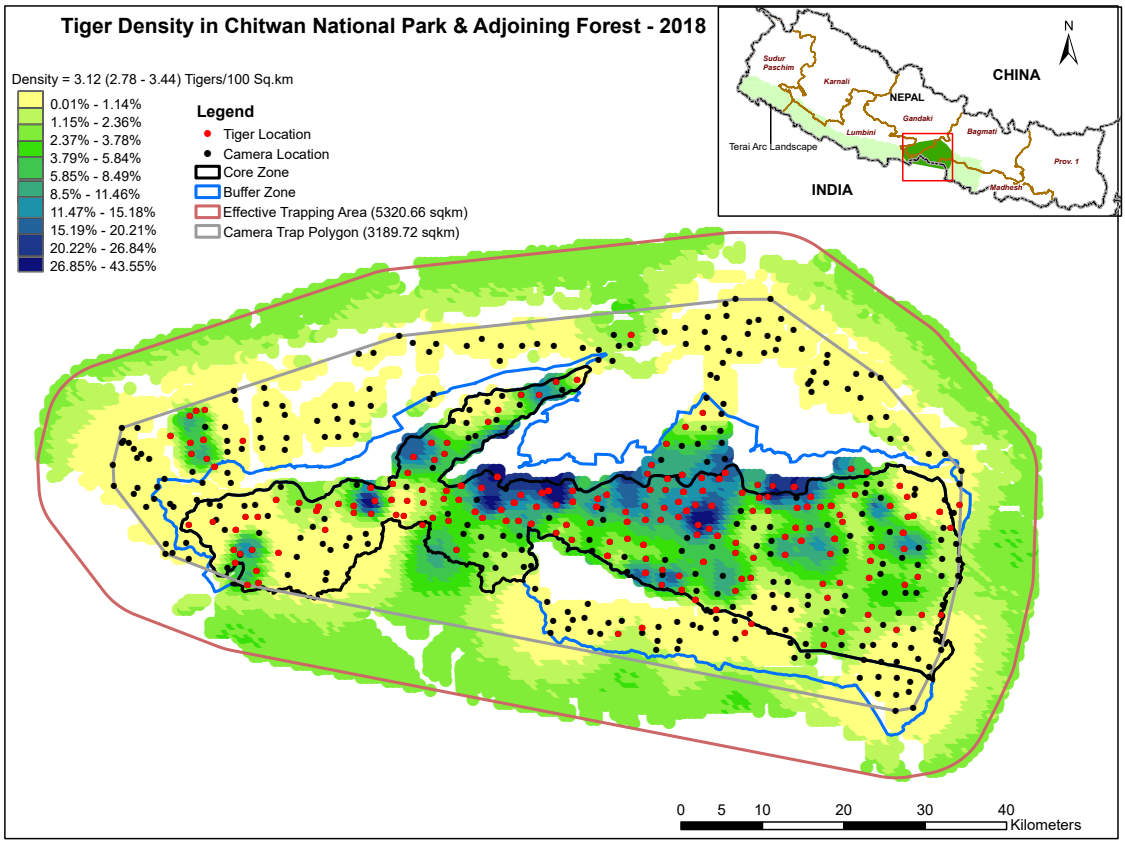


Figure 5.3. Pixelated tiger density map of Chitwan National Park, adjoining forests and corridors, 2018

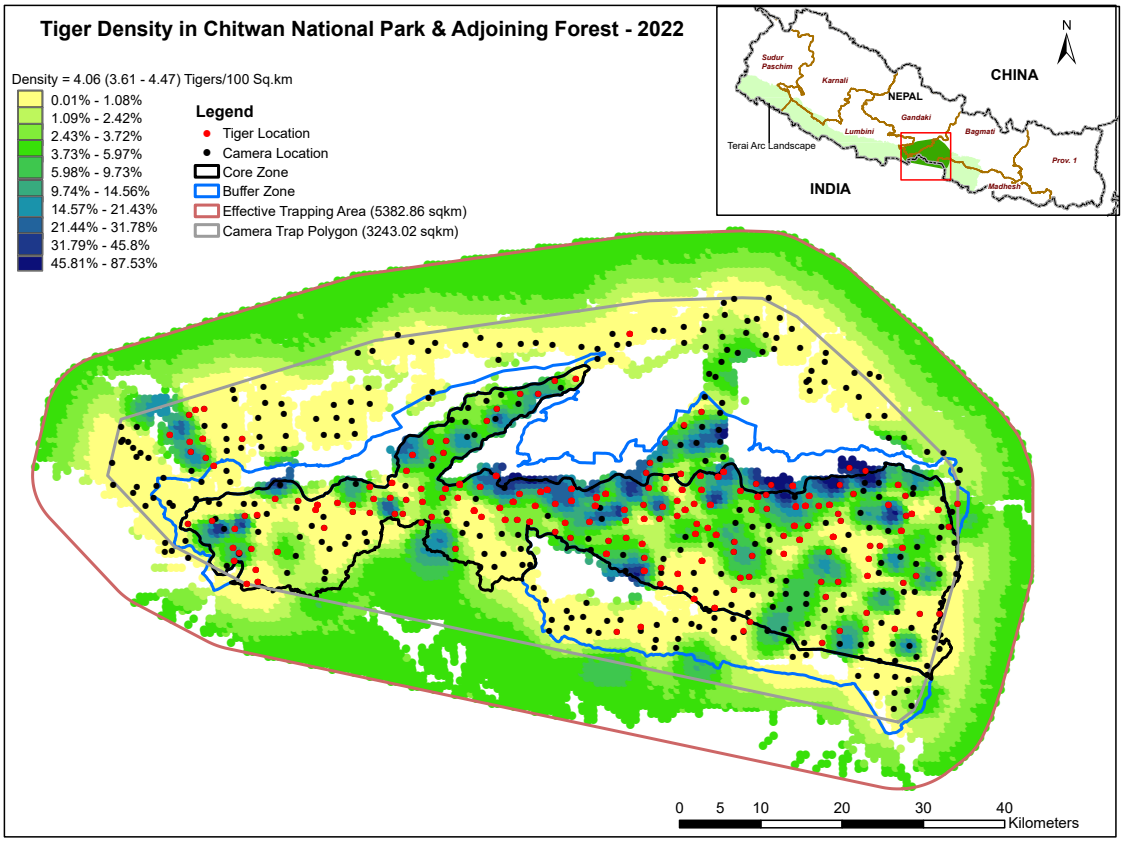


Figure 5.4. Pixelated tiger density map of Chitwan National Park, adjoining forests and corridors, 2022

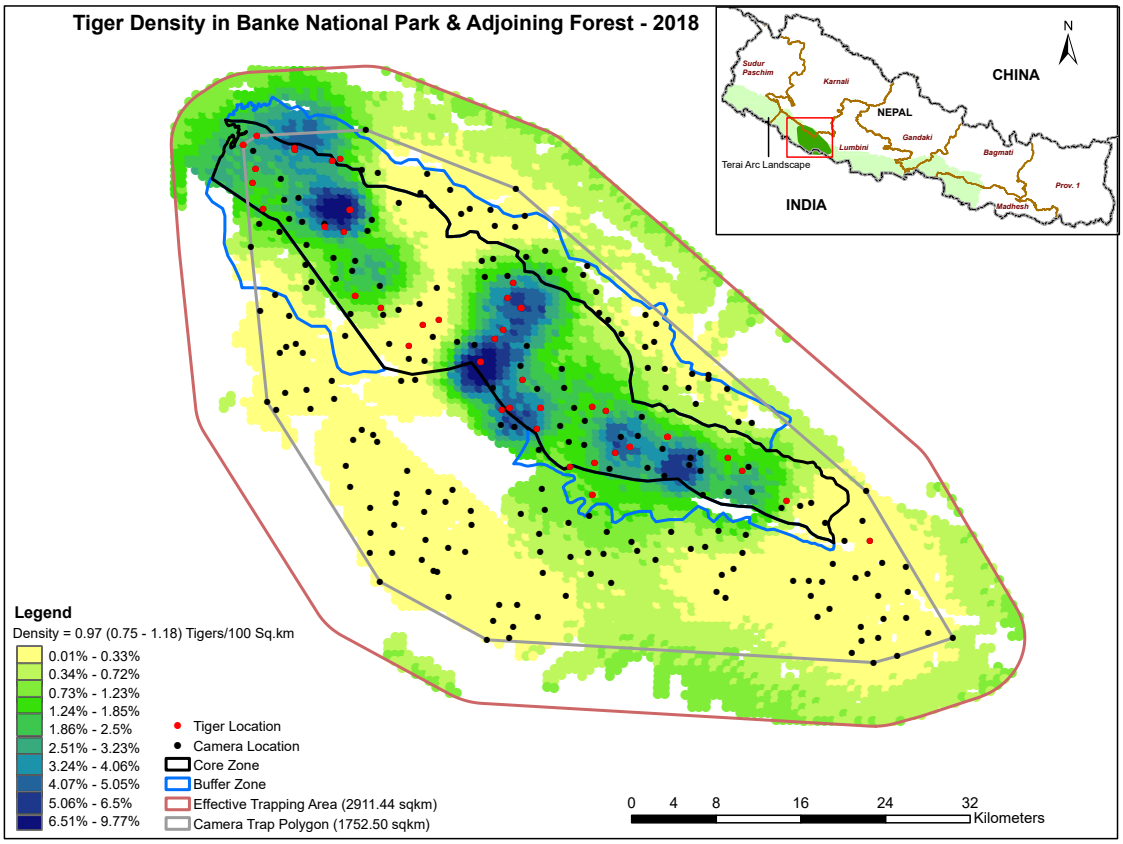


Figure 5.5. Pixelated tiger density map of Banke National Park, adjoining forests and corridors, 2018

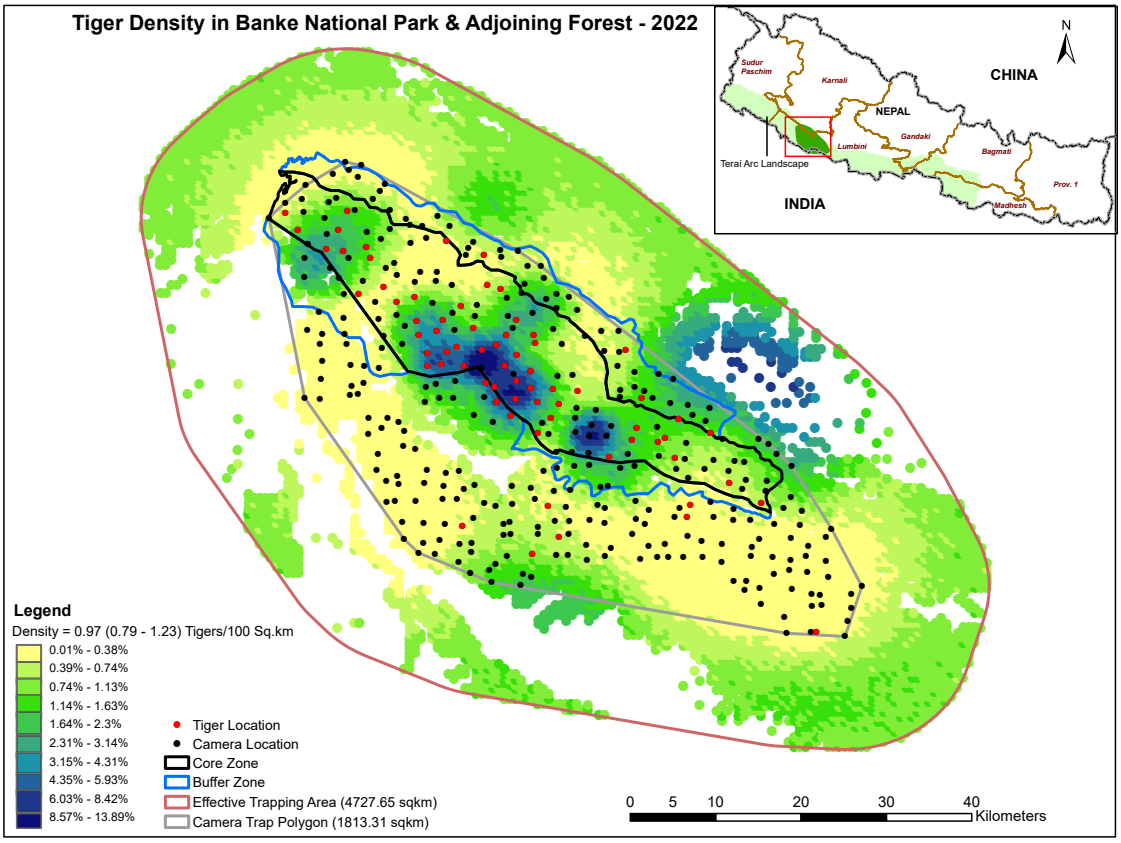


Figure 5.6. Pixelated tiger density map of Banke National Park, adjoining forests and corridors, 2022

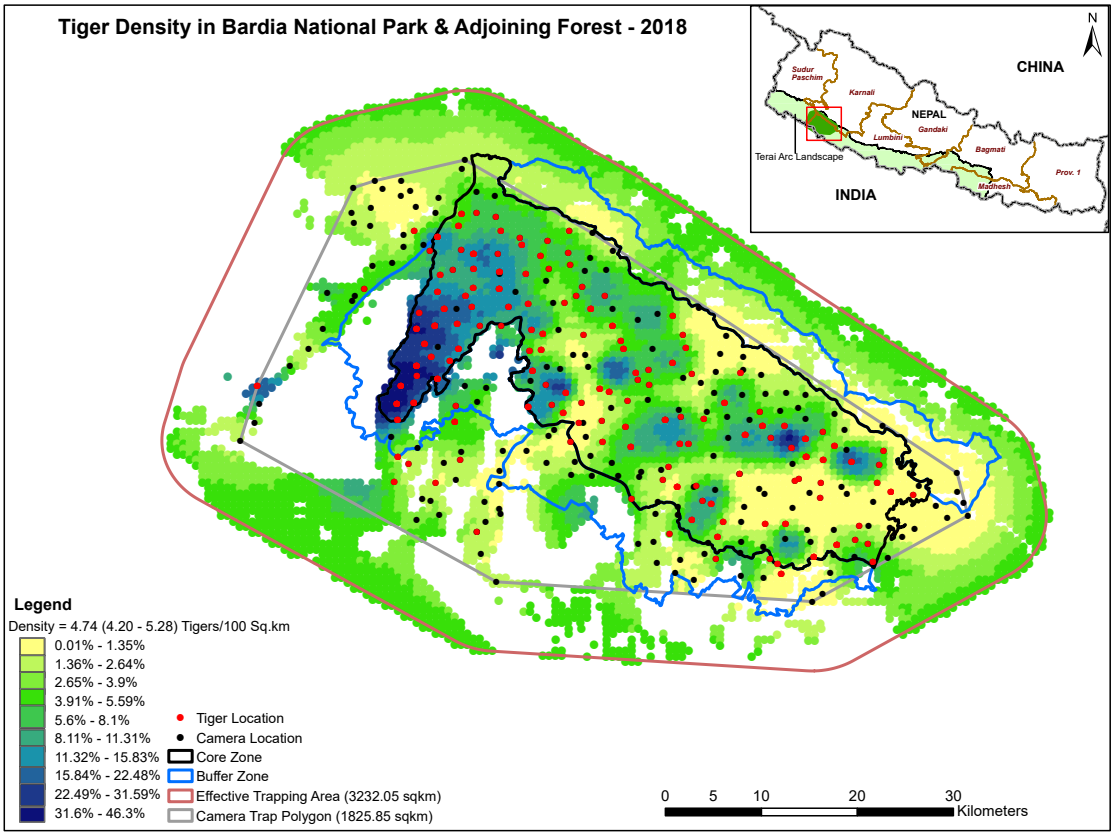


Figure 5.7. Pixelated tiger density map of Bardia National Park, adjoining forests and corridors, 2018

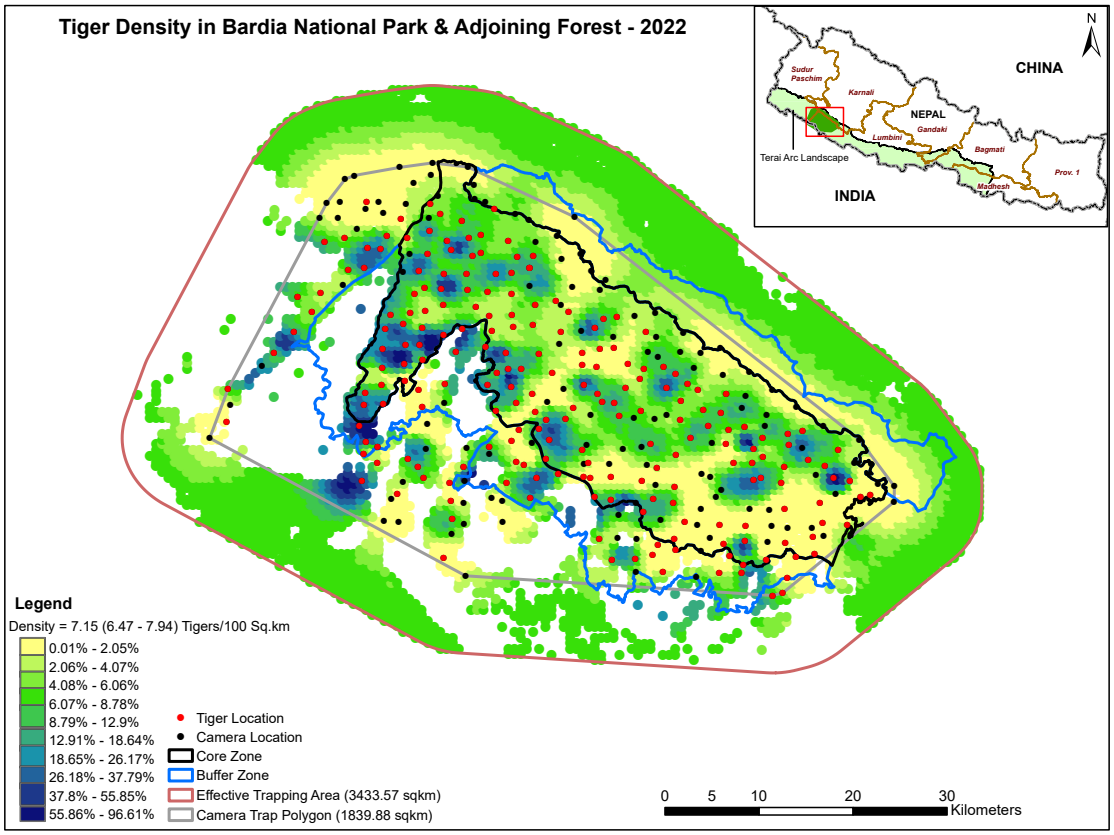


Figure 5.8. Pixelated tiger density map of Bardia National Park, adjoining forests and corridors, 2022

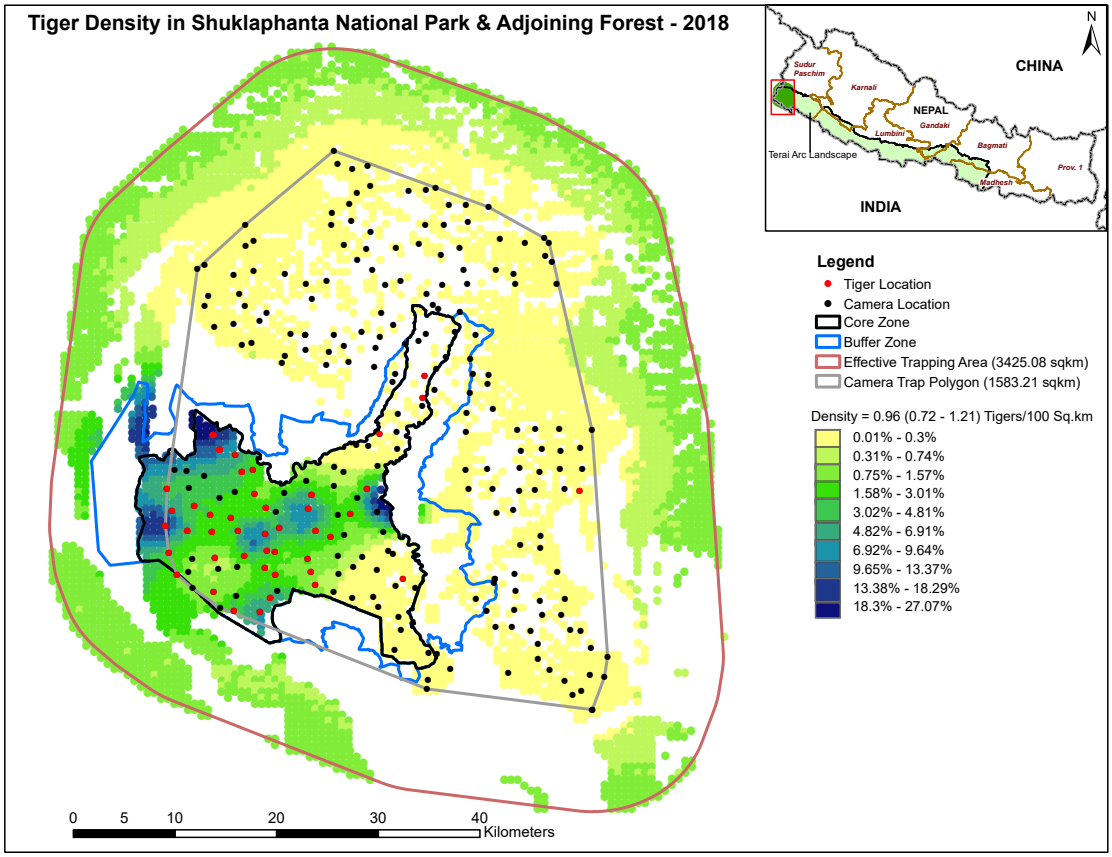


Figure 5.9. Pixelated tiger density map of Shuklaphanta National Park, adjoining forests and corridors, 2018

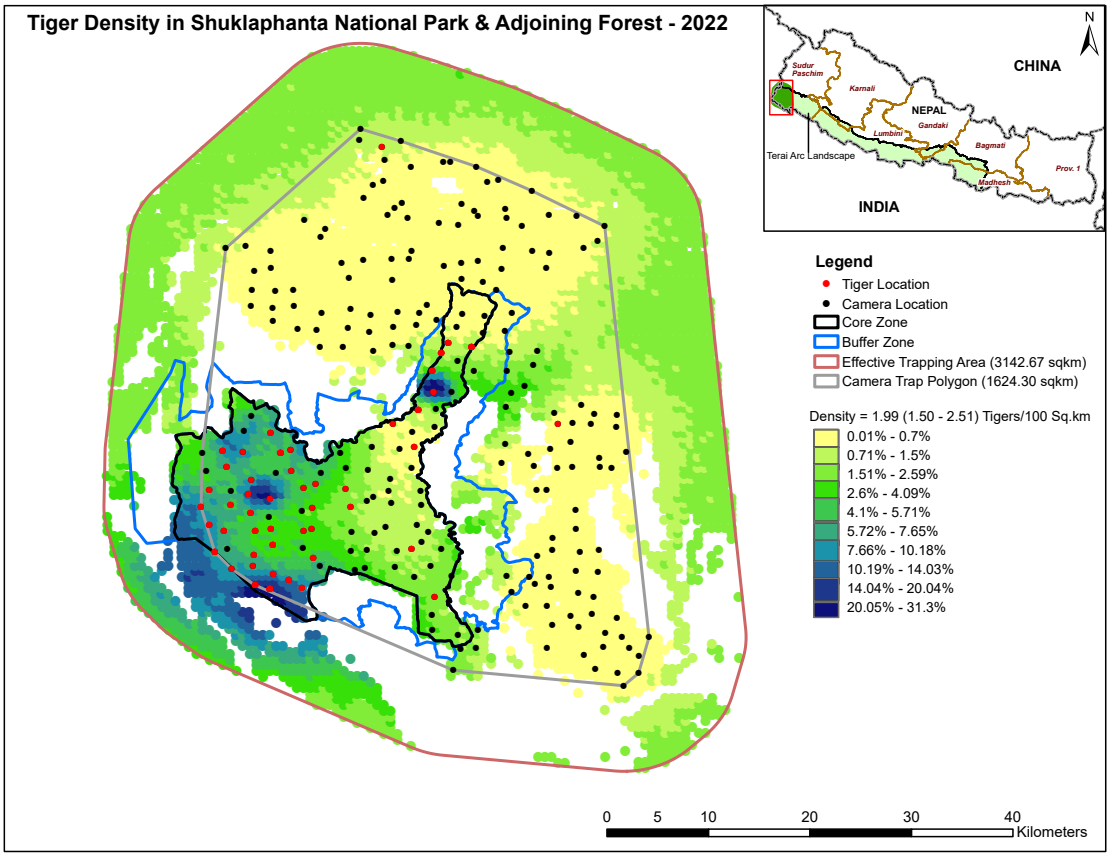


Figure 5.10. Pixelated tiger density map of Shuklaphanta National Park, adjoining forests and corridors, 2022

Annex 6: A comparison of tiger density estimates derived by SECR-ML and SECR- Bayesian approaches

	SECR-ML				SECR-Bayesian			
Site	Density	SD	95%_LCL	95%_UCL	Density	SE	95%_LCL	95%_UCL
PNP and adjoining forests	1.9	0.3	1.4	2.7	1.7	0.2	1.4	2.0
CNP and adjoining forests	4.5	0.4	3.7	5.5	4.06	0.22	3.61	4.47
BaNP and adjoining forests	1.1	0.2	0.7	1.7	1.0	0.1	0.8	1.2
BNP and adjoining forests	7.7	0.7	6.4	9.2	7.2	0.4	6.5	7.9
ShNP and adjoining forests	2.4	0.5	1.6	3.5	2.0	0.3	1.5	2.5

Annex 7: Prey density estimates and survey effort in each protected area and adjoining forests

Protected Area	Efforts (km)	Spatial Replicates	Species	No. of Obs	Density (per km²)	SE	% of CV	95% CI	P	ESW (SE)	GoF-Chi-P
PNP*	226	109	All Prey	148	75.10	11.4	15.13	55.9-101.0	0.2	19.2 (1.2)	0.99
			Spotted Deer	31	25.99	9.2	35.3	13.2-51.3	0.3	22.0 (3.1)	0.16
			Sambar	41	18.04	5.6	31	9.9-32.9	0.2	13.6 (3.2)	0.54
CNP*	415	200	All Prey	501	99.74	9.1	9.13	83.4-119.3	0.2	30.5 (1.2)	0.04
			Spotted Deer	199	74.45	12.1	16.24	54.2-102.2	0.3	33.2 (2.6)	0.86
			Sambar Deer	112	7.90	1.2	14.62	5.9-10.5	0.4	32.1 (2.1)	0.50
			Barking Deer	61	2.94	0.5	17.21	2.1-4.1	0.4	29.3 (2.4)	0.40
			Wild Boar	52	5.03	1.0	20.74	3.4-7.5	0.3	26.3 (2.4)	0.72
			Hog Deer	26	2.15	0.7	33.89	1.1-4.1	0.4	28.8 (4.5)	0.58
			Monkey (*Rhesus* and *Langur*)	37	18.50	6.6	35.7	9.3-36.7	0.3	30.4 (7.0)	0.01
BaNP*	248	163	All Prey	101	32.64	6.6	20.23	22.0-48.4	0.4	40.0 (2.8)	0.66
BNP*	267	151	All Prey	320	90.164**	11.2	12.41	70.7-114.9	0.3	46.3 (2.7)	0.63
			Spotted Deer	183	44.05	6.3	14.34	33.3-58.3	0.3	49.4 (2.7)	0.27
			Rhesus Macaque	36	14.86	4.0	26.7	8.9-25.0	0.4	42.6 (4.7)	0.45
			Terai Grey Langur	50	25.77	6.5	25.11	15.8-42.0	0.4	40.8 (3.6)	0.86
ShNP*	282	155	All Prey	325	146.24**	19.0	13	113.4-188.6	0.2	34.6 (2.4)	0.62
			Spotted Deer	188	114.61	17.2	14.99	85.5-153.6	0.2	37.5 (2.5)	0.77
			Wild Boar	43	5.42	1.2	22.19	3.5-8.4	0.4	36.3 (3.8)	0.79

**Denotes the coverage of adjoining forests in line transect survey. ** denotes density estimates of all prey excluding swamp deer that was not detected during the line transect survey in both Bardia National Park and Shuklaphanta National Park. (p denotes detection probability at defined area, ESW denotes Effective Strip Width of detection, GOF- Chi P- denotes probability of chi square for goodness of fit test*

Annex 8. Maps illustrating movement off tigers outside protected area boundary (the usage is illustrated by tiger individuals having their MCP lying beyond the boundary)

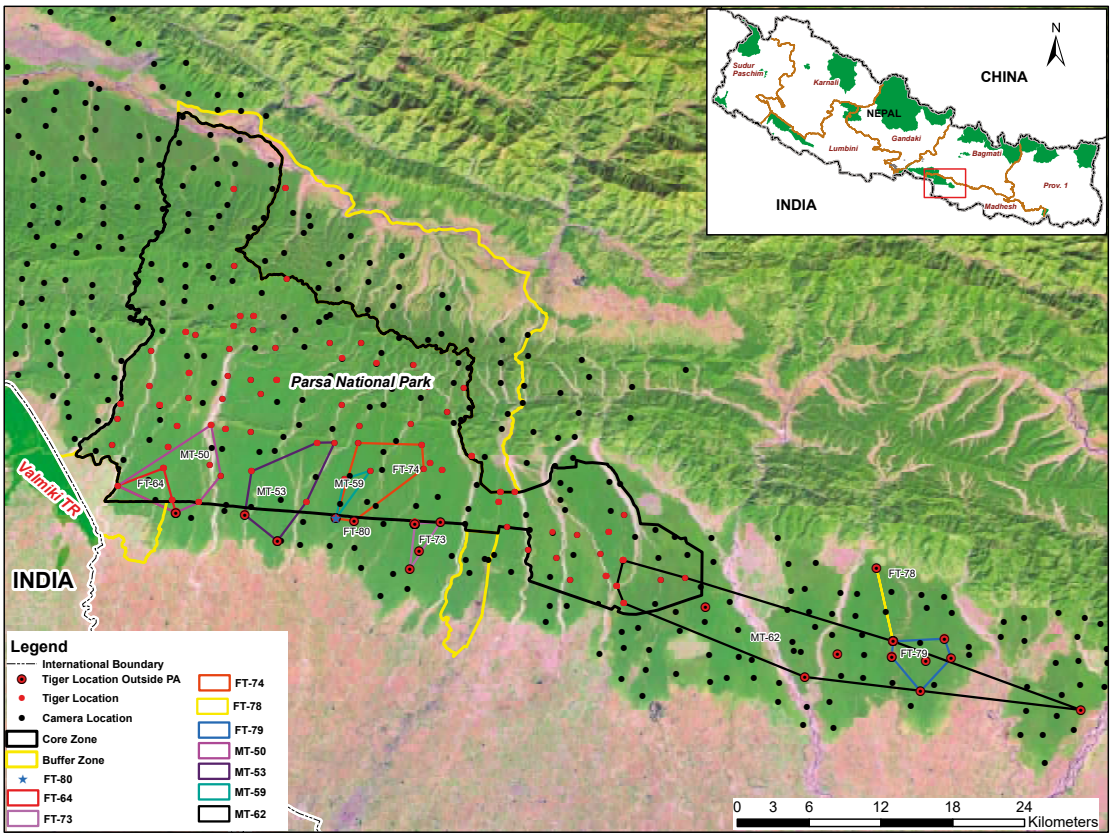


Figure 8.1. Movement of tigers in adjoining forests of Parsa National Park

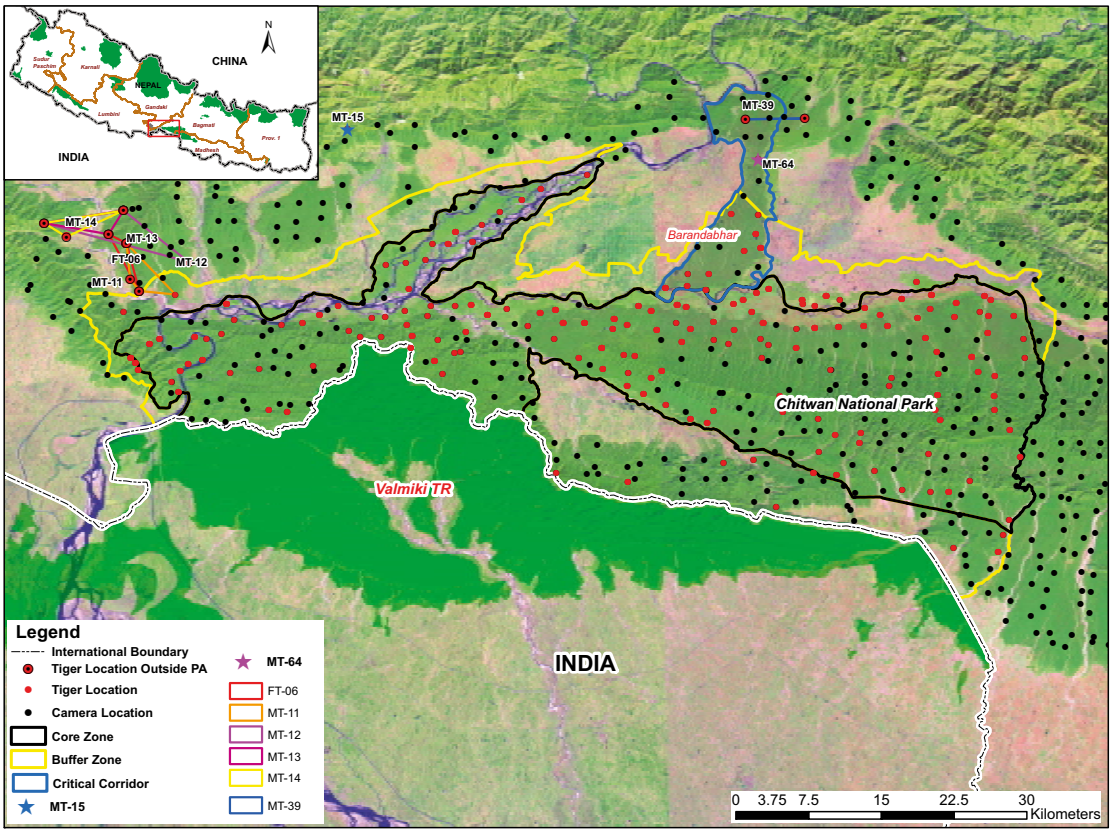


Figure 8.2. Movement of tigers in adjoining forests of Chitwan National Park

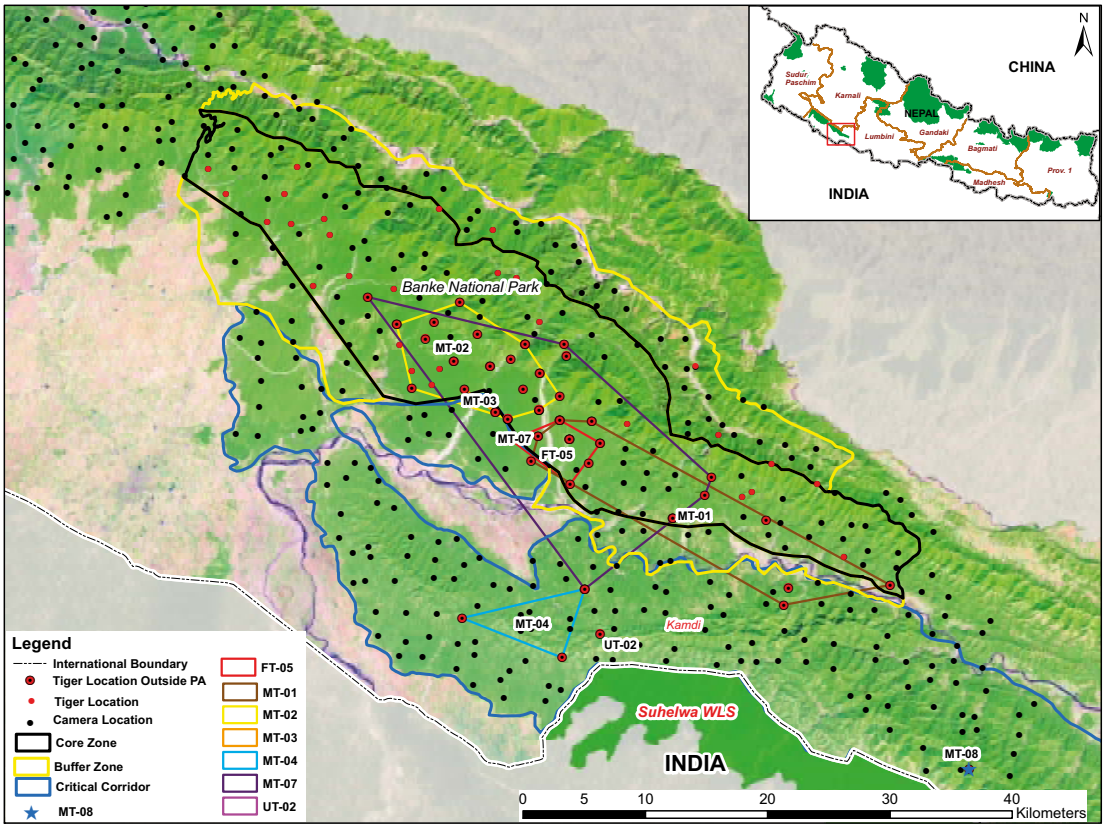


Figure 8.3. Movement of tigers in adjoining forests of Banke National Park

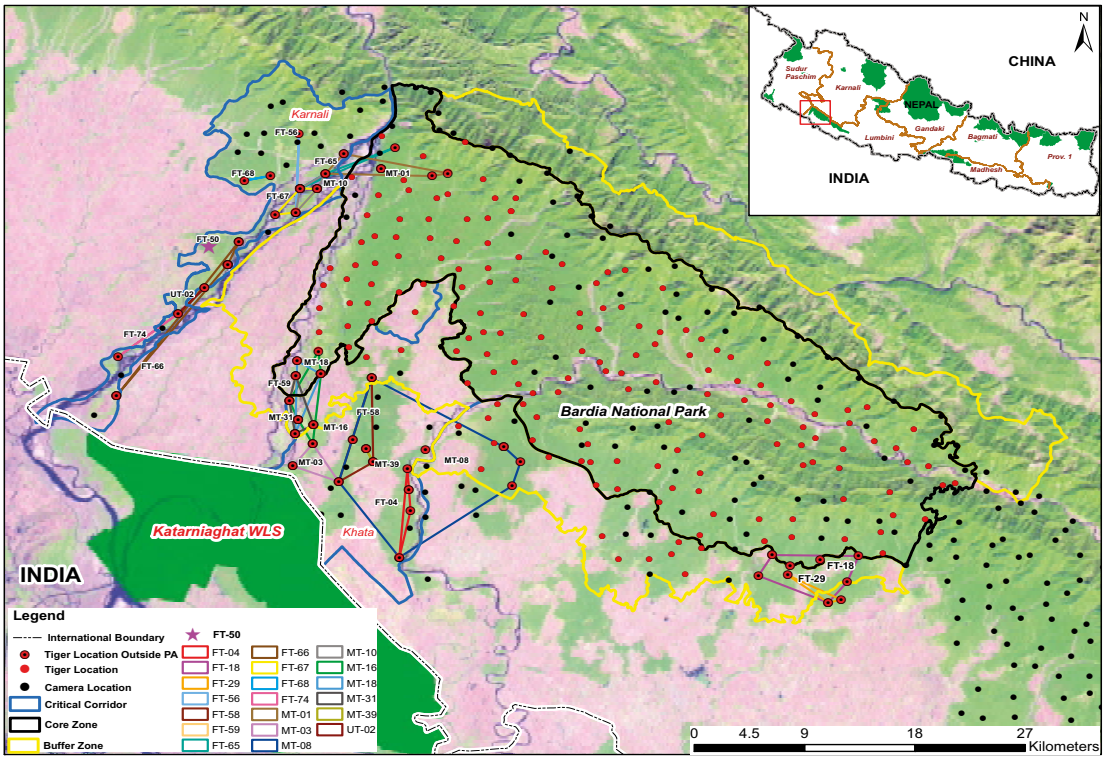


Figure 8.4. Movement of tigers in adjoining forests of Bardia National Park

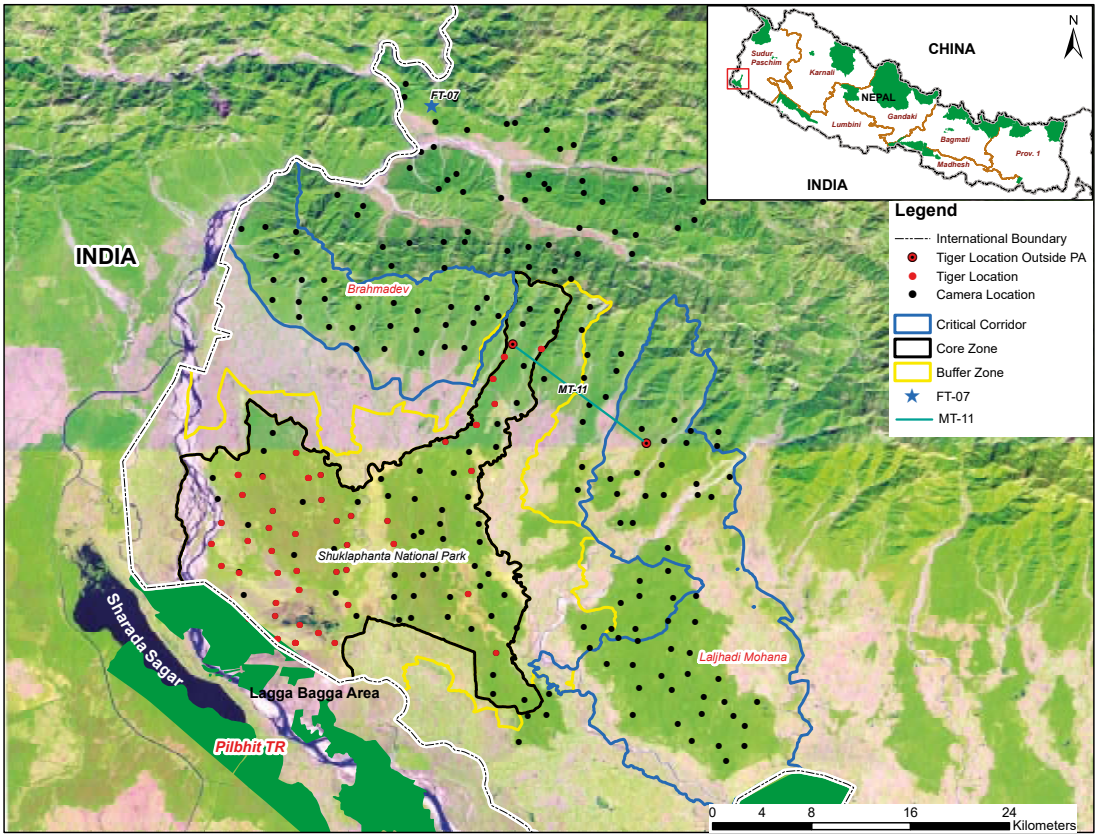


Figure 8.5. Movement of tigers in adjoining forests of Shuklaphanta National Park

Annex 9. National Tiger Survey time frame and human resource involved

SN	Protected area	Training organized	Field survey	Person days	Elephant days
1	Chitwan NP, Parsa NP and adjoining forests	December 4-5, 2021	December 6, 2021 - February 6, 2022	5668	120
2	Banke NP, Bardia NP and adjoining forests	December 13-14, 2021	December 16, 2021 - March 12, 2022	3794	90
3	Shuklaphanta NP, Laljhadi corridor and Jogbuda forest	February 11-12, 2022	February 14 - March 4, 2022	1680	54
4	Line Transect Survey	Same date as to the respective study sites	March - May, 2022	1406	391
5	Habitat Occupancy Survey	Same date as to the respective study sites	March - May, 2022	517	
	Total			**13065**	**655**

Annex 10. Ground personnel involved in National Tiger Survey 2022

SN	Name	Complex	Designation	Institution/Address
1	Anukul Ghimire	Chitwan-Parsa	Student Volunteer	Bal Kumari College
2	Kriti Sharma	Chitwan-Parsa	Student Volunteer	Bal Kumari College
3	Prabesh Poudel	Chitwan-Parsa	Student Volunteer	Bal Kumari College
4	Gopi Chaudhary	Chitwan-Parsa	Citizen Scientist	Bardia
5	Narayan Chaudhary	Chitwan-Parsa	Citizen Scientist	Bardia
6	Naresh Tharu	Chitwan-Parsa	Citizen Scientist	Bardia
7	Niresh Tharu	Chitwan-Parsa	Citizen Scientist	Bardia
8	Sagar Chaudhary	Chitwan-Parsa	Student Volunteer	Bardia
9	Sanjeev Tharu	Chitwan-Parsa	Citizen Scientist	Bardia
10	Santosh Tharu	Chitwan-Parsa	Citizen Scientist	Bardia
11	Subas Tharu	Chitwan-Parsa	Citizen Scientist	Bardia
12	Anshram Tharu	Chitwan-Parsa	Member	CBAPU, Bardia
13	Kampana Dongol	Chitwan-Parsa	Student Volunteer	CDB- TU
14	Anil Kami	Chitwan-Parsa	Citizen Scientist	Chitwan
15	Bijaya Lama	Chitwan-Parsa	Citizen Scientist	Chitwan
16	Biphala Mahato	Chitwan-Parsa	Citizen Scientist	Chitwan
17	Bishal Darai	Chitwan-Parsa	Citizen Scientist	Chitwan
18	Bisnu Bahadur Lama	Chitwan-Parsa	Retired Senior Wildlife Technican	Chitwan
19	Bol Bahadur Mahato	Chitwan-Parsa	Cook	Chitwan
20	Buddhiram Mahato	Chitwan-Parsa	Citizen Scientist	Chitwan
21	Dimber Kumar Chaudhary	Chitwan-Parsa	Citizen Scientist	Chitwan
22	Ganga Ram Darai	Chitwan-Parsa	Citizen Scientist	Chitwan
23	Harka Man Lama	Chitwan-Parsa	Retired Senior Wildlife Technican	Chitwan
24	Jitendra Lama	Chitwan-Parsa	Citizen Scientist	Chitwan
25	Kiran Tamang	Chitwan-Parsa	Citizen Scientist	Chitwan
26	Mangal Bahadur Chidi Magar	Chitwan-Parsa	Citizen Scientist	Chitwan
27	Mayaram Mahato	Chitwan-Parsa	Nature Guide	Chitwan
28	Nabin Darai	Chitwan-Parsa	Citizen Scientist	Chitwan
29	Padam Bahadur Pakhrin	Chitwan-Parsa	Citizen Scientist	Chitwan
30	Pradip Mahato	Chitwan-Parsa	Citizen Scientist	Chitwan
31	Rajan Kumal	Chitwan-Parsa	Citizen Scientist	Chitwan
32	Raju Tamang	Chitwan-Parsa	Nature Guide	Chitwan
33	Ramu Mahato	Chitwan-Parsa	Citizen Scientist	Chitwan
34	Sandip Darai	Chitwan-Parsa	Citizen Scientist	Chitwan
35	Saroj Chaudhary	Chitwan-Parsa	Nature Guide	Chitwan
36	Shiva Raj Mahato	Chitwan-Parsa	Citizen Scientist	Chitwan
37	Som Bahadur Tamang	Chitwan-Parsa	Citizen Scientist	Chitwan
38	Somraj Bote	Chitwan-Parsa	Citizen Scientist	Chitwan
39	Sudhir Kumar Mahato	Chitwan-Parsa	Gamescout	Chitwan
40	Suman Kumal	Chitwan-Parsa	Citizen Scientist	Chitwan
41	Sunil Kandel	Chitwan-Parsa	Nature Guide	Chitwan
42	Suresh Darai	Chitwan-Parsa	Citizen Scientist	Chitwan
43	Sushil Darai	Chitwan-Parsa	Citizen Scientist	Chitwan
44	Bishal Lama	Chitwan-Parsa	Cook	Citizen Scientist
45	Ajaya Chaudhary	Chitwan-Parsa	Elephant Staff	CNP
46	Amrit Chaudhary	Chitwan-Parsa	Elephant Staff	CNP

SN	Name	Complex	Designation	Institution/Address
47	Anil Prasad Yadav	Chitwan-Parsa	Senior Gamescout	CNP
48	Arjun Chaudhary	Chitwan-Parsa	Elephant Staff	CNP
49	Balkrishna Dagar	Chitwan-Parsa	Gamescout	CNP
50	Bijaya Das Tharu	Chitwan-Parsa	Elephant Staff	CNP
51	Binod Chaudhary	Chitwan-Parsa	Elephant Staff	CNP
52	Bishnu Mahato	Chitwan-Parsa	Senior Gamescout	CNP
53	Brijmohan Chaudhary	Chitwan-Parsa	Gamescout	CNP
54	Deb Narayan Panohar	Chitwan-Parsa	Elephant Staff	CNP
55	Derananda Chaudhary	Chitwan-Parsa	Elephant Staff	CNP
56	Deunath Tharu	Chitwan-Parsa	Citizen Scientist	CNP
57	Dinesh Chaudhary	Chitwan-Parsa	Ranger	CNP
58	Gajendra Prasad Mahato	Chitwan-Parsa	Gamescout	CNP
59	Gam Bahadur Ghalan	Chitwan-Parsa	Senior Gamescout	CNP
60	Jitendra Mardaniya	Chitwan-Parsa	Elephant Staff	CNP
61	Kamlesh Kumar Chaudhary	Chitwan-Parsa	Elephant Staff	CNP
62	Kausila Moktan	Chitwan-Parsa	Gamescout	CNP
63	Krishna Poudel	Chitwan-Parsa	Gamescout	CNP
64	Lalit Malla	Chitwan-Parsa	Senior Gamescout	CNP
65	Madav Chaulagain	Chitwan-Parsa	Senior Gamescout	CNP
66	Mahendra Mahato	Chitwan-Parsa	Gamescout	CNP
67	Nabin Kumar Chaudhary	Chitwan-Parsa	Elephant Staff	CNP
68	Parbati Thapa	Chitwan-Parsa	Gamescout	CNP
69	Prabej Hawari	Chitwan-Parsa	Gamescout	CNP
70	Pradip Meheta	Chitwan-Parsa	Gamescout	CNP
71	Rabindra Chaudhary	Chitwan-Parsa	Senior Gamescout	CNP
72	Raj Kumar Chaudhary	Chitwan-Parsa	Elephant Staff	CNP
73	Rajendra Panohar	Chitwan-Parsa	Subba	CNP
74	Rajkishor Singh	Chitwan-Parsa	Gamescout	CNP
75	Ram Datta Chaudhary	Chitwan-Parsa	Elephant Staff	CNP
76	Ram Kunwar	Chitwan-Parsa	Ranger	CNP
77	Ram Narayan Chaudhary	Chitwan-Parsa	Elephant Staff	CNP
78	Ram Prasad Chaudhary	Chitwan-Parsa	Gamescout	CNP
79	Rohit Kumar Chaudhary	Chitwan-Parsa	Elephant Staff	CNP
80	Roshan Chaulagain	Chitwan-Parsa	Senior Gamescout	CNP
81	Rudra Prasad Chuwai	Chitwan-Parsa	Gamescout	CNP
82	Sanjay Kumar Chaudhary	Chitwan-Parsa	Elephant Staff	CNP
83	Sanjay Kumar Yadav	Chitwan-Parsa	Senior Gamescout	CNP
84	Sanjaya Kumar Panjiyar	Chitwan-Parsa	Elephant Staff	CNP
85	Santosh Kumar Yadav	Chitwan-Parsa	Senior Gamescout	CNP
86	Shree Narayan Dhami	Chitwan-Parsa	Elephant Staff	CNP
87	Shree Shyam Chaudhary	Chitwan-Parsa	Gamescout	CNP
88	Sitaram Phuyal	Chitwan-Parsa	Ranger	CNP
89	Smiriti Lama	Chitwan-Parsa	Ranger	CNP
90	Sunil Chaudhary	Chitwan-Parsa	Elephant Staff	CNP
91	Surendra Chaudhary	Chitwan-Parsa	Elephant Staff	CNP
92	Suresh Kumar Yadav	Chitwan-Parsa	Senior Gamescout	CNP
93	Tarapati Mardaniya	Chitwan-Parsa	Citizen Scientist	CNP
94	Toplal Shrestha	Chitwan-Parsa	Gamescout	CNP
95	Ramesh Darai	Chitwan-Parsa	Wildlife Technician	NTNC-BCC

SN	Name	Complex	Designation	Institution/Address
96	Sandip Patel	Chitwan-Parsa	Ranger	DFO-Bara
97	Bishnu Gautam	Chitwan-Parsa	Subedar	DFO-Chitwan
98	Kundan Kumar Mahato	Chitwan-Parsa	Forester	DFO-Parsa
99	Sujan Moktan	Chitwan-Parsa	Ranger	DFO-Rapti
100	Chetan Kumar Mahato	Chitwan-Parsa	Forester	DFO-Rautahat
101	Prakash Bahadur Bhandari	Chitwan-Parsa	Student Volunteer	India
102	Banita Bajgain	Chitwan-Parsa	Student Volunteer	IoF, Hetauda
103	Bishwajit Chaudhary	Chitwan-Parsa	Student Volunteer	IoF, Hetauda
104	Gita Niraula	Chitwan-Parsa	Student Volunteer	IoF, Hetauda
105	Kamana Chamlagain	Chitwan-Parsa	Student Volunteer	IoF, Hetauda
106	Lalita Kumari Joshi	Chitwan-Parsa	Student Volunteer	IoF, Hetauda
107	Ambika Regmi	Chitwan-Parsa	Student Volunteer	IoF, Pokhara
108	Ashok Bhandari	Chitwan-Parsa	Student Volunteer	IoF, Pokhara
109	Rakesh Basnet	Chitwan-Parsa	Student Volunteer	IoF, Pokhara
110	Ravi Bikram Saha	Chitwan-Parsa	Student Volunteer	IoF, Pokhara
111	Roshan Kumar Chaudhary	Chitwan-Parsa	Student Volunteer	IOF/Pokhara
112	Astha Poudel	Chitwan-Parsa	Student Volunteer	KAFCOL
113	Jyoti Poudel	Chitwan-Parsa	Student Volunteer	KAFCOL
114	Man Bahadur Bohara	Chitwan-Parsa	Student Volunteer	KAFCOL
115	Susmita Lama	Chitwan-Parsa	Student Volunteer	KAFCOL
116	Antaram Chaudhary	Chitwan-Parsa	Citizen Scientist	Kailali
117	Asre Rana	Chitwan-Parsa	Citizen Scientist	Kanchanpur CFCC
118	Krishna K.C.	Chitwan-Parsa	Citizen Scientist	Madi
119	Babu Ram Mahato	Chitwan-Parsa	Wildlife Technician	Nepal Tiger Trust
120	Raju Kumal	Chitwan-Parsa	Wildlife Technician	Nepal Tiger Trust
121	Aaita Ram Tamang	Chitwan-Parsa	Driver /NTNC-BCC	NTNC-BCC
122	Aashish Gurung	Chitwan-Parsa	Conservation Officer	NTNC-BCC
123	Binod Darai	Chitwan-Parsa	Team Leader	NTNC-BCC
124	Dip Prasad Chaudhary	Chitwan-Parsa	Wildlife Technician	NTNC-BCC
125	Diplal Chaudhary	Chitwan-Parsa	Citizen Scientist	NTNC-BCC
126	Ganesh Lama	Chitwan-Parsa	Wildlife Technician	NTNC-BCC
127	Kiran Thakuri	Chitwan-Parsa	Wildlife Technician	NTNC-BCC
128	Lal Bahadur Mahatara	Chitwan-Parsa	Wildlife Technician	NTNC-BCC
129	Santosh Bhattarai	Chitwan-Parsa	Conservation Officer	NTNC-BCC
130	Shiva Mahato	Chitwan-Parsa	Wildlife Technician	NTNC-BCC
131	Surendra Chaudhary	Chitwan-Parsa	Wildlife Technician	NTNC-BCC
132	Suresh Sahi	Chitwan-Parsa	Wildlife Technician	NTNC-BCC
133	Tika Ram Tharu	Chitwan-Parsa	Team Leader	NTNC-BCC
134	Tirtha Lama	Chitwan-Parsa	Wildlife Technician	NTNC-BCC
135	Amar Thakur	Chitwan-Parsa	Wildlife Technician	NTNC-SCP
136	Ganesh Rana	Chitwan-Parsa	Wildlife Technician	NTNC-SCP
137	Kritana Bhandari	Chitwan-Parsa	Student Volunteer	Nuwakot
138	Barun Kumar Pandey	Chitwan-Parsa	Gamescout	PNP
139	Dhiraj Kumar Shah	Chitwan-Parsa	Senior Gamescout	PNP
140	Jit Narayan Yadav	Chitwan-Parsa	Gamescout	PNP
141	Ram Narayan Yadav	Chitwan-Parsa	Senior Gamescout	PNP
142	Bibek Chaudhary	Chitwan-Parsa	Citizen Scientist	Saptari
143	Aasaram Chauhdary	Banke-Bardia	Gamescout	BaNP
144	Arjun Kumar Khattri	Banke-Bardia	Gamescout	BaNP

SN	Name	Complex	Designation	Institution/Address
145	Bhagiram Chaudhary	Banke-Bardia	Gamescout	BaNP
146	Bishal Thapa Magar	Banke-Bardia	Gamescout	BaNP
147	Bishnu Gharti	Banke-Bardia	Gamescout	BaNP
148	Dipendra Khadka	Banke-Bardia	Gamescout	BaNP
149	Gopal Jung Chand	Banke-Bardia	Elephant Staff	BaNP
150	Hemraj Chaudhary	Banke-Bardia	Gamescout	BaNP
151	Hemraj Rokaya	Banke-Bardia	Senior Gamescout	BaNP
152	Jhapendra Paudel	Banke-Bardia	Gamescout	BaNP
153	Khum Bahadur Pun	Banke-Bardia	Gamescout	BaNP
154	Lokesh Bista	Banke-Bardia	Gamescout	BaNP
155	Madan Bhandari	Banke-Bardia	Gamescout	BaNP
156	Prithivi Singh Thapa	Banke-Bardia	Gamescout	BaNP
157	Purnalal Kami	Banke-Bardia	Gamescout	BaNP
158	Raju B.K	Banke-Bardia	Senior Gamescout	BaNP
159	Ram Bahadur Pun Magar	Banke-Bardia	Senior Gamescout	BaNP
160	Ratan Buda	Banke-Bardia	Gamescout	BaNP
161	Sahadev Tharu	Banke-Bardia	Gamescout	BaNP
162	Sarad Sharma	Banke-Bardia	Senior Gamescout	BaNP
163	Saurav Bista	Banke-Bardia	Gamescout	BaNP
164	Shyam Kumar Saru Magar	Banke-Bardia	Gamescout	BaNP
165	Suresh Rana	Banke-Bardia	Gamescout	BaNP
166	Udaya Ram Oli	Banke-Bardia	Gamescout	BaNP
167	Uttam Khadka	Banke-Bardia	Gamescout	BaNP
168	Aasharam Chaudhary	Banke-Bardia	Gamescout	BNP
169	Amrit Tharu	Banke-Bardia	Gamescout	BNP
170	Dinesh Mahat	Banke-Bardia	Senior Gamescout	BNP
171	Dipak Kusari	Banke-Bardia	Gamescout	BNP
172	Gagan Rawat	Banke-Bardia	Gamescout	BNP
173	Haridevi Bhakri	Banke-Bardia	Gamescout	BNP
174	Hemanta Chaudhary	Banke-Bardia	Driver	BNP
175	Hikmat Chitaure Magar	Banke-Bardia	Gamescout	BNP
176	Jagat Budha	Banke-Bardia	Driver	BNP
177	Jit Bahadur Waiba	Banke-Bardia	Driver	BNP
178	Kaladhar Gautam	Banke-Bardia	Ranger	BNP
179	Kalu Chand Thakuri	Banke-Bardia	Gamescout	BNP
180	Kalu Thapa	Banke-Bardia	Gamescout	BNP
181	Khagendra Chhatyal	Banke-Bardia	Senior Gamescout	BNP
182	Lekh Raj Rai	Banke-Bardia	Senior Gamescout	BNP
183	Manbir Pun	Banke-Bardia	Senior Gamescout	BNP
184	Manoj Rana Magar	Banke-Bardia	Driver	BNP
185	Matrika Prasad Rijal	Banke-Bardia	Senior Gamescout	BNP
186	Mausam Sah	Banke-Bardia	Gamescout	BNP
187	Narendra Budha	Banke-Bardia	Senior Gamescout	BNP
188	Naresh Bikram Chand	Banke-Bardia	Gamescout	BNP
189	Nirmal Chaudhary	Banke-Bardia	Senior Gamescout	BNP
190	Pankharaj Tiruwa	Banke-Bardia	Senior Gamescout	BNP
191	Prayag Raj Kumai	Banke-Bardia	Senior Gamescout	BNP
192	Prem Karki	Banke-Bardia	Gamescout	BNP
193	Raghupati Chaudhary	Banke-Bardia	Gamescout	BNP
194	Raj Kumar Yadav	Banke-Bardia	Gamescout	BNP

SN	Name	Complex	Designation	Institution/Address
195	Rakesh Sah	Banke-Bardia	Gamescout	BNP
196	Rakesh Tharu	Banke-Bardia	Driver	BNP
197	Ram Kumar Chaudhary	Banke-Bardia	Gamescout	BNP
198	Sita Kumari Kandel	Banke-Bardia	Gamescout	BNP
199	Tej Bahadur Kami	Banke-Bardia	Gamescout	BNP
200	Upahar Singh Lama	Banke-Bardia	Gamescout	BNP
201	Gangaram Tharu	Banke-Bardia	Elephant Staff	BNP Kumargaj
202	Ram Gopal Tharu	Banke-Bardia	Elephant Staff	BNP Kumargaj
203	Bishnu Tharu	Banke-Bardia	Elephant Staff	BNP Thakurgaj
204	Ishwor B.K	Banke-Bardia	Elephant Staff	BNP Thakurgaj
205	Krishna Tharu	Banke-Bardia	Elephant Staff	BNP Thakurgaj
206	Ankush Lohani	Banke-Bardia	Student Volunteer	BSc
207	Bikram Singh Chaudhary	Banke-Bardia	Student Volunteer	BSc
208	Rajan Khattri	Banke-Bardia	Student Volunteer	BSc
209	Tilak Parsad Khanal	Banke-Bardia	Student Volunteer	BSc
210	Bir Bahadur Chaudhary	Banke-Bardia	Volunteer	CBAPU
211	Chhotaram Tharu	Banke-Bardia	Volunteer	CBAPU
212	Daman Kumar Thapa	Banke-Bardia	Volunteer	CBAPU
213	Dip Bahadur Shahi	Banke-Bardia	Volunteer	CBAPU
214	Jit Bahadur Tharu	Banke-Bardia	Volunteer	CBAPU
215	Khomlal Chaudhary	Banke-Bardia	Volunteer	CBAPU
216	Parkash Chaudhary	Banke-Bardia	Volunteer	CBAPU
217	Pithhu Chaudhary	Banke-Bardia	Volunteer	CBAPU
218	Ram Krishna Yogi	Banke-Bardia	Volunteer	CBAPU
219	Darsan Chaudary	Banke-Bardia	Member	CBAPU, Bardia
220	Tilak Kumar Saud	Banke-Bardia	Member	CBAPU, Bardia
221	Yubaraj Tharu	Banke-Bardia	Member	CBAPU, Bardia
222	Bhojraj Khattri	Banke-Bardia	Cook	CBAPU/Banke
223	Ganesh Bahadur Khattri	Banke-Bardia	Cook	CBAPU/Banke
224	Krishna Bahadur Bhandari	Banke-Bardia	Cook	CBAPU/Banke
225	Tek Bahadur K.C	Banke-Bardia	Cook	CBAPU/Banke
226	Saru Chaudhary	Banke-Bardia	Student Volunteer	KAFCOL
227	Balkrishna Tharu	Banke-Bardia	Elephant Staff	NTNC-BCP
228	Hari Bahadur Chaudhary	Banke-Bardia	Elephant Staff	NTNC-BCP
229	Kararu Chaudhary	Banke-Bardia	Driver /NTNC-BCP	NTNC-BCP
230	Khusi Ram Chaudary	Banke-Bardia	Wildlife Technician	NTNC-BCP
231	Krishna Kumar Chand	Banke-Bardia	Driver /NTNC-BCP	NTNC-BCP
232	Phiru Lal Chaudary	Banke-Bardia	Wildlife Technician	NTNC-BCP
233	Rabin Bahadur K.C	Banke-Bardia	Data Base Consultant	NTNC-BCP
234	Ramraj Chaudary	Banke-Bardia	Wildlife Technician	NTNC-BCP
235	Anas Ram Chudhary	Shuklaphanta-Laljhadi-Jogbuda	Citizen Scientist	Bardia
236	Narayan Chudhary	Shuklaphanta-Laljhadi-Jogbuda	Citizen Scientist	Bardia
237	Rupak Chaudhary	Shuklaphanta-Laljhadi-Jogbuda	Student Volunteer	Basanta CFCC
238	Moti Ram Rana	Shuklaphanta-Laljhadi-Jogbuda	Chairperson	CBAPU, Laljhadi, Kanchanpur
239	Chakra Negi	Shuklaphanta-Laljhadi-Jogbuda	Chairperson	CBAPU
240	Anta Ram Chaudhary	Shuklaphanta-Laljhadi-Jogbuda	Citizen Scientist	CBAPU, Kailali
241	Shuk Ram Rana	Shuklaphanta-Laljhadi-Jogbuda	Cook	CBAPU, Kailali
242	Rupak Bam	Shuklaphanta-Laljhadi-Jogbuda	Citizen Scientist	CBAPU, Kanchanpur
243	Ganesh Rokaya	Shuklaphanta-Laljhadi-Jogbuda	Citizen Scientist	CBAPU, Shukla

SN	Name	Complex	Designation	Institution/Address
244	Shankar Singh Mahara	Shuklaphanta-Laljhadi-Jogbuda	Member	CFCC, Dadeldhura
245	Damodar Joshi	Shuklaphanta-Laljhadi-Jogbuda	Secretary	CFUG, Kanchanpur
246	Rajendra Prasad Bhandari	Shuklaphanta-Laljhadi-Jogbuda	Member	CFUG, Kanchanpur
247	Tara Pati Mardaniya	Shuklaphanta-Laljhadi-Jogbuda	Citizen Scientist	Chitwan
248	Khagendra Nath	Shuklaphanta-Laljhadi-Jogbuda	Member	Chure Sanjal, Dadeldhura
249	Karan Bhatta	Shuklaphanta-Laljhadi-Jogbuda	Chairperson	Chure Sanjal, Kanchanpur
250	Binod Darai	Shuklaphanta-Laljhadi-Jogbuda	Wildlife Technician	Cook
251	Harish Thakur	Shuklaphanta-Laljhadi-Jogbuda	Cook	Cook
252	Jeevan Rana	Shuklaphanta-Laljhadi-Jogbuda	Cook	Cook
253	Rajendra Negi	Shuklaphanta-Laljhadi-Jogbuda	Cook	Cook
254	Surendra Rana	Shuklaphanta-Laljhadi-Jogbuda	Cook	Cook
255	Surendra Rawal	Shuklaphanta-Laljhadi-Jogbuda	Cook	Cook
256	Tilak Bahadur Jagri	Shuklaphanta-Laljhadi-Jogbuda	Cook	Cook
257	Upendra Singh Kuwar	Shuklaphanta-Laljhadi-Jogbuda	Cook	Cook
258	Jeewan Bohara	Shuklaphanta-Laljhadi-Jogbuda	Citizen Scientist	Dadeldhura
259	Khadak Singh Saanki	Shuklaphanta-Laljhadi-Jogbuda	Citizen Scientist	Dadeldhura
260	Arjun Singh Thapa	Shuklaphanta-Laljhadi-Jogbuda	Jamdar	DFO, Kanchanpur
261	Devi Singh Bhat	Shuklaphanta-Laljhadi-Jogbuda	Forest guard	DFO, Kanchanpur
262	Dhana Joshi	Shuklaphanta-Laljhadi-Jogbuda	Forest guard	DFO, Kanchanpur
263	Man Bahadur Nath	Shuklaphanta-Laljhadi-Jogbuda	Forester	DFO, Kanchanpur
264	Chudamani Bhatt	Shuklaphanta-Laljhadi-Jogbuda	Student Volunteer	Jogbuda, CFCC
265	Roshan Singh Dhami	Shuklaphanta-Laljhadi-Jogbuda	Student Volunteer	KAFCOL
266	Bhagwan Kalauni	Shuklaphanta-Laljhadi-Jogbuda	Student Volunteer	Kanchanpur
267	Man Bahadur Dangaura Tharu	Shuklaphanta-Laljhadi-Jogbuda	Citizen Scientist	Kanchanpur
268	Navin Raj Joshi	Shuklaphanta-Laljhadi-Jogbuda	Student Volunteer	Kanchanpur
269	Phula Ram Chaudhary	Shuklaphanta-Laljhadi-Jogbuda	Citizen Scientist	Kanchanpur
270	Sabika Tiwari	Shuklaphanta-Laljhadi-Jogbuda	Student Volunteer	Kanchanpur
271	Asare Rana	Shuklaphanta-Laljhadi-Jogbuda	Citizen Scientist	Kanchanpur, CFCC
272	Puna Ram Chaudhary	Shuklaphanta-Laljhadi-Jogbuda	Citizen Scientist	Kanchanpur, CFCC
273	Naresh Tharu	Shuklaphanta-Laljhadi-Jogbuda	Citizen Scientist	Khata, CFCC
274	Prawesh Paudel	Shuklaphanta-Laljhadi-Jogbuda	Student Volunteer	Lalitpur
275	Saru Chaudhary	Shuklaphanta-Laljhadi-Jogbuda	Student Volunteer	Makwanpur
276	Harka Bdr Khadka	Shuklaphanta-Laljhadi-Jogbuda	Devidal Battalion	Nepal Army
277	Milan Ray	Shuklaphanta-Laljhadi-Jogbuda	Devidal Battalion	Nepal Army
278	Ramesh Thakuri	Shuklaphanta-Laljhadi-Jogbuda	Devidal Battalion	Nepal Army
279	Yam Bdr Sarki	Shuklaphanta-Laljhadi-Jogbuda	Devidal Battalion	Nepal Army
280	Birendra Khati	Shuklaphanta-Laljhadi-Jogbuda	Nature Guide	NGT
281	Dambar Paitala	Shuklaphanta-Laljhadi-Jogbuda	Nature Guide	NGT
282	Dinesh Kuwar	Shuklaphanta-Laljhadi-Jogbuda	Nature Guide	NGT
283	Dipendra Bhatta	Shuklaphanta-Laljhadi-Jogbuda	Nature Guide	NGT
284	Gobinda Pandit	Shuklaphanta-Laljhadi-Jogbuda	Nature Guide	NGT
285	Mahesh Dangaura	Shuklaphanta-Laljhadi-Jogbuda	Nature Guide	NGT
286	Amar Sing Thakur	Shuklaphanta-Laljhadi-Jogbuda	Wildlife Technician	NTNC
287	Dev Raj Joshi	Shuklaphanta-Laljhadi-Jogbuda	Wildlife Technician	NTNC
288	Dip Chaudhary	Shuklaphanta-Laljhadi-Jogbuda	Wildlife Technician	NTNC
289	Ganesh Lama	Shuklaphanta-Laljhadi-Jogbuda	Wildlife Technician	NTNC
290	Ganesh Rana	Shuklaphanta-Laljhadi-Jogbuda	Wildlife Technician	NTNC
291	Ganesh Singh Dhami	Shuklaphanta-Laljhadi-Jogbuda	Cook	NTNC

SN	Name	Complex	Designation	Institution/Address
292	Ram Prasad Joshi	Shuklaphanta-Laljhadi-Jogbuda	Driver	NTNC
293	Ramesh Darai	Shuklaphanta-Laljhadi-Jogbuda	Wildlife Technician	NTNC
294	Shambhu Acharya	Shuklaphanta-Laljhadi-Jogbuda	Gamescout	NTNC
295	Suman Malla	Shuklaphanta-Laljhadi-Jogbuda	Senior Wildlife Technician	NTNC
296	Tej Kadal	Shuklaphanta-Laljhadi-Jogbuda	Gamescout	NTNC
297	Tika Ram Tharu	Shuklaphanta-Laljhadi-Jogbuda	Wildlife Technician	NTNC
298	Tula Datta Badu	Shuklaphanta-Laljhadi-Jogbuda	Cook	NTNC
299	Aanand Sunaha	Shuklaphanta-Laljhadi-Jogbuda	Elephant Staff	ShNP
300	Bhubneshwor Chaudhary	Shuklaphanta-Laljhadi-Jogbuda	Ranger	ShNP
301	Chote Lal Rana	Shuklaphanta-Laljhadi-Jogbuda	Elephant Staff	ShNP
302	Durbesh Thakur	Shuklaphanta-Laljhadi-Jogbuda	Gamescout	ShNP
303	Gajendra Singh Dhangra	Shuklaphanta-Laljhadi-Jogbuda	Elephant Staff	ShNP
304	Ganesh Bdr Bista	Shuklaphanta-Laljhadi-Jogbuda	Gamescout	ShNP
305	Govinda Bdr. Shahi	Shuklaphanta-Laljhadi-Jogbuda	Gamescout	ShNP
306	Hem Raj Panta	Shuklaphanta-Laljhadi-Jogbuda	Gamescout	ShNP
307	Kabi Raj Bohara	Shuklaphanta-Laljhadi-Jogbuda	Gamescout	ShNP
308	Karan Yadav	Shuklaphanta-Laljhadi-Jogbuda	Ranger	ShNP
309	Khadak Sing Bista	Shuklaphanta-Laljhadi-Jogbuda	Driver	ShNP
310	Lokendra Bdr. Bohara	Shuklaphanta-Laljhadi-Jogbuda	Driver	ShNP
311	Madan Bhatta	Shuklaphanta-Laljhadi-Jogbuda	Gamescout	ShNP
312	Man Bahadur Bohara	Shuklaphanta-Laljhadi-Jogbuda	Gamescout	ShNP
313	Nim Bdr Chaudhary	Shuklaphanta-Laljhadi-Jogbuda	Ranger	ShNP
314	Prakash Rana	Shuklaphanta-Laljhadi-Jogbuda	Gamescout	ShNP
315	Prayash Kc	Shuklaphanta-Laljhadi-Jogbuda	Ranger	ShNP
316	Rabindra Chaudhari	Shuklaphanta-Laljhadi-Jogbuda	Driver	ShNP
317	Roshan Panthi	Shuklaphanta-Laljhadi-Jogbuda	Gamescout	ShNP
318	Shiv Charan Rana	Shuklaphanta-Laljhadi-Jogbuda	Elephant Staff	ShNP
319	Shiv Datt Chaudhary	Shuklaphanta-Laljhadi-Jogbuda	Daroga	ShNP
320	Sunil Dangaura	Shuklaphanta-Laljhadi-Jogbuda	Driver	ShNP
321	Taula Rana	Shuklaphanta-Laljhadi-Jogbuda	Elephant Staff	ShNP
322	Thaggu Rana Rana	Shuklaphanta-Laljhadi-Jogbuda	Elephant Staff	ShNP
323	Laxman Singh Negi	Shuklaphanta-Laljhadi-Jogbuda	Gamescout	ShNP
324	Bibek Chaudhary	Shuklaphanta-Laljhadi-Jogbuda	Gamescout	ShNP
325	Ram Chandra Chaudhary	Shuklaphanta-Laljhadi-Jogbuda	Gamescout	ShNP
326	Dev Singh Saud	Shuklaphanta-Laljhadi-Jogbuda	Gamescout	ShNP
327	Ganesh Aidi	Shuklaphanta-Laljhadi-Jogbuda	Gamescout	ShNP
328	Bijaya Sunaha	Shuklaphanta-Laljhadi-Jogbuda	Mahut	ShNP
329	Binod Chaudhary	Shuklaphanta-Laljhadi-Jogbuda	Mahut	ShNP
330	Ramcharan Rana	Shuklaphanta-Laljhadi-Jogbuda	Mahut	ShNP
331	Manpuran Rana	Shuklaphanta-Laljhadi-Jogbuda	Mahut	ShNP
332	Himal Chaudhary	Shuklaphanta-Laljhadi-Jogbuda	Mahut	ShNP
333	Mukesh Rana	Shuklaphanta-Laljhadi-Jogbuda	Mahut	ShNP
334	Umesh Sunaha	Shuklaphanta-Laljhadi-Jogbuda	Mahut	ShNP
335	Prem Rana	Shuklaphanta-Laljhadi-Jogbuda	Mahut	ShNP
336	Megh Rana	Shuklaphanta-Laljhadi-Jogbuda	Mahut	ShNP
337	Chhote Lala Rana	Shuklaphanta-Laljhadi-Jogbuda	Mahut	ShNP
338	Shiv Raj Rana	Shuklaphanta-Laljhadi-Jogbuda	Cook	ShNP
339	Ugrasen Rana	Shuklaphanta-Laljhadi-Jogbuda	Mahut	ShNP

Tigers of Parsa National Park and Adjoining Forests

PNP-FT01-Right

PNP-FT01-Left

PNP-FT02-Right

PNP-FT02-Left

PNP-FT03-Right

PNP-FT03-Left

PNP-FT04-Right

PNP-FT04-Left

PNP-FT05-Right

PNP-FT05-Left

PNP-FT06-Right

PNP-FT06-Left

PNP-FT07-Right

PNP-FT07-Left

PNP-FT08-Right

PNP-FT08-Left

PNP-FT09-Right

PNP-FT09-Left

PNP-FT10-Right

PNP-FT10-Left

PNP-FT11-Right

PNP-FT11-Left

PNP-FT12-Right

PNP-FT12-Left

PNP-FT13-Right

PNP-FT13-Left

PNP-FT14-Right

PNP-FT14-Left

PNP-FT15-Right

PNP-FT15-Left

PNP-FT16-Right

PNP-FT16-Left

PNP-FT17-Right

PNP-FT17-Left

PNP-FT18-Right

PNP-FT18-Left

PNP-FT19-Right

PNP-FT19-Left

PNP-MT01-Right

PNP-MT01-Left

PNP-MT02-Right

PNP-MT02-Left

PNP-MT03-Right

PNP-MT03-Left

PNP-MT04-Right

PNP-MT04-Left

PNP-MT05-Right

PNP-MT05-Left

PNP-MT06-Right

PNP-MT06-Left

PNP-MT07-Right

PNP-MT07-Left

PNP-MT08-Right

PNP-MT08-Left

PNP-MT09-Right

PNP-MT09-Left

PNP-MT10-Right

PNP-MT10-Left

PNP-MT11-Right

PNP-MT11-Left

PNP-MT12-Right

PNP-MT12-Left

PNP-MT13-Right

PNP-MT13-Left

PNP-MT14-Right

PNP-MT14-Left

PNP-UK01-Right

PNP-UK01-Left

PNP-UK02-Right

CNP-FT01-Right

CNP-FT01-Left

CNP-FT02-Right

CNP-FT02-Left

CNP-FT03-Right

CNP-FT03-Left

CNP-FT04-Right

CNP-FT04-Left

CNP-FT05-Right

CNP-FT05-Left

CNP-FT06-Right

CNP-FT06-Left

CNP-FT07-Right

CNP-FT07-Left

CNP-FT08-Right

CNP-FT08-Left

CNP-FT09-Right

CNP-FT09-Left

CNP-FT10-Right

CNP-FT10-Left

CNP-FT11-Right

CNP-FT11-Left

CNP-FT12-Right

CNP-FT12-Left

CNP-FT13-Right

CNP-FT13-Left

CNP-FT14-Right

CNP-FT14-Left

CNP-FT15-Right

CNP-FT15-Left

CNP-FT16-Right

CNP-FT16-Left

CNP-FT17-Right

CNP-FT17-Left

CNP-FT18-Right

CNP-FT18-Left

CNP-FT19-Right

CNP-FT19-Left

CNP-FT20-Right

CNP-FT20-Left

CNP-FT21-Right

CNP-FT21-Left

CNP-FT22-Right

CNP-FT22-Left

CNP-FT23-Right

CNP-FT23-Left

CNP-FT24-Right

CNP-FT24-Left

CNP-FT25-Right

CNP-FT25-Left

CNP-FT26-Right

CNP-FT26-Left

CNP-FT27-Left

CNP-FT28-Right

CNP-FT28-Left

CNP-FT29-Right

CNP-FT29-Left

CNP-FT30-Right

CNP-FT30-Left

CNP-FT31-Right

CNP-FT31-Left

CNP-FT32-Right

CNP-FT32-Left

CNP-FT33-Right

CNP-FT33-Left

CNP-FT34-Right

CNP-FT34-Left

CNP-FT35-Right

CNP-FT35-Left

CNP-FT36-Right

CNP-FT36-Left

CNP-FT37-Right

CNP-FT37-Left

CNP-FT38-Right

CNP-FT38-Left

CNP-FT39-Right

CNP-FT39-Left

CNP-FT40-Right

CNP-FT40-Left

CNP-FT41-Right

CNP-FT41-Left

CNP-FT42-Right

CNP-FT42-Left

CNP-FT43-Right

CNP-FT43-Left

CNP-FT44-Right

CNP-FT44-Left

CNP-FT45-Right

CNP-FT46-Right

CNP-FT46-Left

CNP-FT47-Right

CNP-FT47-Left

CNP-FT48-Right

CNP-FT48-Left

CNP-FT49-Right

CNP-FT49-Left

CNP-FT50-Right

CNP-FT50-Left

CNP-FT51-Right

CNP-FT51-Left

CNP-FT52-Right

CNP-FT52-Left

CNP-FT53-Right

CNP-FT53-Left

CNP-FT54-Right

CNP-FT54-Left

CNP-FT55-Right

CNP-FT55-Left

CNP-FT56-Right

CNP-FT56-Left

CNP-FT57-Right

CNP-FT57-Left

CNP-MT01-Right

CNP-MT01-Left

CNP-MT02-Right

CNP-MT02-Left

CNP-MT03-Right

CNP-MT03-Left

CNP-MT04-Right

CNP-MT04-Left

CNP-MT05-Right

CNP-MT05-Left

CNP-MT06-Right

CNP-MT06-Left

CNP-MT07-Right

CNP-MT07-Left

CNP-MT08-Right

CNP-MT08-Left

CNP-MT09-Right

CNP-MT09-Left

CNP-MT10-Right

CNP-MT10-Left

CNP-MT11-Right

CNP-MT11-Left

CNP-MT12-Right

CNP-MT12-Left

CNP-MT13-Right

CNP-MT13-Left

CNP-MT14-Right

CNP-MT14-Left

CNP-MT15-Right

CNP-MT16-Right

CNP-MT16-Left

CNP-MT17-Right

CNP-MT17-Left

CNP-MT18-Right

CNP-MT18-Left

CNP-MT19-Right

CNP-MT19-Left

CNP-MT20-Right

CNP-MT20-Left

CNP-MT21-Right

CNP-MT21-Left

CNP-MT22-Right

CNP-MT22-Left

CNP-MT23-Right

CNP-MT23-Left

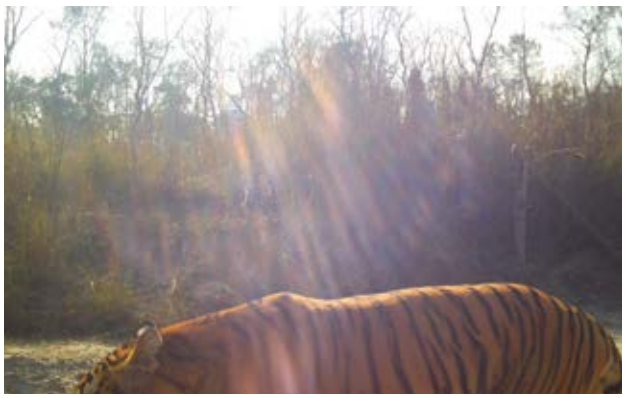
CNP-MT24-Right

CNP-MT24-Left

CNP-MT25-Right

CNP-MT25-Left

CNP-MT26-Right



CNP-MT26-Left

CNP-MT27-Right

CNP-MT27-Left

CNP-MT28-Right

CNP-MT28-Left

CNP-MT29-Right

CNP-MT29-Left

CNP-MT30-Right

CNP-MT30-Left

CNP-MT31-Right

CNP-MT31-left

CNP-MT32-Right

CNP-MT32-Left

CNP-MT33-Right

CNP-MT33-Left

CNP-MT34-Right

CNP-MT34-Left

CNP-MT35-Right

CNP-MT35-Left

CNP-MT36-Right

CNP-MT36-Left

CNP-MT37-Right

CNP-MT37-Left

CNP-MT38-Right

CNP-MT38-Left

CNP-MT39-Right

CNP-MT40-Right

CNP-MT40-Left

CNP-MT41-Right

CNP-MT42-Right

CNP-MT42-Left

CNP-MT43-Right

CNP-MT43-Left

CNP-MT44-Right

CNP-MT44-Left

CNP-MT45-Right

CNP-MT45-Left

CNP-MT46-Right

CNP-MT47-Right

CNP-MT48-Right

CNP-MT48-Left

CNP-UK01-Right

CNP-UK01-Left

CNP-UK02-Right

CNP-UK03-Right

CNP-UK03-Left

CNP-UK04-Right

CNP-UK04-Left

CNP-UK05-Right

CNP-UK05-Left

CNP-UK06-Right

CNP-UK07-Right

CNP-UK08-Right

CNP-UK08-Left

BaNP-FT01-Right

BaNP-FT01-Left

BaNP-FT02-Right

BaNP-FT02-Left

BaNP-FT03-Right

BaNP-FT03-Left

BaNP-FT04-Right

BaNP-FT04-Left

BaNP-FT05-Right

BaNP-FT05-Left

BaNP-FT06-Right

BaNP-FT06-Left

BaNP-FT07-Right

BaNP-FT07-Left

BaNP-FT08-Right

BaNP-FT08-Left

BaNP-FT09-Right

BaNP-FT09-Left

BaNP-FT10-Right

BaNP-FT10-Left

BaNP-FT11-Right

BaNP-FT11-Left

BaNP-FT12-Right

BaNP-FT12-Left

BaNP-MT01-Right

BaNP-MT01-Left

BaNP-MT02-Right

BaNP-MT02-Left

BaNP-MT03-Right

BaNP-MT03-Left

BaNP-MT04-Right

BaNP-MT04-Left

BaNP-MT05-Right

BaNP-MT05-Left

BaNP-MT06-Right

BaNP-MT06-Left

BaNP-MT07-Right

BaNP-MT07-Left

BaNP-MT08-Right

BaNP-MT08-Left

BaNP-MT09-Right

BaNP-MT09-Left

BaNP-UK01-Right

BaNP-UK01-Left

BaNP-UK02-Left

BNP-FT01-Right

BNP-FT01-Left

BNP-FT02-Right

BNP-FT02-Left

BNP-FT03-Right

BNP-FT03-Left

BNP-FT04-Right

BNP-FT04-Left

BNP-FT05-Right

BNP-FT05-Left

BNP-FT06-Right

BNP-FT06-Left

BNP-FT07-Right

BNP-FT07-Left

BNP-FT08-Right

BNP-FT08-Left

BNP-FT09-Right

BNP-FT09-Left

BNP-FT10-Right

BNP-FT10-Left

BNP-FT11-Right

BNP-FT11-Left

BNP-FT12-Right

BNP-FT12-Left

BNP-FT13-Right

BNP-FT13-Left

BNP-FT14-Right

BNP-FT14-Left

BNP-FT15-Right

BNP-FT15-Left

BNP-FT16-Right

BNP-FT16-Left

BNP-FT17-Right

BNP-FT17-Left

BNP-FT18-Right

BNP-FT18-Left

BNP-FT19-Right

BNP-FT19-Left

BNP-FT20-Right

BNP-FT20-Left

BNP-FT21-Right

BNP-FT21-Left

BNP-FT22-Right

BNP-FT22-Left

BNP-FT23-Right

BNP-FT23-Left

BNP-FT24-Right

BNP-FT24-Left

BNP-FT25-Right

BNP-FT25-Left

BNP-FT26-Right

BNP-FT26-Left

BNP-FT27-Right

BNP-FT27-Left

BNP-FT28-Right

BNP-FT28-Left

BNP-FT29-Right

BNP-FT29-Left

BNP-FT30-Right

BNP-FT30-Left

BNP-FT31-Right

BNP-FT31-Left

BNP-FT32-Right

BNP-FT32-Left

BNP-FT33-Right

BNP-FT33-Left

BNP-FT34-Left

BNP-FT35-Right

BNP-FT35-Left

BNP-FT36-Right

BNP-FT36-Left

BNP-FT37-Right

BNP-FT37-Left

BNP-FT38-Right

BNP-FT38-Left

BNP-FT39-Right

BNP-FT39-Left

BNP-FT40-Right

BNP-FT40-Left

BNP-FT41-Right

BNP-FT41-Left

BNP-FT42-Right

BNP-FT42-Left

BNP-FT43-Right

BNP-FT43-Left

BNP-FT44-Right

BNP-FT44-Left

BNP-FT45-Right

BNP-FT45-Left

BNP-FT46-Right

BNP-FT46-Left

BNP-FT47-Right

BNP-FT47-Left

BNP-FT48-Right

BNP-FT48-Left

BNP-FT49-Right

BNP-FT49-Left

BNP-FT50-Right

BNP-FT50-Left

BNP-FT51-Left

BNP-FT52-Right

BNP-FT52-Left

BNP-FT53-Right

BNP-FT53-Left

BNP-FT54-Right

BNP-FT54-Left

BNP-FT55-Right

BNP-FT55-Left

BNP-FT56-Right

BNP-FT56-Left

BNP-FT57-Right

BNP-FT57-Left

BNP-FT58-Right

BNP-FT58-Left

BNP-FT59-Right

BNP-FT59-Left

BNP-FT60-Right

BNP-FT60-Left

BNP-FT61-Right

BNP-FT61-Left

BNP-FT62-Right

BNP-FT62-Left

BNP-FT63-Right

BNP-FT63-Left

BNP-FT64-Right

BNP-FT64-Left

BNP-FT65-Right

BNP-FT65-Left

BNP-FT66-Right

BNP-FT66-Left

BNP-FT67-Right

BNP-FT67-Left

BNP-FT68-Right

BNP-FT68-left

BNP-FT69-Right

BNP-FT69-Left

BNP-FT70-Right

BNP-FT70-Left

BNP-FT71-Right

BNP-FT71-Left

BNP-FT72-Left

BNP-FT73-Right

BNP-FT73-Left

BNP-FT74-Left

BNP-MT01-Right

BNP-MT01-Left

BNP-MT02-Right

BNP-MT02-Left

BNP-MT03-Right

BNP-MT03-Left

BNP-MT04-Right

BNP-MT04-left

BNP-MT05-Right

BNP-MT05-Left

BNP-MT06-Right

BNP-MT06-Left

BNP-MT07-Right

BNP-MT07-Left

BNP-MT08-Right

BNP-MT08-Left

BNP-MT09-Right

BNP-MT09-Left

BNP-MT10-Right

BNP-MT10-Left

BNP-MT11-Right

BNP-MT11-Left

BNP-MT12-Right

BNP-MT12-Left

BNP-MT13-Right

BNP-MT13-Left

BNP-MT14-Right

BNP-MT14-Left

BNP-MT15-Right

BNP-MT15-Left

BNP-MT16-Right

BNP-MT16-Left

BNP-MT17-Right

BNP-MT17-Left

BNP-MT18-Right

BNP-MT18-Left

BNP-MT19-Right

BNP-MT19-Left

BNP-MT20-Right

BNP-MT20-Left

BNP-MT21-Right

BNP-MT21-Left

BNP-MT22-Right

BNP-MT22-Left

BNP-MT23-Right

BNP-MT23-Left

BNP-MT24-Right

BNP-MT24-Left

BNP-MT25-Right

BNP-MT25-Left

BNP-MT26-Right

BNP-MT26-Left

BNP-MT27-Right

BNP-MT27-Left

BNP-MT28-Right

BNP-MT28-Left

BNP-MT29-Right

BNP-MT29-Left

BNP-MT30-Right

BNP-MT30-Left

BNP-MT31-Right

BNP-MT31-Left

BNP-MT32-Right

BNP-MT32-Left

BNP-MT33-Right

BNP-MT33-Left

BNP-MT34-Right

BNP-MT34-Left

BNP-MT35-Right

BNP-MT35-Left

BNP-MT36-Right

BNP-MT36-Left

BNP-MT37-Right

BNP-MT37-Left

BNP-MT38-Right

BNP-MT38-Left

BNP-MT39-Right

BNP-MT39-Left

BNP-MT40-Right

BNP-MT40-Left

BNP-UK01-Right

BNP-UK01-Left

BNP-UK02-Right

BNP-UK02-Left

BNP-UK03-Left

ShNP-FT01-Right

ShNP-FT01-Left

ShNP-FT02-Right

ShNP-FT02-Left

ShNP-FT03-Right

ShNP-FT03-Left

ShNP-FT04-Right

ShNP-FT04-Left

ShNP-FT05-Right

ShNP-FT05-Left

ShNP-FT06-Right

ShNP-FT06-left

ShNP-FT07-Right

ShNP-FT07-Left

ShNP-FT08-Right

ShNP-FT08-Left

ShNP-FT09-Right

ShNP-FT09-Left

ShNP-FT10-Right

ShNP-FT10-Left

ShNP-FT11-Right

ShNP-FT11-Left

ShNP-FT12-Right

ShNP-FT12-Left

ShNP-FT13-Right

ShNP-FT13-Left

ShNP-FT14-Right

ShNP-FT14-Left

ShNP-FT15-Right

ShNP-FT15-Left

ShNP-FT16-Right

ShNP-FT16-Left

ShNP-MT01-Right

ShNP-MT01-Left

ShNP-MT02-Right

ShNP-MT02-Left

ShNP-MT03-Right

ShNP-MT03-Left

ShNP-MT04-Right

ShNP-MT04-Left

ShNP-MT05-Right

ShNP-MT05-Left

ShNP-MT06-Right

ShNP-MT06-left

ShNP-MT07-Right

ShNP-MT07-Left

ShNP-MT08-Right

ShNP-MT08-Left

ShNP-MT09-Right

ShNP-MT09-Left

ShNP-MT10-Right

ShNP-MT10-Left

ShNP-MT11-Right

ShNP-MT11-Left

ShNP-MT12-Right

ShNP-MT12-Left

ACKNOWLEDGEMENT

The Government of Nepal acknowledges and appreciates the support received from the following organizations to carry out the nationwide survey for the Tigers and Prey in Nepal 2022:

Government of Nepal
Ministry of Forests and Environment

Department of National Parks and
Wildlife Conservation

Department of Forests and
Soil Conservation

Kathmandu, Nepal