

TECHNICAL SUMMARY REPORT

**ANNUAL MONITORING OF TIGERS, CO-
PREDATORS AND PREY IN
MANAS NATIONAL PARK, INDIA**

2021

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**THIS YEAR MANAS NATIONAL PARK CELEBRATES CONTINUOUS
ELEVEN YEARS OF PHASE-IV MONITORING**

(2010-2021)



The Garuchara female with her little cub

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EXECUTIVE SUMMARY

- The systematic phase-IV camera trapping as suggested by NTCA conducted in the Manas Tiger Reserve (MTR) between 14 December 2020 and 16 June 2021. The cameras were placed in Manas National Park (500 sq.km), First addition to Manas National Park (350 sq.km) and Barnadi Wildlife Sanctuary within the MTR.
- Manas National Park (MNP), the core of the Manas Tiger Reserve (TR) is a key tiger conservation site with a growing tiger population.
- The population has been monitoring closely since 2010 by the Forest Department BTC in a productive collaboration in partnership with Aaranyak and WWF India.
- The MNP is also the core area of the Transboundary Manas Conservation Area (TraMCA) (6500 sq.km), falling in the Indo-Bhutan border area, and contiguous with the Royal Manas National Park (RMNP), Bhutan, on the southern boundary of the MNP.
- Joint monitoring of tigers across the border revealed regular movement of tigers between MNP and RMNP, across the international boundary.
- This summary report presents the findings of the annual tiger monitoring exercise carried out in four study blocks through the mark recapture method as prescribed (Phase IV) by the National Tiger Conservation Authority (NTCA). In block-1, we covered Bhuyanpara and parts of the Bansbari Ranges between 14 December 2020 and 18 February 2021 covering ~340 sq.km; in block-2, Panbari Range and Kahitema area of Bansbari Range between 18 February 2021 and 08 May 2021 covering ~150 sq.km, in block-3, First Addition to Manas National Park between 02 March 2021 and 17 April 2021 and in forth block, we covered the Barnadi Wildlife Sanctuary between 14 March 2021 and 16 June 2021 covering 26 sq.km.

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- Here we present detail findings of the block-1 and block-2 (falls in Manas National Park) camera trapping results and also present the information about the individual tigers (Mt+1) and leopard (Mt+1) captured in block-3 and Block-4 respectively. In total, camera traps were places at 124 locations in block-1 and block-2 and 30 locations in block-3 and 10 in block-4. Twenty-three camera traps were stollen and 13 were destroyed by wild animal during the entire survey period.
- Following a camera trapping effort of 6816 trap-days spread across in block-1 and block-2 and 904 trap-days in block-3 and 668 trap-days in block-4, we identified 29 terrestrial mammal species.
- The study identified 34 individuals of adult tigers, 07 sub-adults and 03 cubs in block-1 and block-2, 06 individuals in block-3 (three were common with Block-2) and 01 in block-4.



A tiger pugmark on a dry riverbed Photo credit: Dipankar Lahkar

(The size of the adult tiger's pugmark varies between 12 and 18 cm in length. The sex can be also identified by measuring the morphometry of the pugmark. The shape of the male pugmark is squarish and female is rectangular.)

BACKGROUND

The tiger *Panthera tigris* symbolizes wilderness values and acts as an umbrella species for the conservation of biodiversity in the forest systems of South and Southeast Asia. As a top predator, tigers play a vital role in regulating and perpetuating ecological processes and systems (Sunquist *et al.* 1999). Tigers, being highly adaptable, exist in a wide range of forest types, and climatic regimes and subsist on diverse prey (Schaller 1967; Sunquist *et al.* 1999). Tigers have an extensive range spanning a total of 1.5 million sq. km area across Asia, within which surviving populations occur patchily and at low densities. Over the past 100 years, in Asia, tigers have lost 93% of their former range (Sanderson *et al.* 2006; Dinerstein *et al.* 2006). Only 5% of the world 's wild tigers continue to survive since the last century (Stokes 2010). India represents the world's greatest stronghold for the species, with an overall population of more than 2,200 individuals. The All-India Tiger Monitoring (AITM) (once in four years) employs rigorous and robust camera trap mark recapture techniques to estimate tiger population initially developed by Karanth (1995). The method has been refined subsequently (Karanth and Nichols 1998). Over the years this method got lot of faiths from the scientific community and has proved as a reliable technique for estimating abundance of tigers and other cryptic animals.

The large and medium sized ungulates are one of the key factors for the survival of tigers and other co-predators. Over the years the large ungulates have faced the onslaught of hunters and several other anthropogenic threats. The densities of tropical ungulates are often extremely low and even extirpated from several habitats. Decline and complete loss of prey population eventually affects the tiger population of an area. It is crucial that populations of prey animals are assessed reliably.

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After a long period, socio-political turbulences that led to loss of infrastructure and protection and loss of population across species, Manas National Park and Tiger Reserve are reviving back at a slow but steady pace since 2004. Hence it is urgent to embark on long-term population monitoring of tigers, co-predators, prey and their habitat to understand the demographic features for continued management intervention.

Thus, the park authority and Forest Department, Bodoland Territorial Council (BTC) mandated the tigers, co-predators and prey population in the National Park. The present study was carried out jointly by a team of Aaranyak and WWF India with support from forest officials and frontline staff on ground on an invitation by the Field Directorate to assist in the Phase IV monitoring.



Grassland ecosystem of the Manas National Park Photo Credit: Sunit Kr. Das

(The grassland ecosystem of the MNP supports some of world's rarest and Endangered species like Pigmy Hog, Hispid Hare, Hog Deer, Bengal Florican)

1. STUDY AREA

Manas National Park is located in the foothills of the Bhutan Himalayas in Baksa and Chirang districts (26°35'-26°50'N, 90°45'-91°15'E) of Assam. The boundary of Manas NP is clearly distinguished by the international boundary with Bhutan to the north, to the south by thickly populated villages and to the east and west by the forest reserves. Elevation ranges from 50 m above MSL on the southern boundary to 200 m above MSL along the Bhutan hills. Manas NP occupies an area of 500 sq.km that forms the core area of Manas Tiger Reserve which is 2837 sq.km. The tiger reserve stretches over as a continuous belt of forests along the foothills between the River Sankosh in the west to the River Dhansiri in the east. The Manas NP is contiguous with the Royal Manas National Park (1059 sq.km), Bhutan.

Manas National Park is located at the junction of Indo-Gangetic, Indo-Malayan and Indo-Bhutan realms and is a key conservation area in the Jigme Dorji-Manas-Bumdaling conservation landscape in the eastern Himalayan eco-region. The Park is situated in the eastern *duār* and has extensive *Bhabar* and some *terāi* areas, typical of Himalayan foothills. These *terai* like tracts are more or less flat. The northern belt of the tract with major grassland area of Manas is almost flat and well drained.

The climate of Manas is moist tropical with an annual rainfall between 3000 mm to 4000 mm. Grasslands cover about 45% of the National Park area. It is classified as the “Eastern wet alluvial grassland” (Champion and Seth, 1986). In broader scale this grassland can be categorized as *Phragmites-Saccharum-Imperata* type.

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Apart from grasslands rest of Manas forest types are represented by Sub-Himalayan high alluvial Semi-evergreen-2B/C/s, Eastern Himalayan Moist Mixed Deciduous-3c/c3 and Assam valley Semi-evergreen- 2B/C (a, b). There is also a considerable variety of aquatic flora along the riverbanks and in the numerous pools.

The Manas Tiger Reserve is 2834 sq.km that included three National Parks (MNP, First Addition to MNP and Raimona NP), one Wildlife Sanctuary (Barnadi WLS) and thirteen reserve forests. The MNP, First Addition to MNP, Raimon NP and Barnadi WLS are the core of the Manas Tiger Reserve.

The Manas National Park has a 110 year of conservation and protection history with a number of designations:

- ✓ 1905: Reserve Forest called the North Kamrup Reserve Forest.
- ✓ 1907: Manas Reserve Forest.
- ✓ 1928: Manas Wildlife Sanctuary (360 sq.km).
- ✓ 1973: Manas Tiger Reserve (2837 sq.km).
- ✓ 1985: World Heritage Site.
- ✓ 1989: Biosphere Reserve.
- ✓ 1990: National Park (500 sq.km).
- ✓ 2003: Chirang-Ripu Elephant Reserve (2600 sq.km).
- ✓ 2004: Important Bird Area.
- ✓ 2017: Extended the area of MNP from 500 sq.km to 850 sq.km

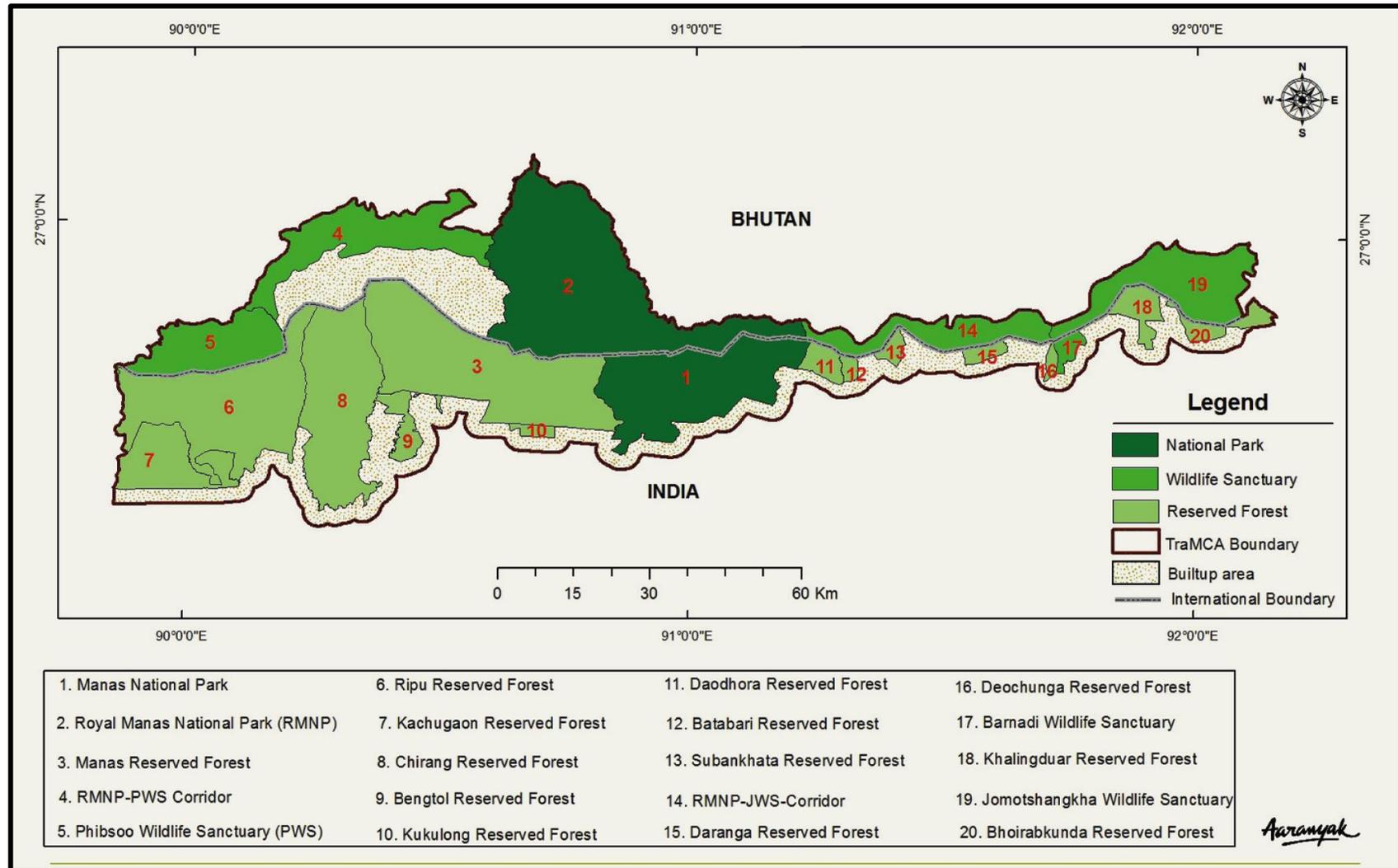


Figure-1. Map of Trans-boundary Manas Conservation Area (TramCA) which is 6500 sq.km.

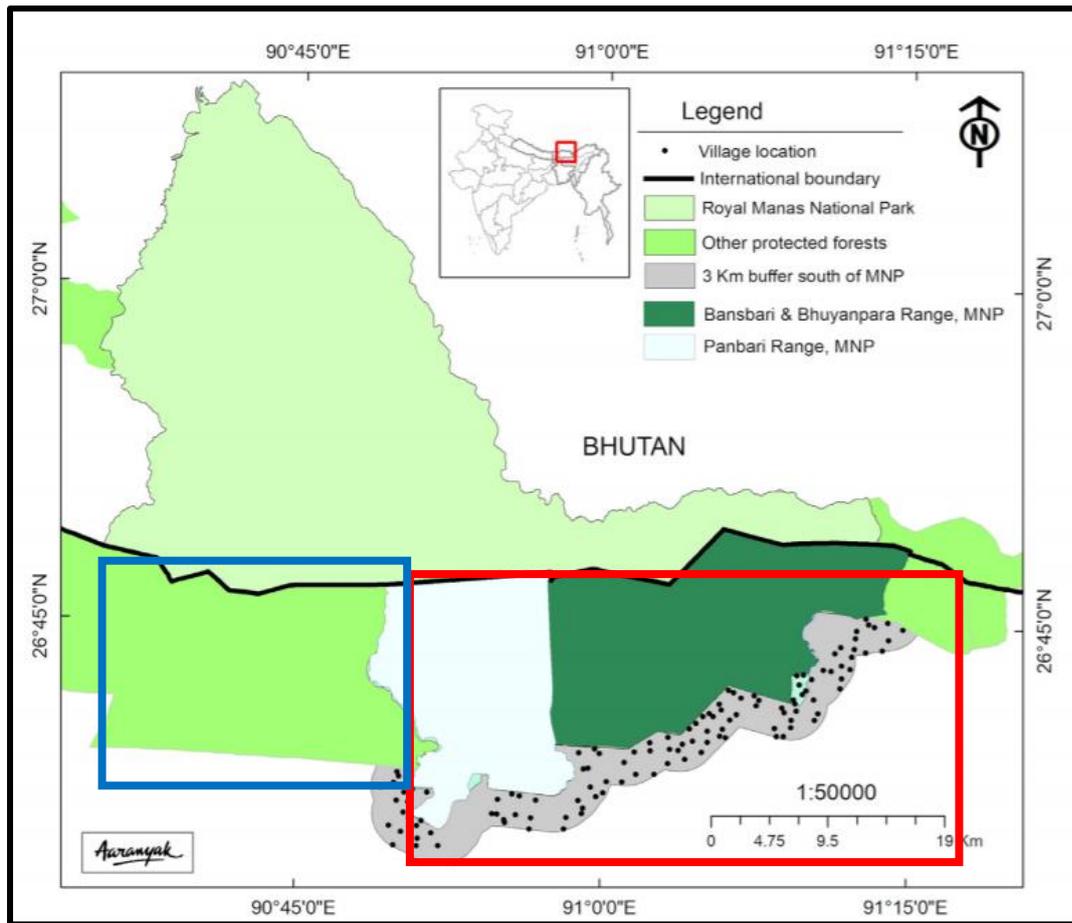


Figure-2. Map of the Manas National Park in red box (MNP) (500 sq.km) with surrounding landscape and First Addition to Manas National Park in blue box (FAMNP) (350 sq.km), BTR, Assam, India. To the north lies Royal Manas National Park, Bhutan. To the south are villages. Highlighted here are 136 village locations with a 3 km buffer of Manas National Park. The dark green section of MNP is the two ranges (Bansbari & Bhuyanpara) and white is the Panbari Range. The First Addition to Manas National Park was notified on 09 June 2021.

Map source: *Lahkar et al. 2020, Biological Conservation*: DOI: <https://doi.org/10.1016/j.biocon.2020.108425>

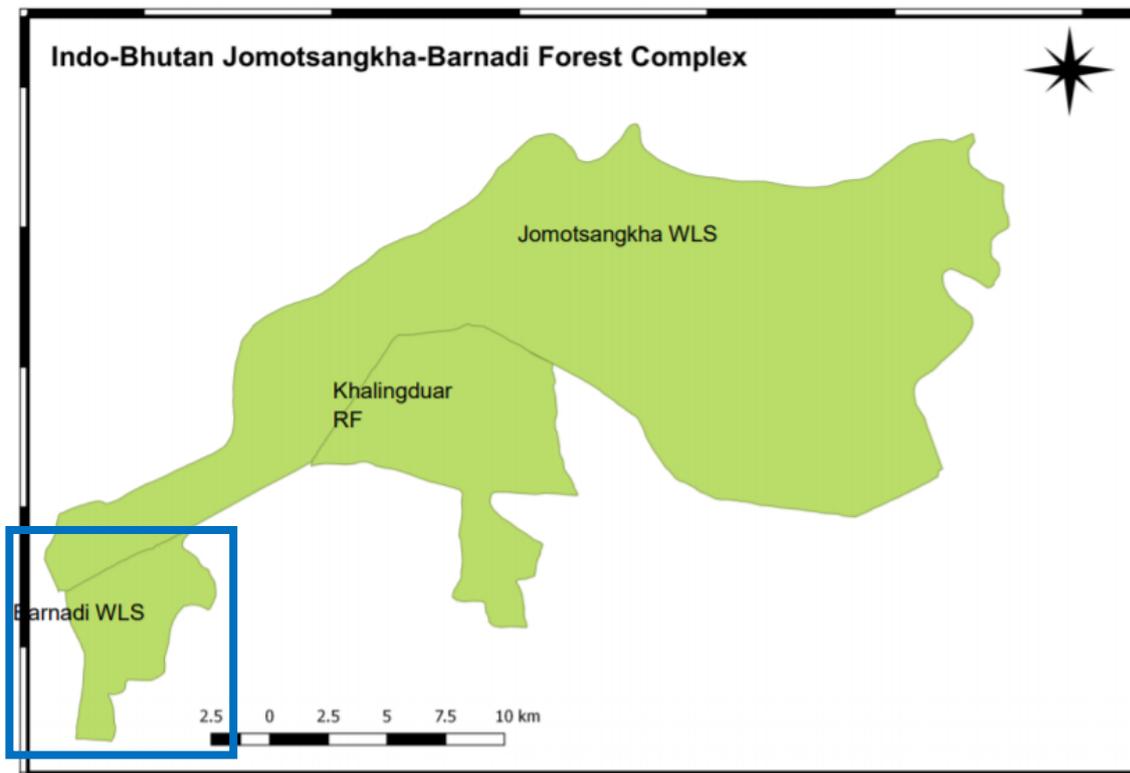


Figure-3. Map of the Barnadi Wildlife Sanctuary (BWLS) along with the trans-boundary India-Bhutan Jomotsagkha-Barnadi forest complex. Barnadi Wildlife Sanctuary (BWLS) one of the protected areas falls under the TrAMCA. It is located in the Baksa District of Assam. It was declared a wildlife sanctuary in 1980. It has a designation of an Important Bird Area (IBA). The river Barnadi forms the western boundary and Nalanadi River forms the eastern boundary of the sanctuary. The sanctuary lies in a *Bhabar* zone. The area is mainly composed with sediments deposited by the river flowing through Bhutan. The vegetation is tropical semi-evergreen, tropical moist and dry deciduous type. The altitude ranges from 150– 200 m. Average annual rainfall is 400mm. Khalingduar RF, (70.33 sq.km 26052’14” N & 91053’01” E) is located in the Udalguri District. The altitude ranges from 250– 450 m. The average annual temperatures range from about 80C in January to 300C in July. The vegetation is moist deciduous, semi-evergreen and mixed deciduous type. Neoli (11.48 sq.km) is a proposed reserve forest and lies between Barnadi WS and Khalingduar RF.

Map source: *Ahmed et al. 2019*: https://conservewildcats.org/wp-content/uploads/sites/5/2019/05/AaranyakFinal_Technical-Report_Indo-BhutanTransboundaryTigers.pdf

2. METHODOLOGY

- (a) **Camera Trapping:** We used grid based (2 x 2) camera trapping as suggested by National Tiger Conservation Authority (NTCA) for the source population sites under phase IV monitoring in 2020-2021. We have covered the entire study area in to four study blocks. In total, camera traps were placed at 124 locations in the Manas National Park, 30 in First Addition to Manas National Park and 10 in Barnadi wildlife Sanctuary.
- (b) **Mapping:** We used open sourced QGIS to create vector layers and maps.
- (c) **Density estimation of tiger:** We used Spatially Explicit Capture Recapture (secr) analytical method in R environment.

3. RESULTS

3.1 SURVEY EFFORT

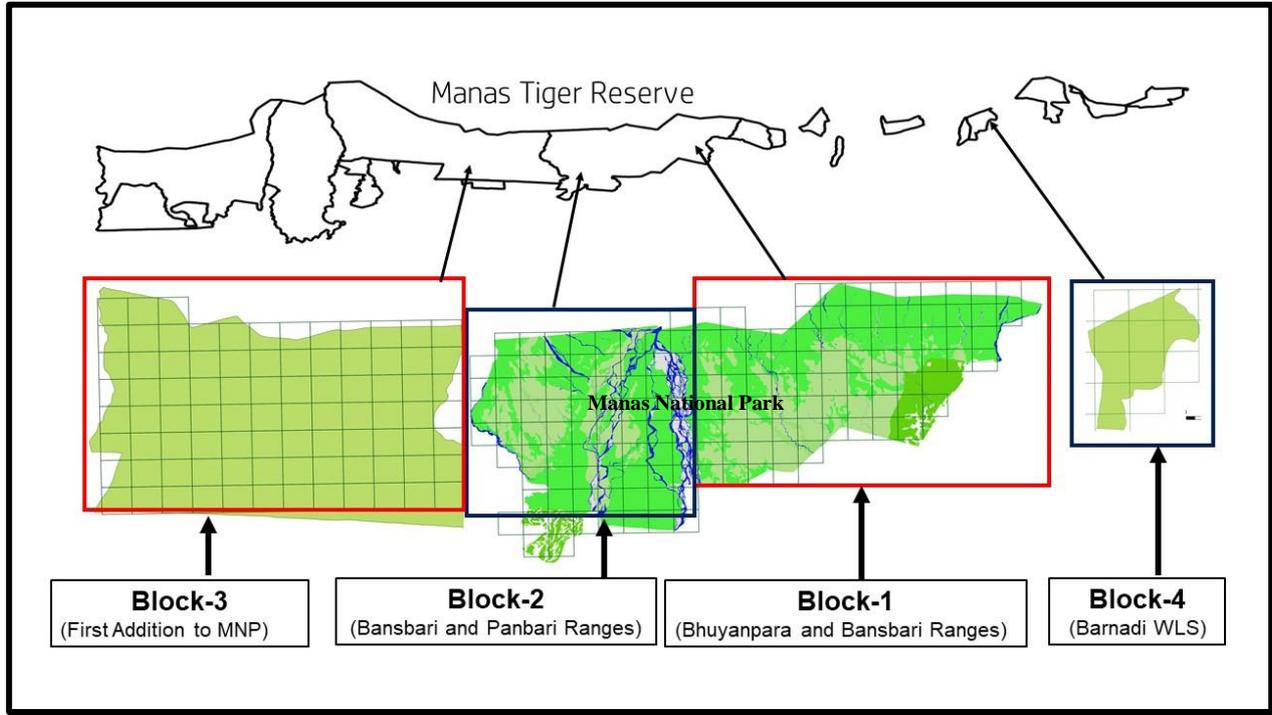


Figure-4. The figure shows the distribution of different survey blocks applied for the phase-IV monitoring in Manas Tiger Reserve, BTR, Assam, India (2020-2021).

3.1.1. MANAS NATIONAL PARK (MNP)

The survey was conducted systematically in three ranges viz. Bhuyanpara, Bansbari and Panbari in two survey blocks.

| Sl. No. | Category | Values |
|---------|------------------------------------------------------------------------------|----------------------|
| 1. | Grid Size | Systematic 2×2 sq.km |
| 2. | Start Date of survey | 14 December 2020 |
| 3. | End Date of survey | 08 May 2021 |
| 4. | Total Duration (Days) | 145 |
| 5. | Total Efforts (Trap-days) | 6816 |
| 6. | Total no. of camera stations (including additional camera stations) | 124 |
| 7. | Total Area covered (Convex polygon) | ~500 sq.km |
| 8. | No. of survey block used | Two |
| 9. | No. Team involved | Four |

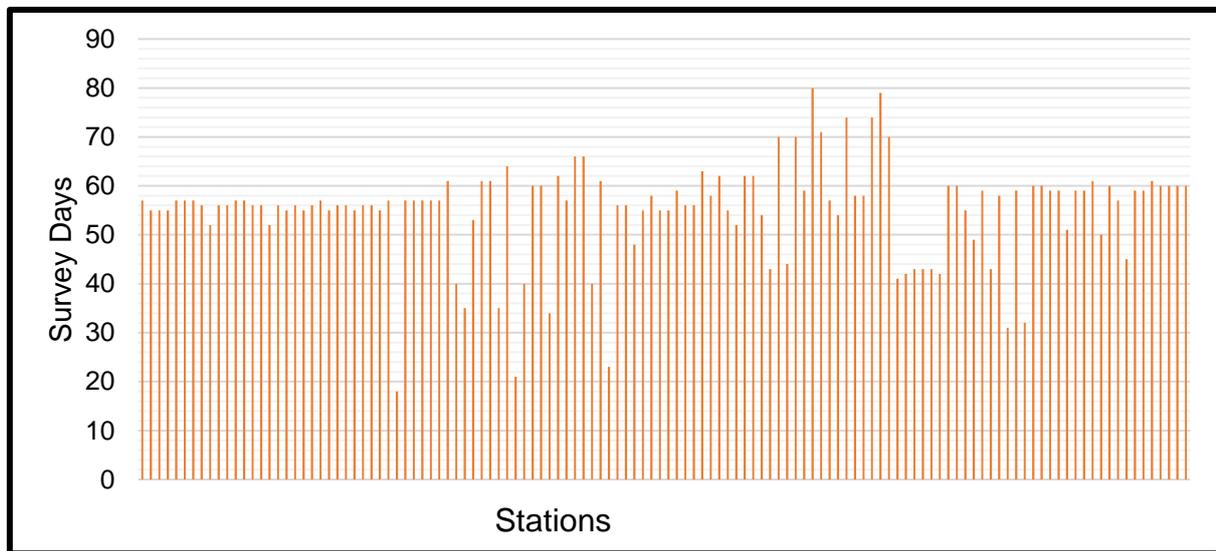


Figure-5. The camera trap efforts in different camera stations in Manas National Park, BTR, Assam, India (2020-2021).

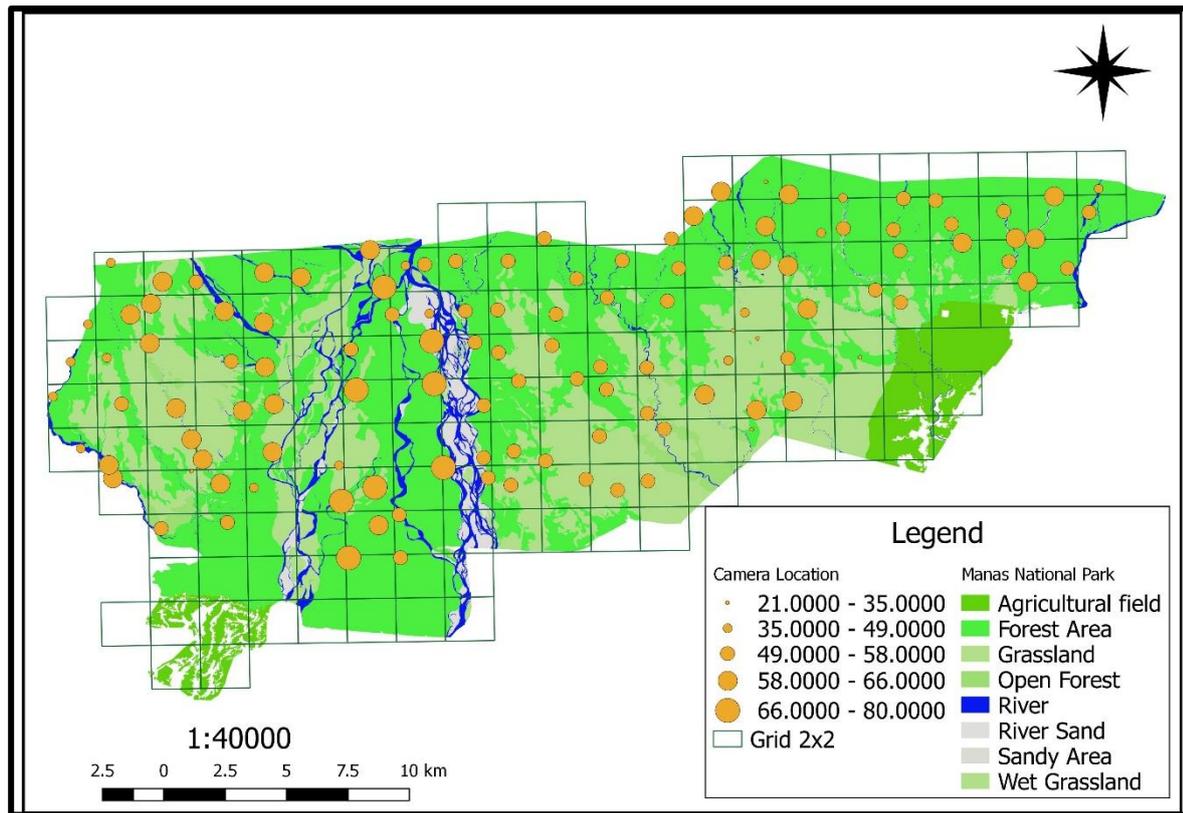


Figure-6. The bubble map showing the trap locations and location per effort spread across the study area in Manas National Park, BTR Assam, India (2020-2021).

3.1.2. FIRST ADDITION TO MANAS NATIONAL PARK (FAMNP)

The survey was conducted opportunistically in both the ranges viz. Aamteka and Khuklung in a single survey block.

| Sl. No. | Category | Values |
|---------|-------------------------------------|---------------|
| 1. | Grid Size | 2×2 sq.km |
| 2. | Start Date of survey | 02 March 2021 |
| 3. | End Date of survey | 17 April 2021 |
| 4. | Total Duration (Days) | 46 |
| 5. | Total Efforts (Trap-days) | 904 |
| 6. | Total no. of camera stations | 30 |
| 7. | Total Area covered (Convex polygon) | ~350 sq.km |
| 8. | No. of survey block used | One |
| 9. | No. Team involved | Two |

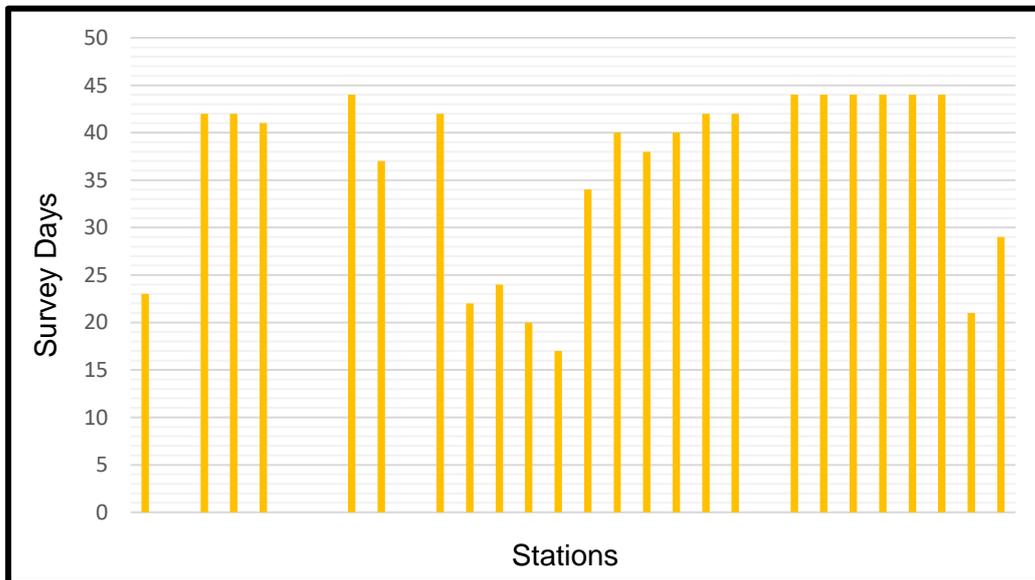


Figure-7. The camera trap efforts in different camera stations in First Addition to Manas National Park, BTR, Assam, India (2020-2021). The gaps show the lost camera trap locations.

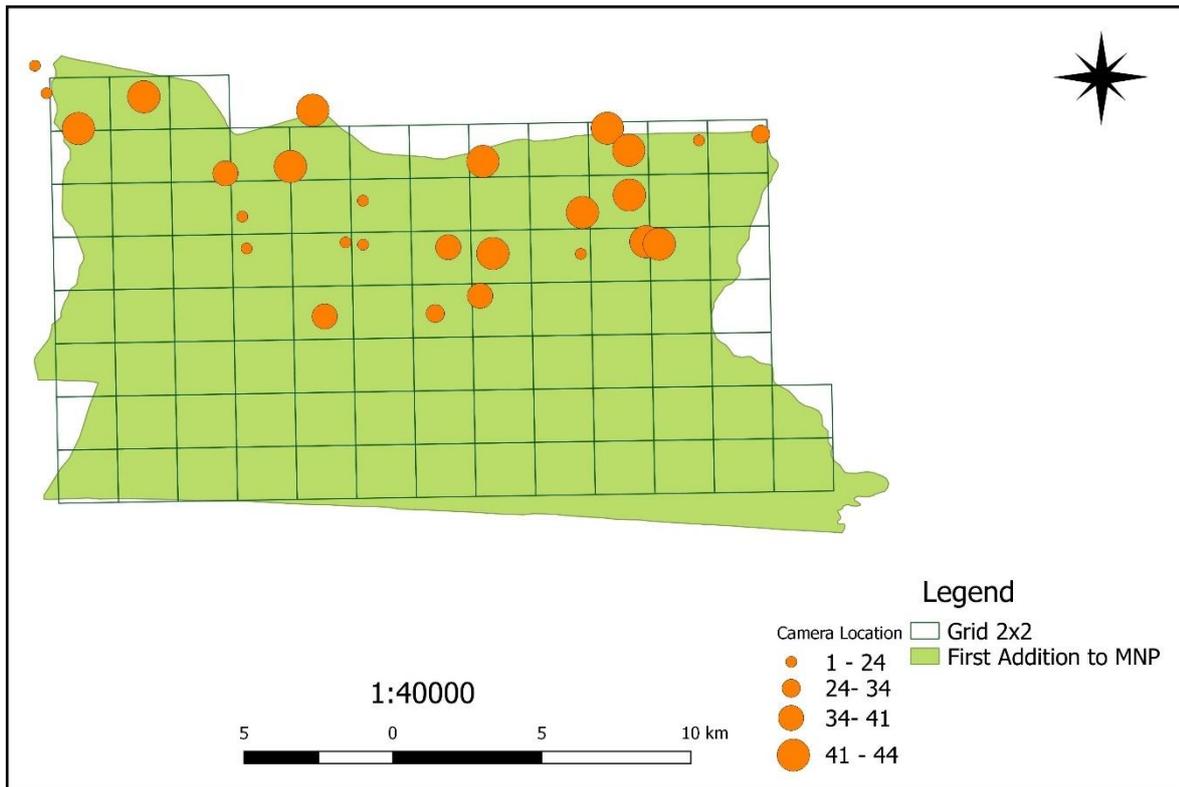


Figure-8. The bubble map showing the trap locations and location per effort spread across the study area in First Addition to Manas National Park, BTR Assam, India (2020-2021).

3.1.3. BARNADI WILDIFE SANCTUARY (BWLS)

The survey was conducted opportunistically in the area in a single survey block.

| Sl. No. | Category | Values |
|---------|-------------------------------------|---------------|
| 1. | Grid Size | 2×2 sq.km |
| 2. | Start Date of survey | 14 March 2021 |
| 3. | End Date of survey | 16 June 2021 |
| 4. | Total Duration (Days) | 94 |
| 5. | Total Efforts (Trap-days) | 668 |
| 6. | Total no. of camera stations | 10 |
| 7. | Total Area covered (Convex polygon) | 26 sq.km |
| 8. | No. of survey block used | One |
| 9. | No. Team involved | One |

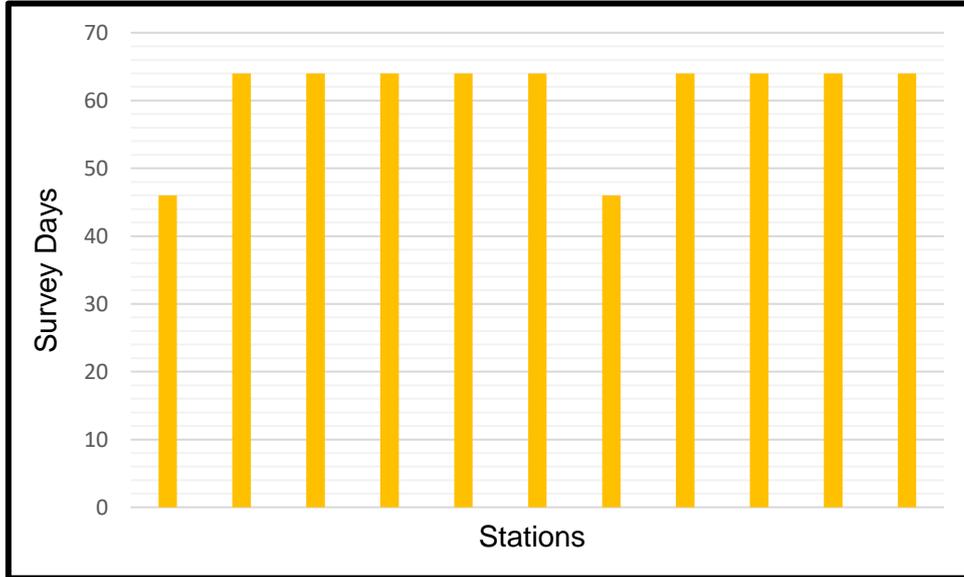


Figure-9. The camera trap efforts in different camera stations in Barnadi Wildlife Sanctuary, BTR, Assam, India (2020-2021).

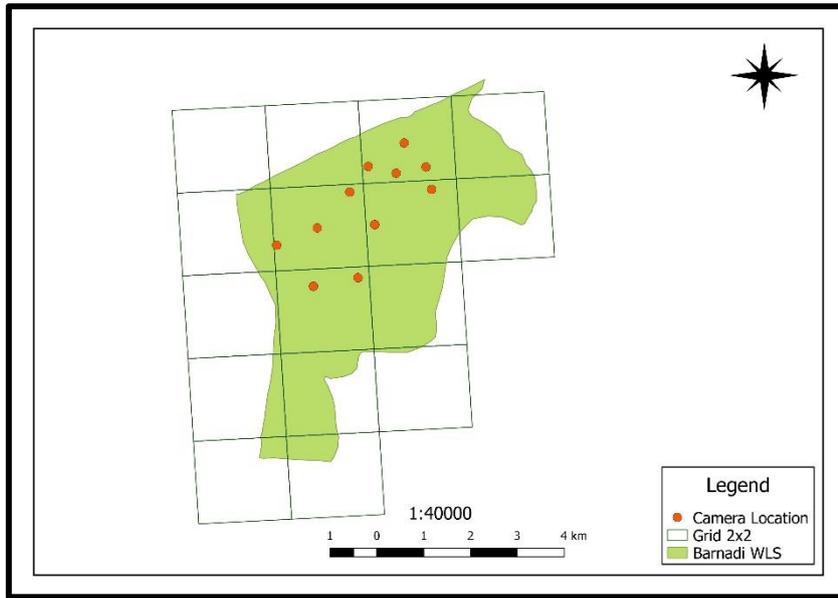


Figure-10. The bubble map showing the trap locations and location per effort spread across the study area in Barnadi Wildlife Sanctuary, BTR, Assam, India (2020-2021).

3.2 CAMERA TRAP ACCOUNTS OF THE MANAS TIGER RESERVE (2020-2021)

| Sl. No. | Category | MNP | FAMNP | BWLS |
|---------|-------------------------------------------------|-----|-------|------|
| 1. | Total no. of camera trap used | 236 | 36 | 13 |
| 2. | Total no. of camera stollen | 10 | 09 | 03 |
| 3. | Total no. of camera traps destroyed by wildlife | 13 | 00 | 00 |
| 4. | Total no. of camera traps destroyed by people | 00 | 00 | 00 |
| 5. | Total no. of camera traps malfunction | 17 | 00 | 00 |



Figure-11. Camera trap used for the population estimation of tiger in MNP (2020-2021)

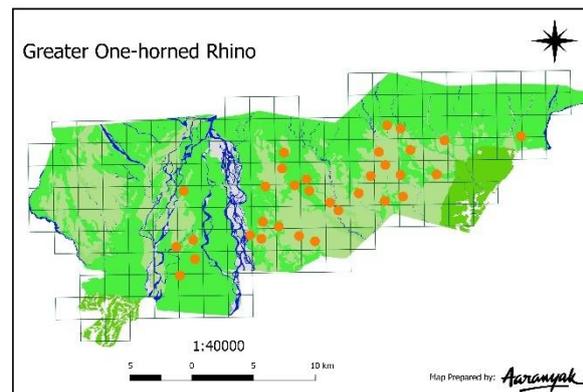
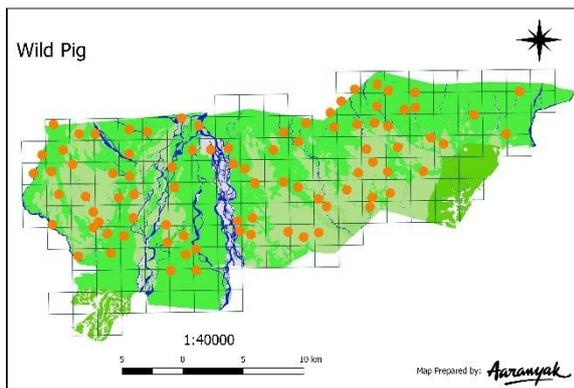
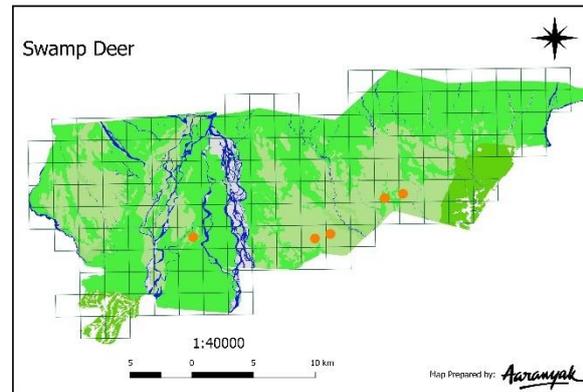
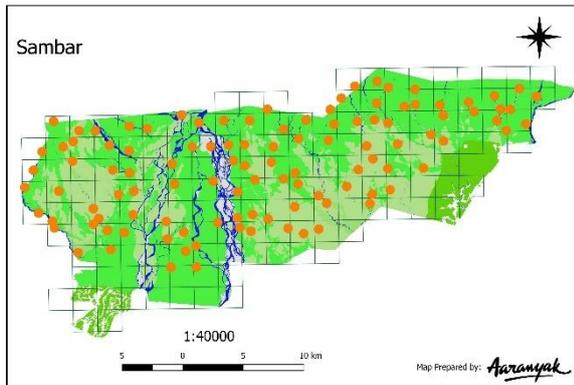
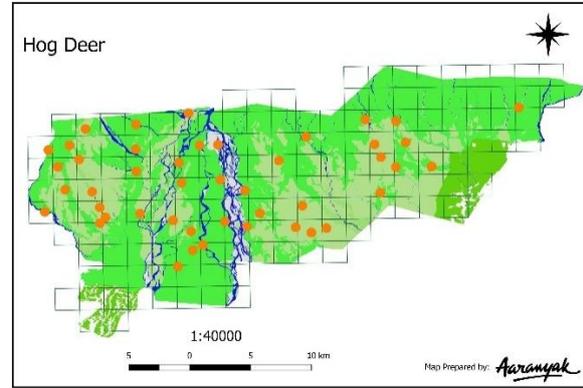
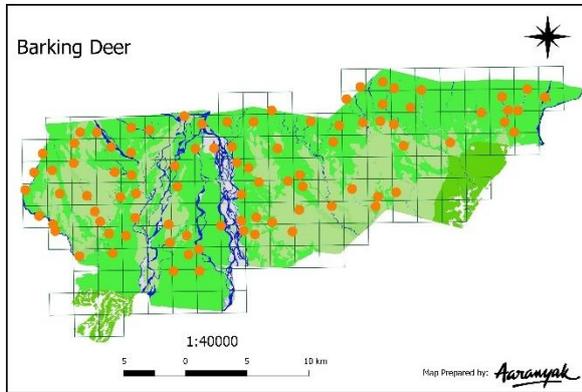
3.3 ANIMAL CAPTURE DETAILS OF MANAS TIGER RESERVE (2020-2021)

| Group | Animal Species | Number of Images | | |
|--------------------------------------------------------|--------------------|------------------|-------|------|
| | | MNP | FAMNP | BWLS |
| Ungulates (Principal tiger prey animal species) | Barking Deer | 1330 | 283 | 119 |
| | Hog Deer | 793 | 68 | 00 |
| | Sambar Deer | 7215 | 298 | 82 |
| | Swamp Deer | 51 | 00 | 00 |
| | Spotted Deer | 04 | 00 | 00 |
| | Himalayan Serow | 03 | 00 | 00 |
| | Gaur | 5199 | 334 | 2793 |
| | Wild Water Buffalo | 2223 | 16 | 00 |
| | Wild Pig | 2735 | 109 | 178 |
| | Elephant | 9814 | 612 | 2388 |
| | Rhino | 563 | 00 | 00 |
| Cats | Tiger | 954 | 28 | 01 |
| | Common Leopard | 582 | 14 | 21 |
| | Leopard Cat | 154 | 03 | 08 |
| | Jungle Cat | 12 | 00 | 00 |
| | Clouded Leopard | 02 | 00 | 01 |
| | Golden Cat | 04 | 00 | 00 |
| | Marbled Cat | 01 | 00 | 0 |
| Other carnivores | Asiatic Black Bear | 05 | 00 | 00 |

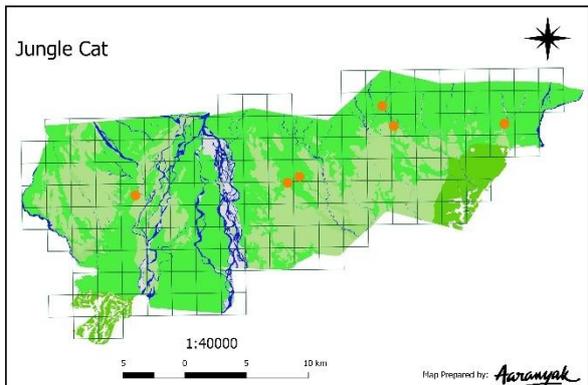
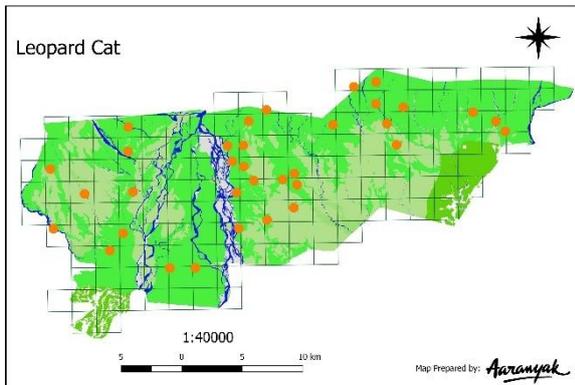
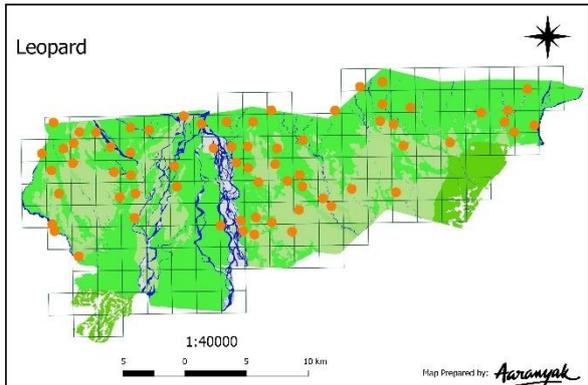
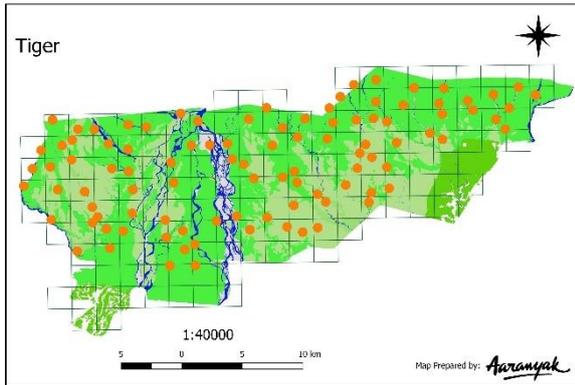
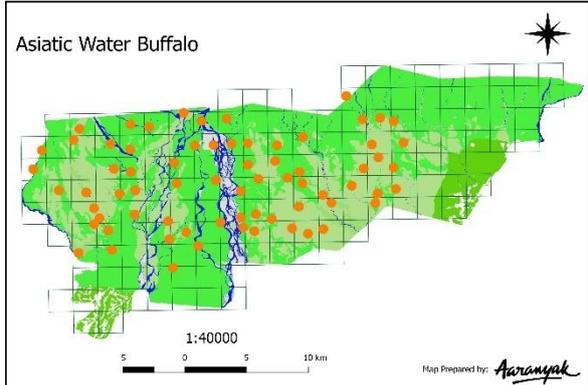
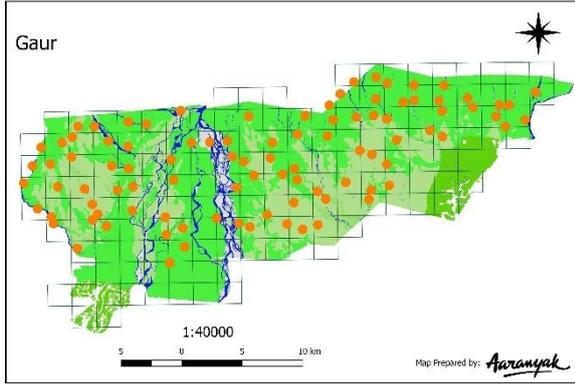
2021-Phase IV Tiger Monitoring Report-Manas Tiger Reserve

| Group | Animal Species | Number of Images | | |
|----------------------------------|--------------------|------------------|-------|------|
| | | MNP | FAMNP | BWLS |
| | Wild Dog | 207 | 22 | 00 |
| | Golden Jackal | 01 | 00 | 00 |
| Other terrestrial mammals | Large-Indian Civet | 289 | 28 | 00 |
| | Small-Indian Civet | 339 | 05 | 00 |
| | Palm Civet | 89 | 07 | 00 |
| | Binturong | 00 | 00 | 01 |

3.4 DISTRIBUTION MAP OF KEY MAMMALIAN SPECIES BASED ON PHOTOCAPTURES IN MANAS NATIONAL PARK (2020-2021)



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2021-Phase IV Tiger Monitoring Report-Manas Tiger Reserve

Table-1. List of mammal's photo-captured in camera traps in Tiger Reserve, BTR, Assam, India 2021.

| Serial No. | Common Name | Scientific Name | IUCN Status |
|-------------------|------------------------|--------------------------------------|--------------------|
| 1 | Asian Elephant | <i>Elephus maximus</i> | Endangered |
| 2 | Bengal Tiger | <i>Panthera tigris</i> | Endangered |
| 3 | Hog Deer | <i>Axis porcinus</i> | Endangered |
| 4 | Wild Dog | <i>Cuon alpinus</i> | Endangered |
| 5 | Hispid Hare | <i>Caprolagus hispidus</i> | Endangered |
| 6 | Wild Buffalo | <i>Bubalus arnee</i> | Endangered |
| 7 | One Horned Rhinoceros | <i>Rhinoceros unicornis</i> | Vulnerable |
| 8 | Indian Gaur | <i>Bos gaurus</i> | Vulnerable |
| 9 | Common Leopard | <i>Panthera pardus</i> | Vulnerable |
| 10 | Sambar Deer | <i>Rusa unicolor</i> | Vulnerable |
| 11 | Swamp Deer | <i>Rucervus duvaucelii</i> | Vulnerable |
| 12 | Himalayan Black Bear | <i>Ursus thibetanus</i> | Vulnerable |
| 13 | Clouded Leopard | <i>Neofelis nebulosa</i> | Vulnerable |
| 14 | Golden Cat | <i>Catopuma temminckii</i> | Near Threatened |
| 15 | Large Indian Civet | <i>Viverra zibetha</i> | Near Threatened |
| 16 | Leopard Cat | <i>Prionailurus bengalensis</i> | Least Concern |
| 17 | Wild Pig | <i>Sus scrofa</i> | Least Concern |
| 18 | Yellow-throated Marten | <i>Martes flavigula</i> | Least Concern |
| 19 | Barking Deer | <i>Muntiacus muntjac</i> | Least Concern |
| 20 | Jungle Cat | <i>Felis chaus</i> | Least concern |
| 21 | Small Indian Civet | <i>Viverricula indica</i> | Least Concern |
| 22 | Palm Civet | <i>Paradoxurus hermaphroditus</i> | Least Concern |
| 23 | Golden Jackal | <i>Canis aureus</i> | Least Concern |
| 24 | Crest-less Porcupine | <i>Hystrix indica</i> | Least Concern |
| 25 | Indian Hare | <i>Lepus nigricollis</i> | Least Concern |
| 26 | Bintourong | <i>Arctictis binturong</i> | Vulnerable |
| 27 | Himalayan Serow | <i>Capricornis sumatraensis thar</i> | Vulnerable |
| 28 | Marbled Cat | <i>Pardofelis marmorata</i> | Neat threatened |
| 29 | Crab Eating Mongoose | <i>Herpestes urva</i> | Least Concern |

3.5 SPECIES PHOTO-CAPTURED FOR THE FIRST TIME IN TIGER RESERVE DURING 2015-2021



Spotted Deer (First captured in 2015)



Marbled Cat (First captured in 2015)



Brush-tail Porcupine (First captured in 2018)



Large-toothed Ferret Badger (First captured in 2018)



Golden Cat (First captured in 2020)



Himalayan Serow (First captured in 2021)

3.6 CAPTURE DETAILS OF THE IDENTIFIABLE INDIVIDUALS

3.6.1 INDIVIDUAL IDENTIFICATION OF TIGERS OF THE MANAS NATIONAL PARK (MNP), BTR, ASSAM (2020-2021)

Given that the maximum number of photos was of the left flank of the tigers, we used the left flank pictures of the individuals except for the cubs for identification.

Table-2. Capture details of Tiger individuals in Manas National Park, BRT, Assam, India (2020-2021).

| Adult Tiger | | | | Cubs | Sub-adult | Grant Total |
|-------------|------|--------|-------------|------|-----------|-------------|
| Total | Male | Female | Unknown sex | | | |
| 34 | 14 | 20 | 00 | 07 | 03 | 44 |

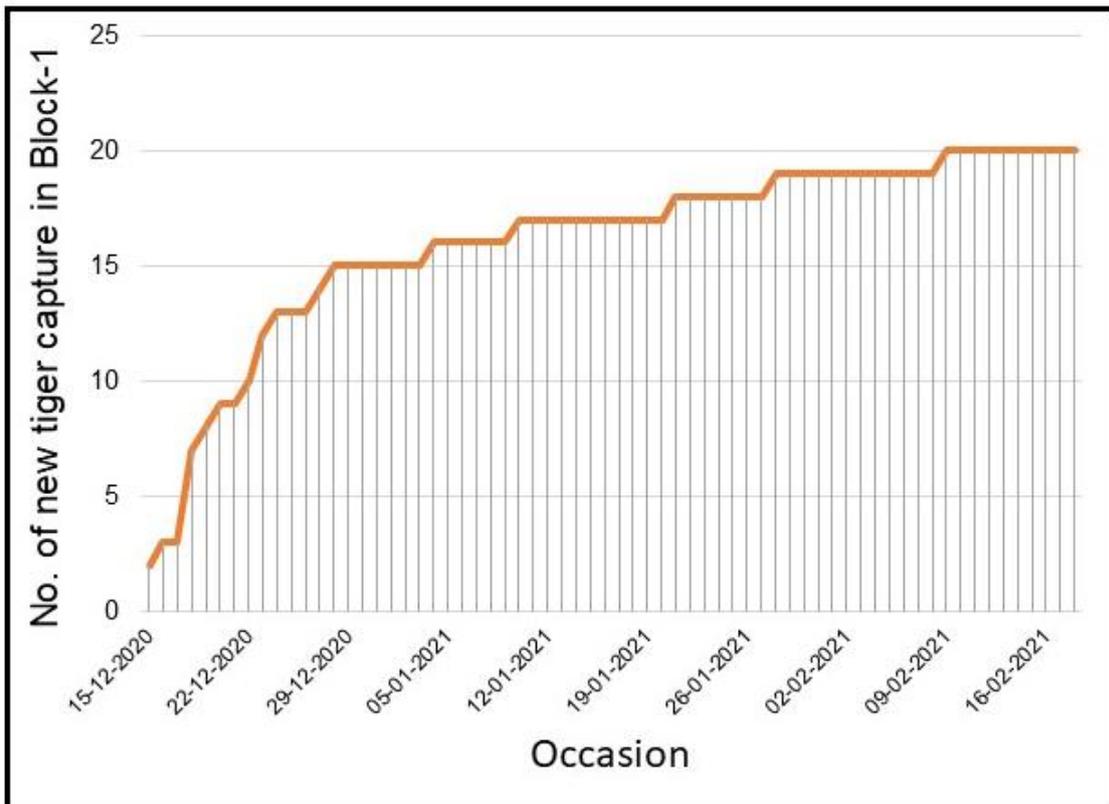


Figure-12. Number of new tigers captured v/s occasion in Block-1 of Manas National Park, BTR, Assam, India (2020-2021). In Block-1 that covered Bhuyanpara and part of the Bansbari

ranges recorded 20 adult individual tigers of which 12 females and 08 males. In both the blocks one individual was common (MNP_68_M).

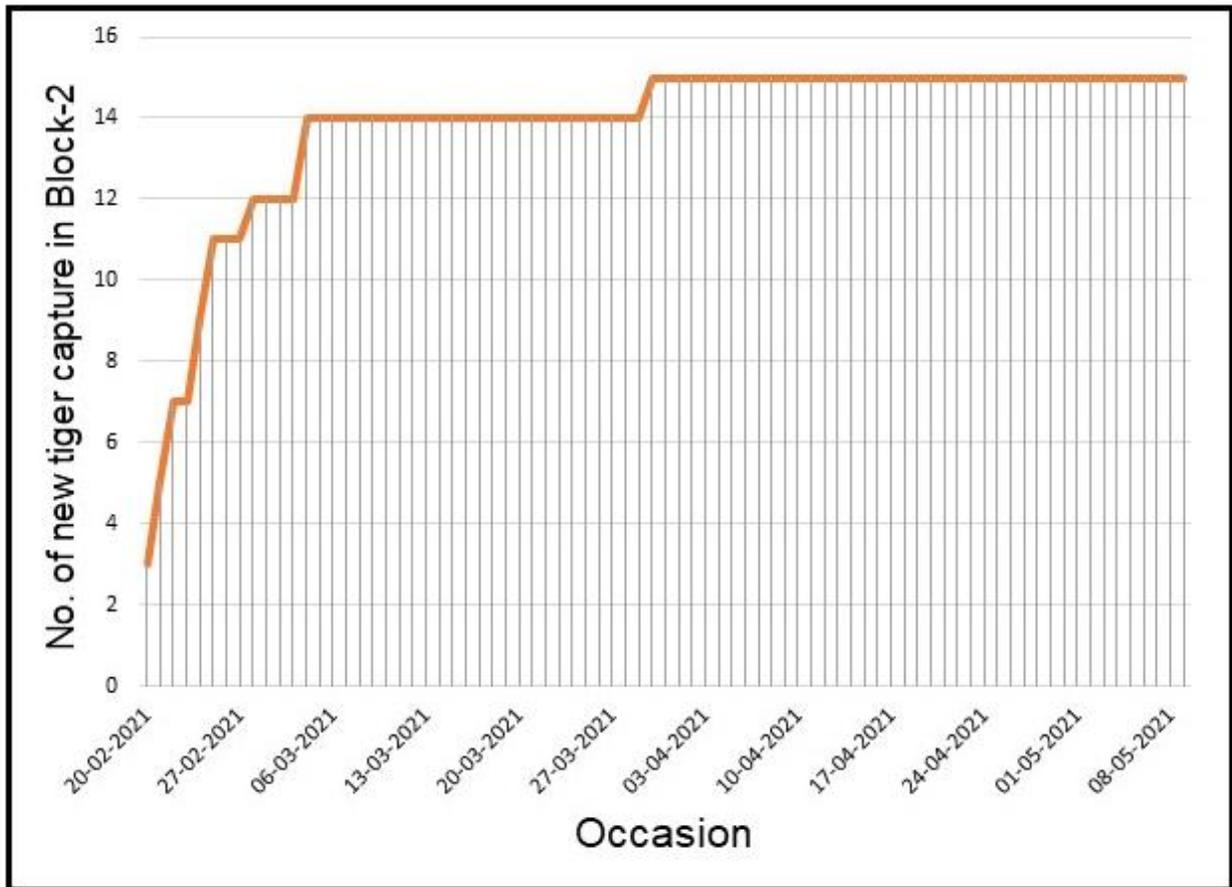


Figure-13. Number of new tigers captured v/s occasion in Block-2 of Manas National Park, BTR, Assam, India (2020-2021). In Block-2 that covered Kahitema area under Bansbari and Panbari ranges recorded 15 adult individual tigers of which 08 females and 07 males. In both the blocks one individual was common (MNP_68_M). The block-2 has also shared three adult tiger individuals with the First Addition to Manas National Park of which two were females and one male (MNP_045_F, MNP_072_F and MNP_075_M). The male and female tiger ratio in the Block-2 is ~ 1:1.

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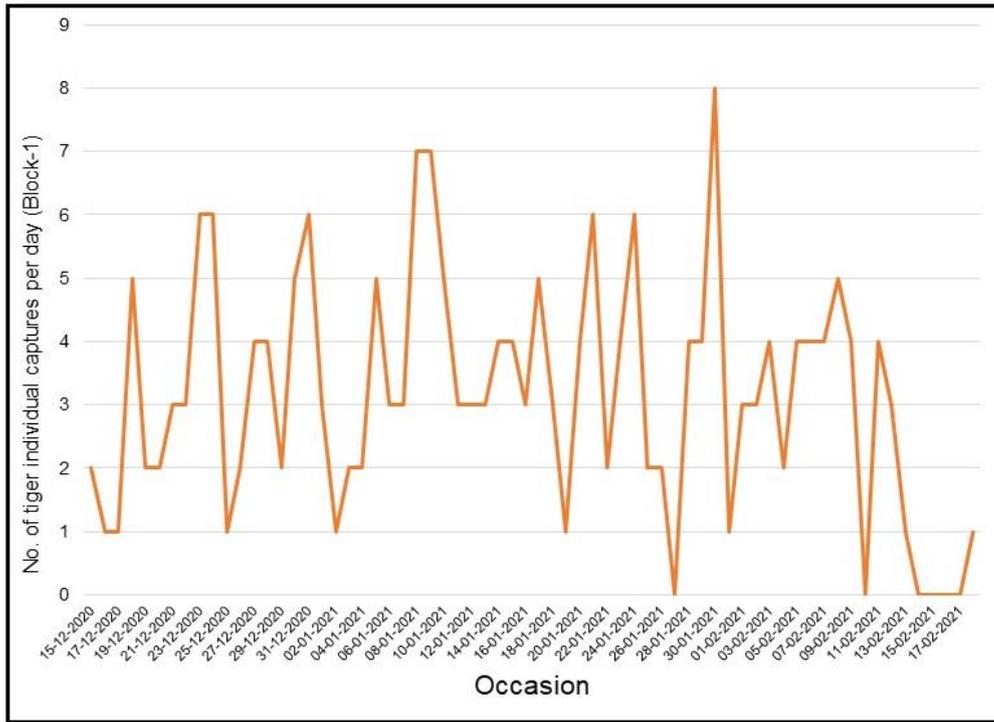


Figure-14. Capture pattern of tigers over the session in Block-1 in Manas National Park, BTR, Assam, India (2020-2021).

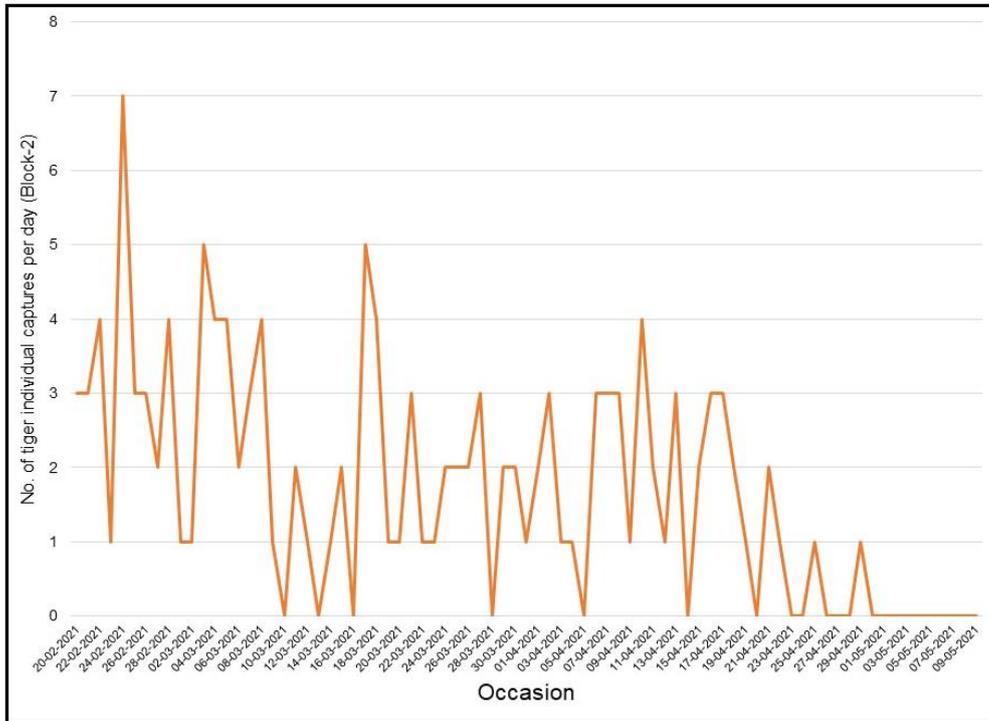


Figure-15. Capture pattern of tigers over the session in Block-2 in Manas National Park, BTR, Assam, India (2020-2021).

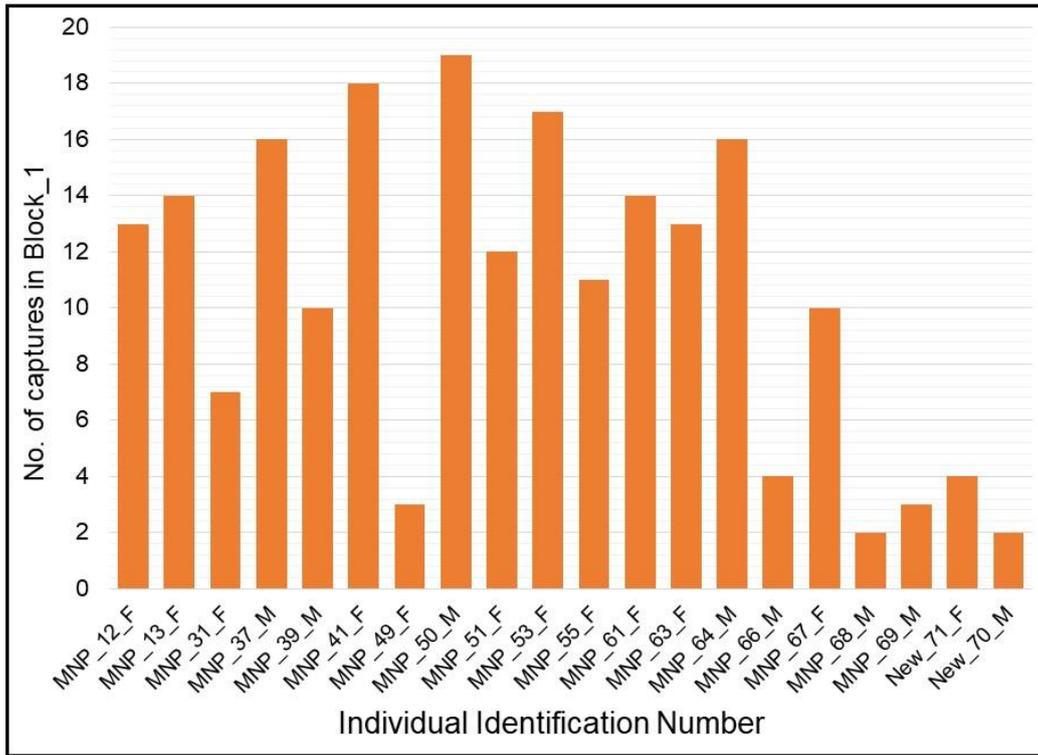


Figure-16. Number of independent captures of each individual tiger per occasion in Block-1 in Manas National Park, BTR, Assam, India (2020-2021).

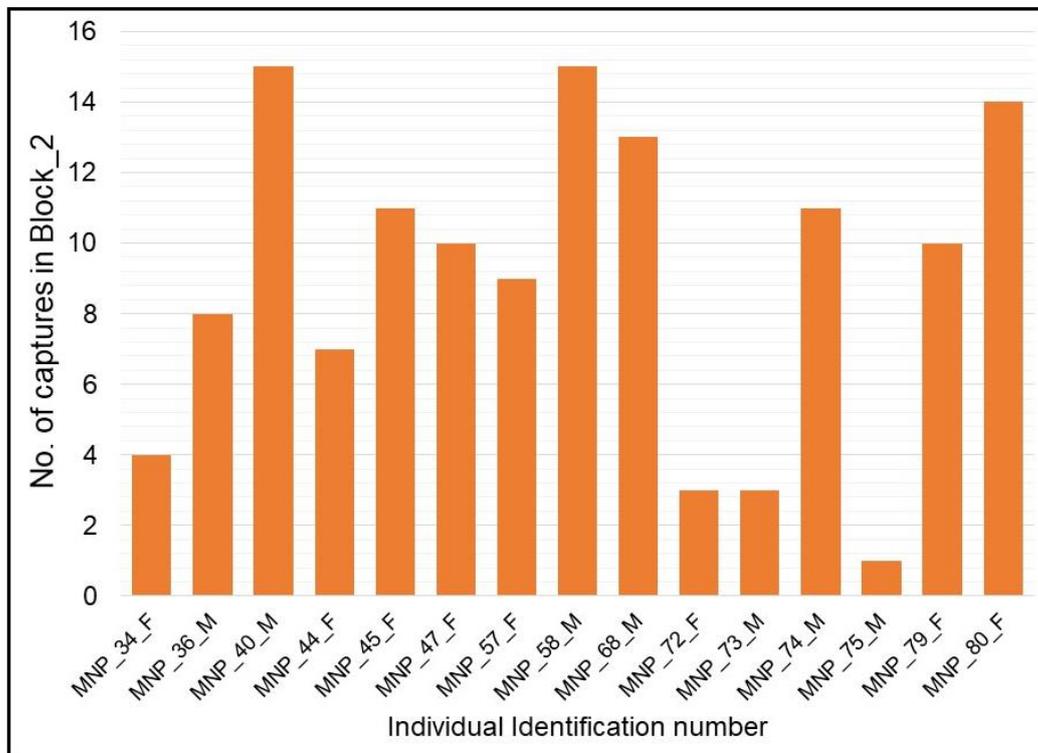


Figure-17. Number of independent captures of each individual tiger per occasion in Block-2 in Manas National Park, BTR, Assam, India (2020-2021).

3.6.1.1. DENSITY ESTIMATES OF TIGERS USING SPATIALLY EXPLICIT CAPTURE RECAPTURE FRAMEWORK UNDER MAXIMUM LIKELIHOOD MANAS NATIONAL PARK, BTR, ASSAM (2020-2021)

| | |
|-----------------------|------------------------|
| Start session | 01-01-2021 |
| End Session | 30-03-2021 |
| N animals | 34 |
| Female | 20 |
| Male | 14 |
| N detections | 281 |
| N occasions | 89 |
| Mask area | 131508.1 ha |
| Best Model | g0~GENDER sigma~GENDER |
| Detection fn | halfnormal |
| N parameters | 4 |
| AIC of null model | 1258.823 |
| AIC of the best model | 1209.102 |

| Density ± SE | Population (CI@ 95%) | Sigma | g0 |
|---------------------|-----------------------------|--------------|-----------|
| 4.38 ± 0.76 | 76 (54-107) | 2420 m | 0.01484 |

3.6.1.2 TIGER POLYGON BASED ON CAMERA TRAP RECORDS FOR MANAS NATIONAL PARK, BTR, ASSAM (2020-2021)

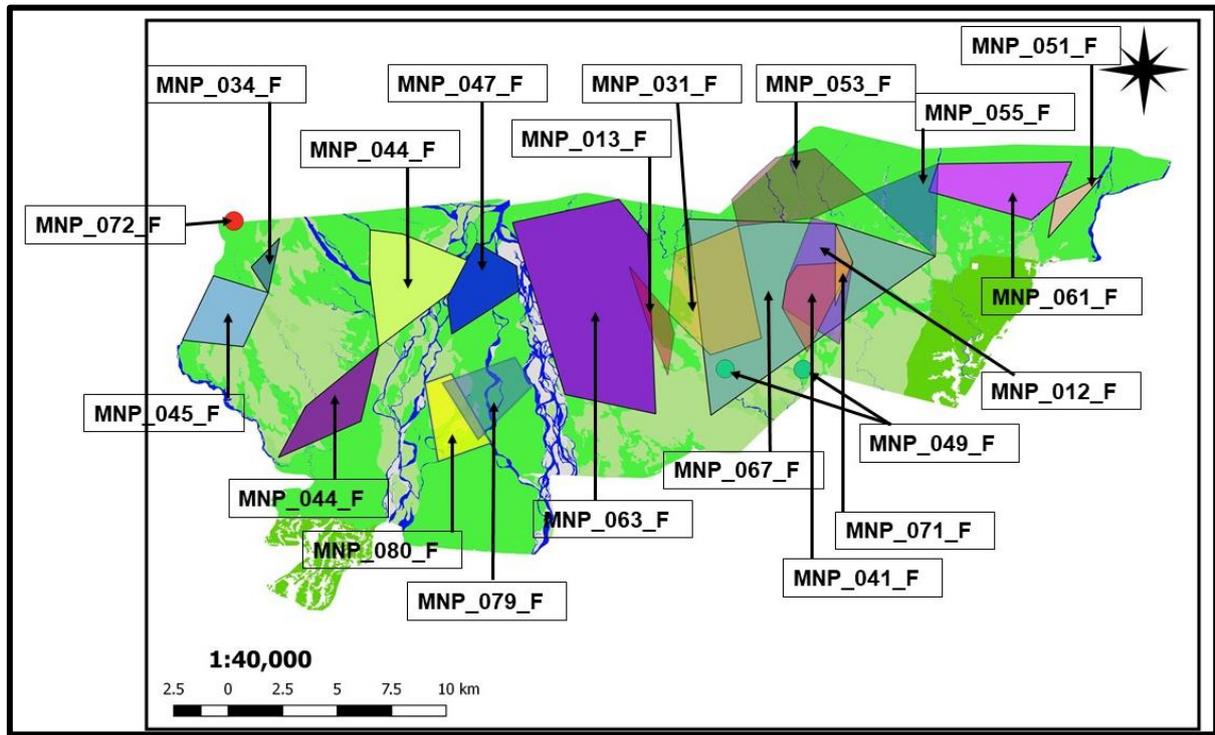


Figure-18. Camera trap detection polygon of different female individual tigers captured in Manas National Park, Assam, India (2020-2021).

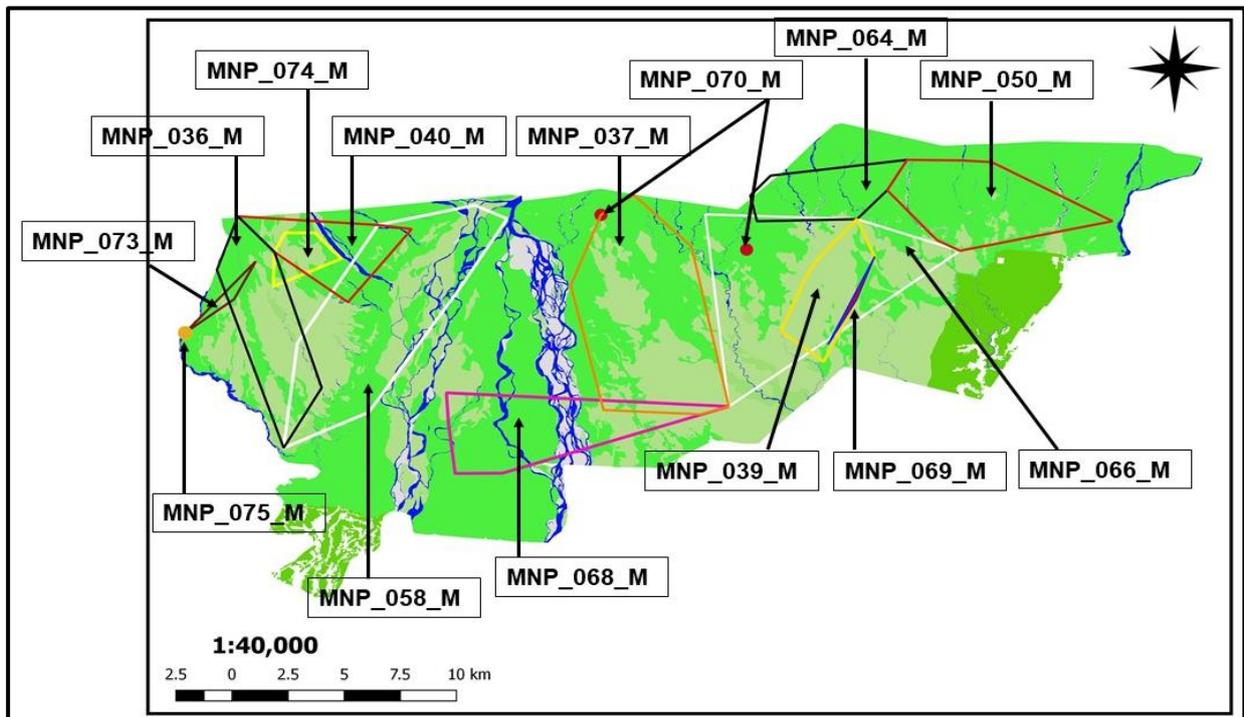


Figure-19. Camera trap detection polygon of different male individual tigers captured in Manas National Park, Assam, India (2020-2021).

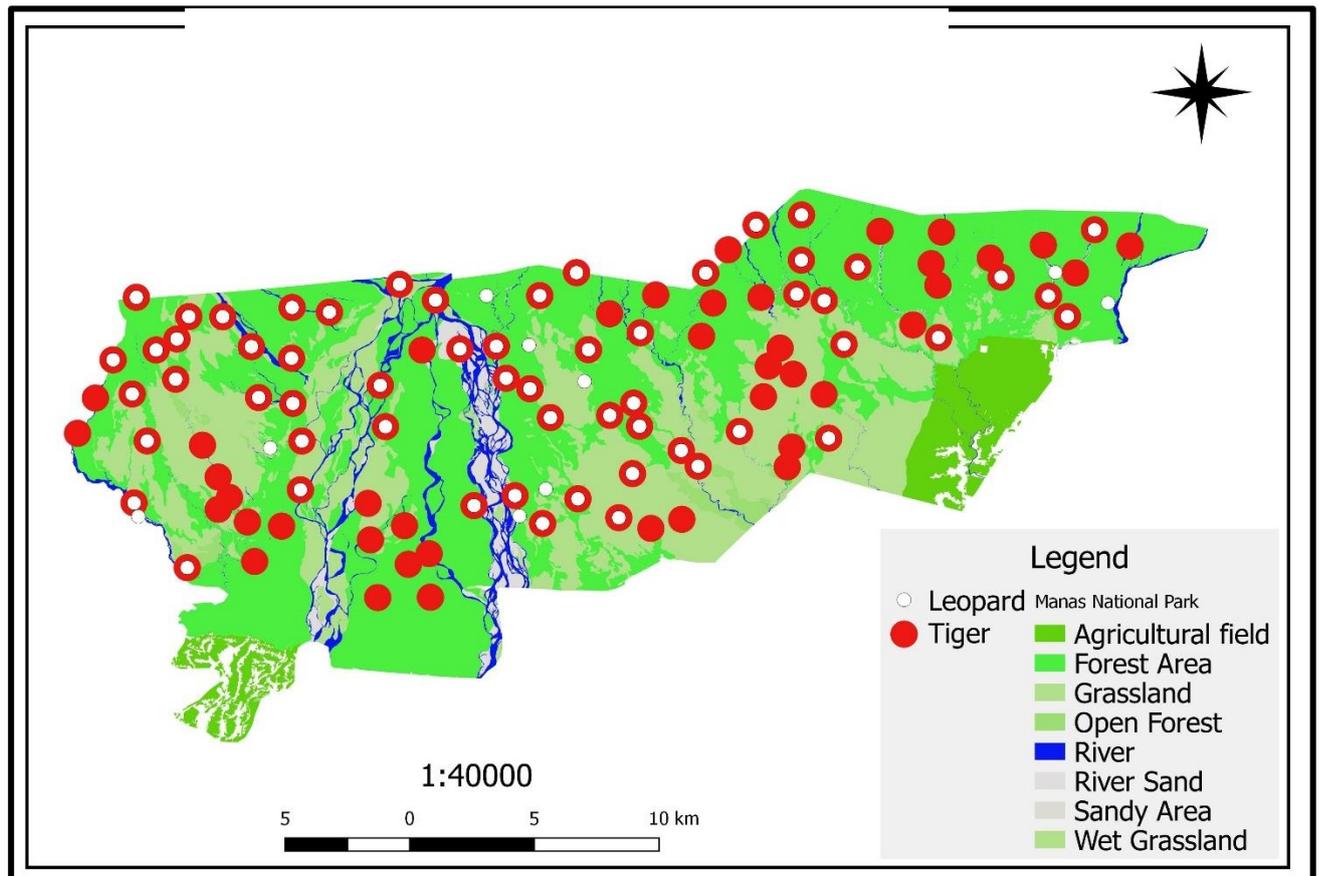


Figure-20. Map showing the distribution of tiger and leopard obtained through camera trapping in Manas National Park, BTR, Assam, India (2020-2021)

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3.6.1.3 OVERVIEW OF THE INDIVIDUAL TIGERS (MT+1) PHOTO-CAPTURED IN THE MANAS TIGER RESERVE (2020-2021)

Here we only present unique individuals only. Some individuals were captured both in MNP and FAMNP that were conceded as MNP tigers.

| Area Name | Adult Tiger | | | | Cubs | Sub-adult | Grant Total |
|--------------|-------------|-----------|-----------|-------------|-----------|-----------|-------------|
| | Total | Male | Female | Unknown sex | | | |
| MNP | 34 | 14 | 20 | 00 | 07 | 03 | 44 |
| FAMNP | 03 | 02 | 01 | 00 | 00 | 00 | 03 |
| BWLS | 01 | 00 | 00 | 01 | 00 | 00 | 01 |
| Total | 38 | 16 | 21 | 01 | 07 | 03 | 48 |

3.6.2 INDIVIDUAL IDENTIFICATION OF LEOPARDS OF THE MANAS NATIONAL PARK (MNP), BTR, ASSAM (2020-2021)

Table-3. Capture details of Leopard (normal) individuals in Manas National Park, BRT, Assam, India (2020-2021).

| Adult Leopard (Normal) | | | | Cubs | Sub-adult | Grant Total |
|------------------------|------|--------|-------------|------|-----------|-------------|
| Total | Male | Female | Unknown sex | | | |
| 25 | 14 | 11 | 00 | 00 | 06 | 31 |

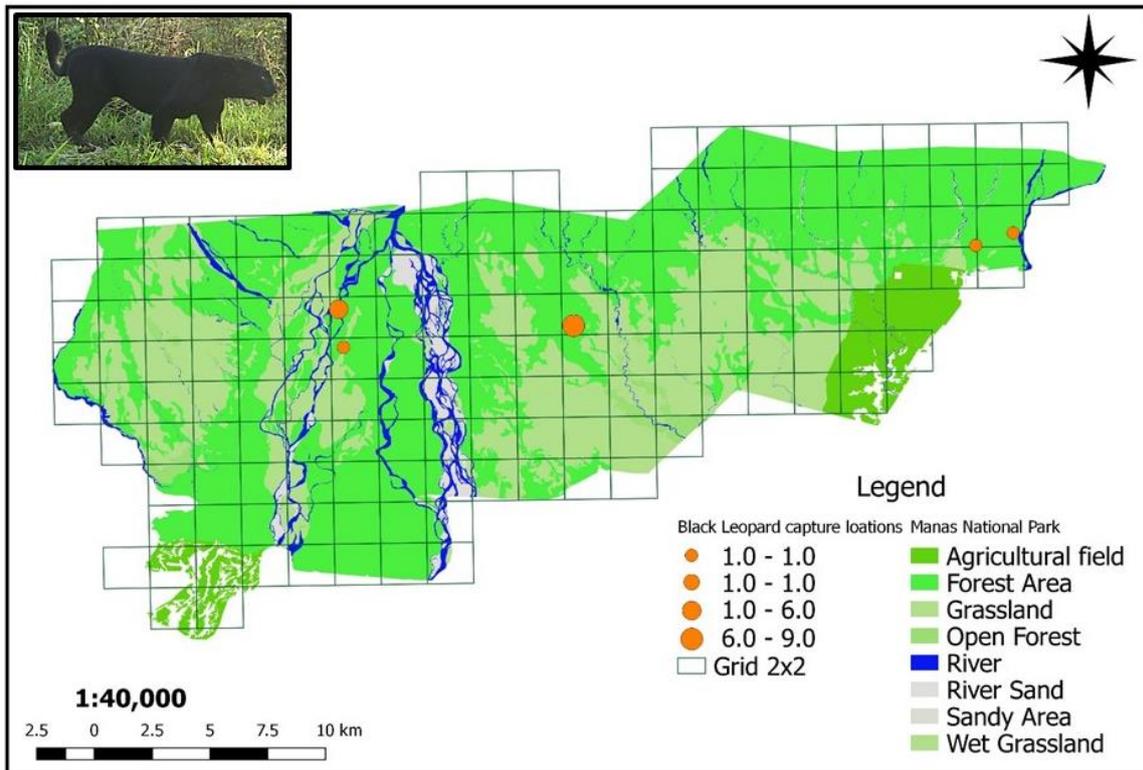


Figure-21. Capture locations of the Black Leopard in Manas National Park, BTR, Assam, India (2020-2021).

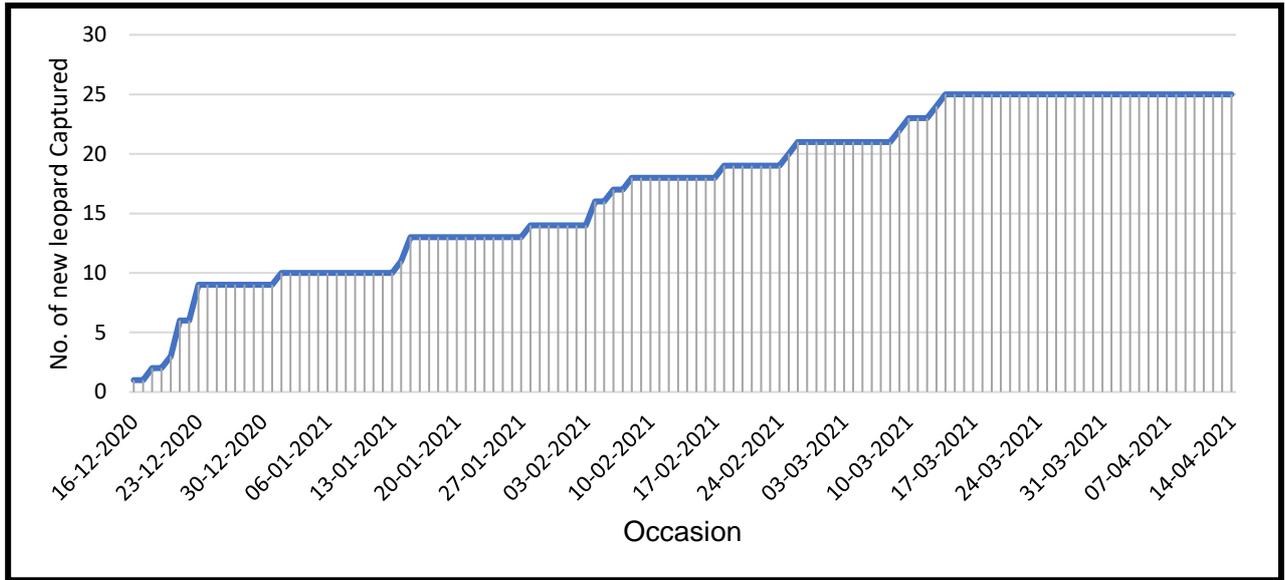


Figure-22. Number of new leopards captured v/s occasion in Manas National Park, BTR, Assam, India (2020-2021).

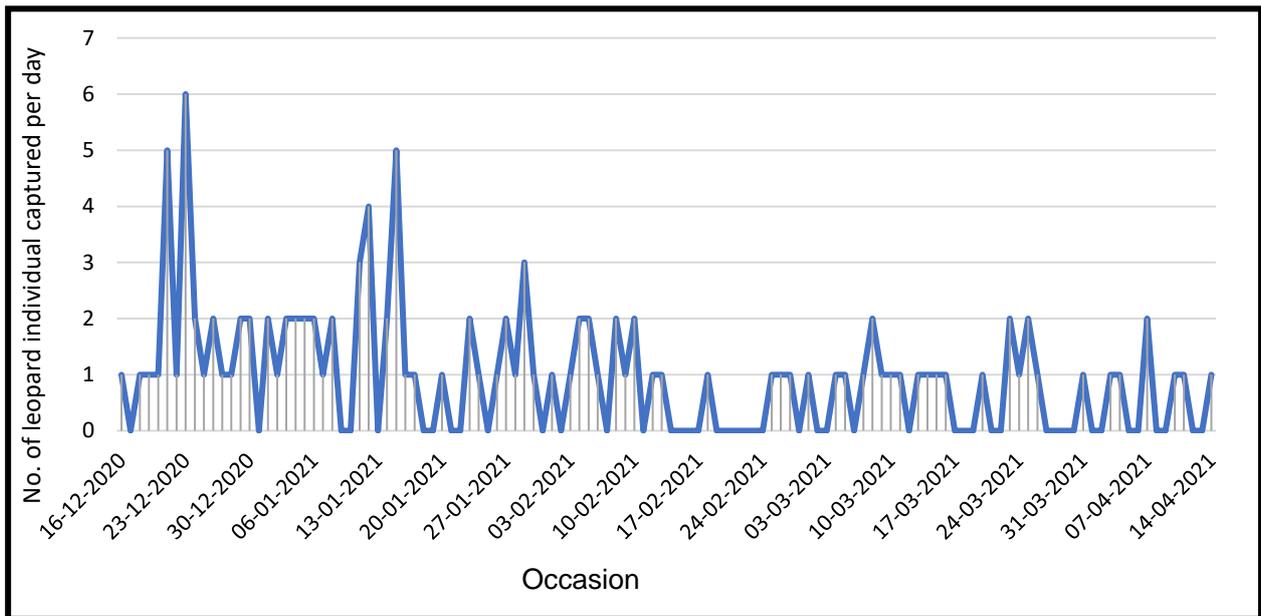


Figure-23. Capture pattern of leopard over the session in Manas National Park, BTR, Assam, India (2020-2021).

Annexure-1

Photo-plates of individual tigers of Manas Tiger Reserve (MTR) (2020-2021)

Details

| | |
|-----------------------------------------|-------------|
| Adult Females | : 21 |
| Unknown Sex | : 01 |
| Adult Males | : 16 |
| Total Adults | : 38 |
| Cub | : 07 |
| Sub-adult | : 03 |
| Total Individuals | : 48 |
| Breeding Female | : 06 |
| First time captured adult individuals | : 12 |
| Last session cub turned to adult | : 00 |

Annexure-2

Photo-plates of individual tigers of Manas National Park (2020-2021)

Details

| | |
|-----------------------------------------|-------------|
| Adult Females | : 20 |
| Unknown Sex | : 00 |
| Adult Males | : 14 |
| Total Adults | : 34 |
| Cub | : 07 |
| Sub-adult | : 03 |
| Total Individuals | : 44 |
| Breeding Female | : 06 |
| First time captured adult individuals | : 08 |
| Last session cub turned to adult | : 00 |

Individual Tigers of Manas NP, Session 2020-2021 [Plate 1]

MNP_012_F



MNP_013_F



MNP_031_F



MNP_034_F



MNP_036_M



Individual Tigers of Manas NP, Session 2020-2021 [Plate 2]

MNP_037_M



MNP_039_M



MNP_040_M



MNP_041_F



MNP_044_F



Individual Tigers of Manas NP, Session 2020-2021 [Plate 3]

MNP_045_F



MNP_004_F (or
MNP_047_F)



MNP_049_F



MNP_050_M



MNP_051_F



Individual Tigers of Manas NP, Session 2020-2021 [Plate 4]

MNP_053_F



MNP_055_F



MNP_057_F



MNP_058_M



MNP_061_F



Individual Tigers of Manas NP, Session 2020-2021 [Plate 5]

MNP_063_F



MNP_064_M



MNP_066_M



MNP_067_F



MNP_068_M



Individual Tigers of Manas NP, Session 2020-2021 [Plate 6]

MNP_069_M



MNP_070_M



MNP_071_F



MNP_072_F



MNP_073_M



Individual Tigers of Manas NP, Session 2020-2021 [Plate 7]

MNP_074_M



MNP_075_M



MNP_079_F



MNP_080_F



Individual Tigers of Manas NP, Session 2020-2021 [Plate 8]

(Cub-1) of
MNP_013_F



(Cub-2) of
MNP_013_F



(Sub-adult-1) of
MNP_045_F



(Cub-1) of
MNP_047_F



(Cub-1) of
MNP_053_F



Individual Tigers of Manas NP, Session 2020-2021 [Plate 9]

(sub-adult-1) of
MNP_061_F



(sub-adult-2) of
MNP_061_F



(Cub-1) of
MNP_072_F



(Cub-2) of
MNP_072_F



(Cub-3) of
MNP_072_F



Annexure-3

**Photo-plates of individual tigers of
First Addition to Manas National Park (FAMNP)
(2020-2021)**

Details

| | |
|-----------------------------------------|-------------|
| Adult Females | : 03 |
| Unknown Sex | : 00 |
| Adult Males | : 03 |
| Total Adults | : 06 |
| Cub | : 00 |
| Sub-adult | : 00 |
| Total Individuals | : 06 |
| Common Individual with MNP | : 03 |
| Total unique individual in FAMNP | : 03 |
| Breeding Female | : 00 |
| First time captured adult individuals | : 03 |
| Last session cub turned to adult | : 00 |

Individual Tigers of First Addition to Manas NP, Session 2020-2021
[Plate 1]

MNP_045_F

(Common with MNP)



MNP_072_F

(Common with MNP)



MNP_075_M

(Common with MNP)



MNP_076_M



MNP_077_F



**Individual Tigers of First Addition to Manas NP, Session 2020-2021
[Plate 2]**

MNP_078_M



Annexure-4

**Photo-plates of individual tigers of
Barnadi Wildlife Sanctuary
(2020-2021)**

Details

| | |
|-----------------------------------------|-------------|
| Adult Females | : 00 |
| Unknown Sex | : 01 |
| Adult Males | : 00 |
| Total Adults | : 01 |
| Cub | : 00 |
| Sub-adult | : 00 |
| Total Individuals | : 01 |
| Breeding Female | : 00 |
| First time captured adult individuals | : 01 |
| Last session cub turned to adult | : 00 |

**Individual Tigers of Barnadi Wildlife Sanctuary, Session 2020-2021
[Plate 1]**

BWLS_001_F



Annexure-5

**Photo-plates of individual Leopards of
Manas Tiger Reserve (MTR)
(2020-2021)**

Details

| | |
|-----------------------------------------|-------------|
| Adult Females | : 14 |
| Unknown Sex | : 00 |
| Adult Males | : 17 |
| Total Adults | : 31 |
| Cub | : 00 |
| Sub-Adult | : 06 |
| Total Individuals | : 37 |
| Breeding Female | : 00 |
| First time captured adult individuals | : 13 |
| Last session cub turned to adult | : 00 |

Annexure-6

**Photo-plates of individual Leopards of
Manas National Park
(2020-2021)**

Details

| | |
|-----------------------------------------|-------------|
| Adult Females | : 11 |
| Unknown Sex | : 00 |
| Adult Males | : 14 |
| Total Adults | : 25 |
| Cub | : 0 |
| Sub-Adult | : 06 |
| Total Individuals | : 31 |
| Breeding Female | : 00 |
| First time captured adult individuals | : 09 |
| Last session cub turned to adult | : 00 |

Individual Leopards of Manas NP, Session 2020-2021 [Plate 1]

MNP_001_M



MNP_006_F



MNP_010_M



MNP_019_F



MNP_023_F



Individual Leopards of Manas NP, Session 2020-2021 [Plate 2]

MNP_025_M



MNP_032_M



MNP_044_M



MNP_047_F



MNP_050_M



Individual Leopards of Manas NP, Session 2020-2021 [Plate 3]

MNP_052_M



MNP_053_M



MNP_054_F



MNP_055_M



MNP_056_F



Individual Leopards of Manas NP, Session 2020-2021 [Plate 4]

MNP_060_F



MNP_061_F



MNP_062_M



MNP_063_M

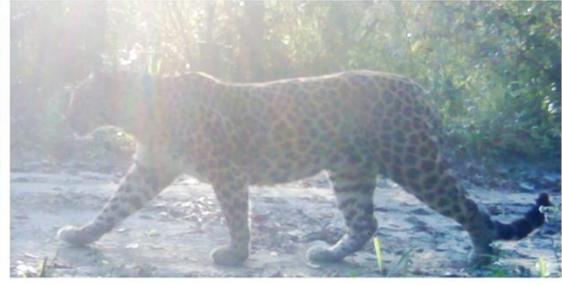


MNP_064_F



Individual Leopards of Manas NP, Session 2020-2021 [Plate 5]

MNP_065_F



MNP_066_M



MNP_067_F



MNP_068_M



MNP_069_M



Individual Leopards of Manas NP, Session 2020-2021 [Plate 6]

MNP_Sub-
Adult 01 F



MNP_Sub-
Adult 02 F



MNP_Sub-
Adult 03 F



MNP_Sub-
Adult 04 F



MNP_Sub-
Adult 05 M



Individual Leopards of Manas NP, Session 2020-2021 [Plate 7]

MNP_Sub-
Adult 06 M



Annexure-7

**Photo-plates of individual Leopards of
First Addition to Manas National Park
(2020-2021)**

Details

| | |
|-----------------------------------------|-------------|
| Adult Females | : 00 |
| Unknown Sex | : 00 |
| Adult Males | : 02 |
| Total Adults | : 02 |
| Cub | : 00 |
| Total Individuals | : 02 |
| Breeding Female | : 00 |
| First time captured adult individuals | : 00 |
| Last session cub turned to adult | : 00 |

Individual Leopards of First Addition to Manas NP, Session 2020-2021
[Plate 1]

FAMNP_031_M



FAMNP_052_M



Annexure-8

**Photo-plates of individual Leopards of
Barnadi Wildlife Sanctuary
(2020-2021)**

Details

| | |
|-----------------------------------------|-------------|
| Adult Females | : 03 |
| Unknown Sex | : 00 |
| Adult Males | : 01 |
| Total Adults | : 04 |
| Cub | : 0 |
| Sub-adult | : 0 |
| Total Individuals | : 04 |
| Breeding Female | : 0 |
| First time captured adult individuals | : 04 |
| Last session cub turned to adult | : 00 |

Individual Leopards of Barnadi Wildlife Sanctuary, Session 2020-2021
[Plate 1]

BWLS_001_M



BWLS_002_F



BWLS_003_F



BWLS_004_F



Annexure-9

List of the terrestrial mammal's photo-captured in Manas Tiger Reserve, BTR, Assam (2020-2021) (Plate-1)



Panthera tigris



Panthera pardus



Neofelis nebulosa



Prionailurus bengalensis



Felis chaus



Cuon alpinus

List of the terrestrial mammal's photo-captured in Manas Tiger Reserve, BTR, Assam (2020-2021) (Plate-2)



Muntiacus muntjak



Axis porcinus



Rusa unicolor



Rucervus duvaucelii



Sus scrofa



Bos gaurus



Bubalus arnee



Elephas maximus

List of the terrestrial mammal's photo-captured in Manas Tiger Reserve, BTR, Assam (2020-2021) (Plate-3)



Lepus nigricollis



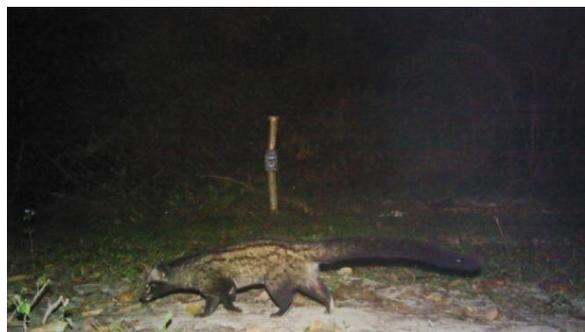
Caprolagus hispidus



Viverra zibetha



Viverricula indica



Paradoxurus brachyuranbtes



Herpestes urva



Arctictis binturong



Hystrix brachyuran

List of the terrestrial mammal's photo-captured in Manas Tiger Reserve, BTR, Assam (2020-2021) (Plate-4)



Ursus thibetanus laniger



Rhinoceros unicornis



Pardofelis marmorata



Capricornis sumatraensis thar

