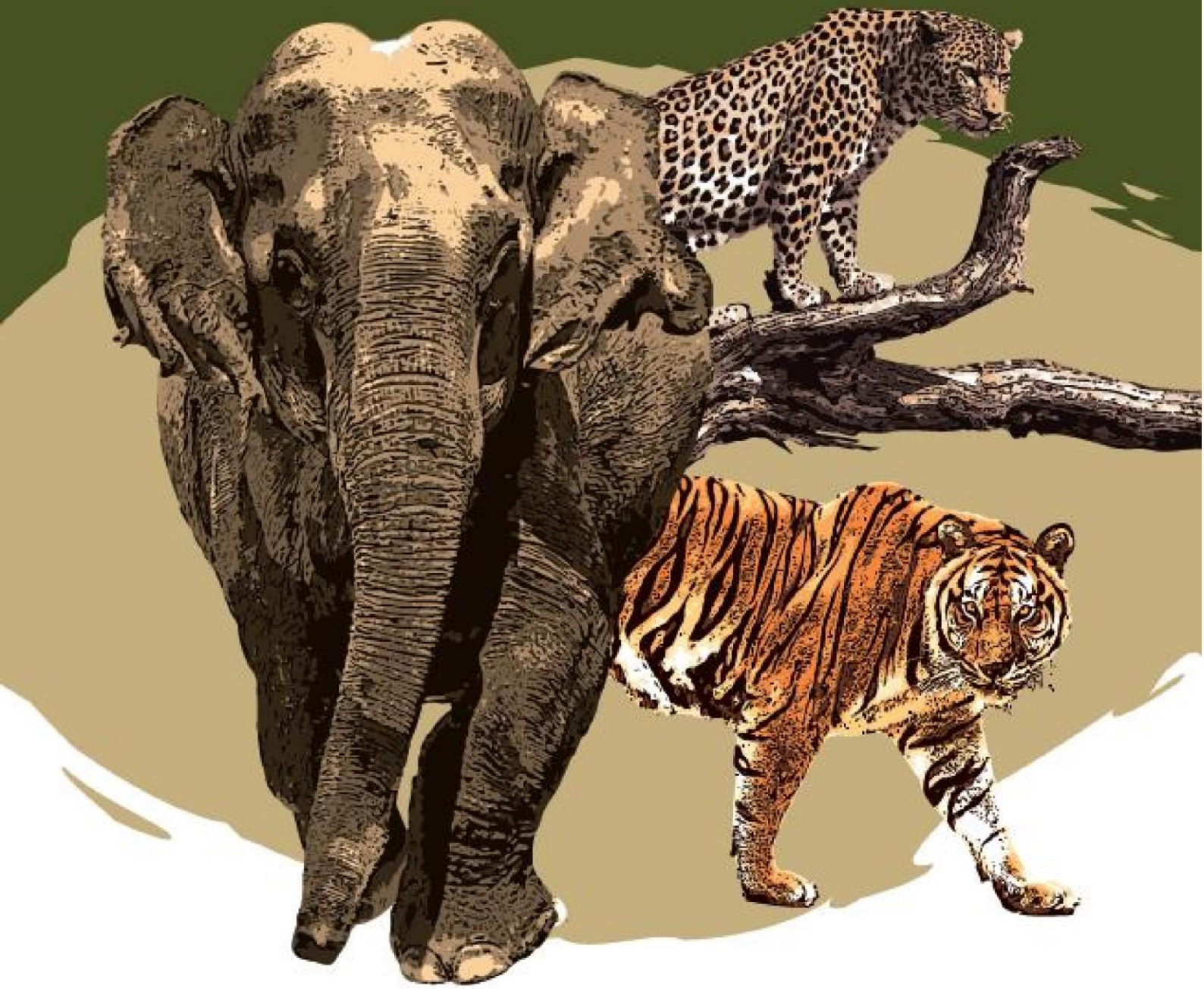
ALL INDIA ELEPHANT TIGER AND LEOPARD ESTIMATION



PROGRESS REPORT

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

Progress April – May, 2023

- Camera trap and dung sampling on-going currently or completed in the following sites:
  1. Bandipur
  2. Nagarhole
  3. Mudumalai
  4. Sathyamangalam
  5. Bhadra
  6. Periyar
  7. KMTR
  8. Satkosia
  9. Simlipal
  10. Palamau
  11. Katerniaghat
  12. Corbett
  13. Bandhavgarh
  14. Manas
  15. Jaldapara
  16. Gorumara
- Genetic sample extractions and standardisation according to the new method on NGS sequencing, due to the urgency and shortened timelime.
- Meeting with IG-PE & NCBS (Dr Uma Ramakrishnan) regarding the feasibility of SNPs and NGS – decided that SNPs need to be standardised and cannot be used for the large scale elephant population estimation currently. It was decided that Microsatellites on NGS would be the apt strategy and standardisation of SNPs on subsets of populations in each landscape for future use would be apt.
- Communications were sent and received from other institutions, as per suggestions of DGF&SS, to Rajiv Gandhi Institute of technology, NCBS, CCMB, ZSI, Aaranyak and SACON. The proposals received were internally reviewed and discussed and strategies of the best way possible have been discussed.

Progress Report October, 2022 – March, 2023

In India, where elephants are an integral part of the ecosystem and a cultural symbol, several methods have been used to estimate their population. Nation wide elephant population estimation has been conducted every five years by the forest department of elephant range states. All elephant range states, except Southern Indian states, conduct population estimation through direct count method. Southern states use dung based population estimation, which was introduced in 2002. The total/direct count method has no scientific basis for large landscapes and elephant population, hence it was modified to sample block counts with restricted areas, to maximise the probability of detection of elephants with small team of enumerators (Project Elephant, August 2017). In 2017, total of 27,312 elephants were counted, of which 11,960 were in Western Ghats, 3,120 in Central India, 2,085 in Shivalik Terai landscape and 10,139 in Northeast India. It was recognised that total count and dung decay based counts are providing unreliable results and thus, new methodology should be adopted to ensure robust population estimation, like line transect, camera trapping, DNA based mark recapture and occupancy models. Though mentioned in Rangarajan et. al (2010), a combination of genetic identity along with modern approach to capture-mark-recapture has yet to be successfully demonstrated for elephants

In 2021, after discussions it was realised that robust scientific approach like dung based mark recapture and camera trap based distance sampling estimation will be feasible methods to enumerate elephant population. Further, by combining the efforts during All India Tiger Estimation, as the sampled area overlap for elephant and tiger presence is maximal, it would result in a prudent use of resources while hastening the process of estimation for tiger, leopard and elephant. Therefore, on 10th March, 2021 Project Elephant (PE) invited to submit a project proposal for a synchronised tiger and elephant population estimation (S1; Table1). A project proposal from WII was submitted to PE in April, 2021 (S2; Table1). The methodology for enumeration was discussed with PE, NTCA and elephant ecology experts on 17th June, 2021 (S3; Table 1) and it was decided to go ahead with this enumeration exercise. In October, 2021 PE requested WII for a submission of proposal with budgetary requirement to CAMPA through PE, which was sanctioned in July, 2022 and funds released in August, 2022.

The elephant enumeration is also divided into three phases of which Phase 1 and 2 are common, wherein during Phase 1, data on occupancy of carnivores, mega herbivores and habitat quality is collected by forest department staff across all the forested habitats of elephant and tiger bearing states. Phase 2 consists of remotely sensed data collection of habitat co-variates that influence animal distribution. Phase 3 is the intensive site monitoring for collecting data to calibrate the models for population estimation of elephants. This phase involves collection of dung samples for mark recapture and camera trapping for distance sampling. A sample area of 200 sq km block is chosen, and a camera trap along with a sign survey and dung collection walk is carried out in every 4 sq. kms within the sampling unit **(Appendix 1)**. This Phase 1 training for collection of dung samples during the sign survey walk was explicitly instructed during September, 2021, along with datasheet and instructions, when training of trainers was completed for the All India Tiger, leopard and Elephant estimation.

Phase I data collection was initiated in October, 2021 and completed by December, 2022. In December, 2021 advertisement for recruitment of researchers for field and limited lab work for the AITE exercise was hired, wherein researchers joined by February, 2022. Following this, a study site for standardising of genetic protocols, was taken up in Karnataka where the density of elephants was known. The genetic mark recapture for large scale sampling was standardised and yielded robust estimates, was completed by August, 2022 **(Appendix 2).**

On continuous review of Phase I data in June, 2022, dung samples were collected **(Appendix 3)** and it was found that data was not collected as per protocol and is inadequate, hence several reminders were sent to states from PE and NTCA (S11, S15, S16, S17; Table1). On release of funds in August, 2022, advertisement for lab researchers was put up and researchers were employed by December, 2022. In November, 2022, researchers were deployed in Bandhavgarh for intensive site sampling, which was completed in January, 2023, by collecting a total of 329 dung samples. In December, 2022 researchers were sent to Bandipur for sampling and finished camera trapping and sampling by March, 2023, after collecting 250 samples.

Table 1: Timeline of Activities for Elephant population estimation

S.no	Activity	Date	Comments
1	Preliminary Discussion about converging Tiger and Elephant estimation	10th March, 2021	
2	Proposal submitted by WII reg the elephant estimation census	9th April, 2021	Letter from DWII to IGF, Project elephant
3	Presentation on methodology to be adopted for elephant estimation to Project Elephant Committee	17th June, 2021	Broader framework for elephant population estimation is accepted. Chair requested to submit method.
4	Timeline for Tiger, leopard and elephant estimation communicated	25th August, 2021	With caveats of budget and timely collection of field data. As per initial submitted timeline, April 2023 is the intended time if start is from September, 2021 and field data submission will be completed by February, 2022, but it was submitted later, see point 6
5	Request from elephant cell to to submit proposal for CAMPA funding	12th October, 2021	Proposal was submitted for funding

6	Phase I data collection initiation and completion	October, 2021 - December, 2022	Data has been collected
7	Advertisement to hire field personnel and limited lab personnel for tiger, leopard and elephant estimation	December, 2021	For field work and standardisation of molecular markers to estimate elephant population
8	Standardisation of genetic mark recapture protocol	January - June, 2022	Protocols were developed for the mark recapture after screening of 20 microsatellite loci, on a known population of elephants in Karnataka. Field work entailed transects, and dung collection and genetic analysis.
9	After due process of exam, and interview, researchers have joined	February-March, 2022	
10	Evaluation of Phase I data	June, 2022	Continuous evaluation of Phase I data has been done, as received at WII and it has been found that elephant data collected is not appropriate for Phase I for population estimation.
11	Letter from Project Elephant to Chief Wildlife Wardens of states to address issue of poor dung collection	July, 2022	Letter sent to several states emphasising for appropriate data collection
12	Sanction order to Pay and Account to release fund to WII for elephant estimation	July, 2022	Letter sent to PAO to release 1.5 crores for conducting elephant estimation, to WII
13	Receipt of funds at WII	19th August, 2022	1.5 crores received at WII
S.no	**Activity**	**Date**	**Comments**
14	Advertisement to recruit researchers for mainly lab work	September, 2022	Advertisement to recruit lab researchers issued, and subsequently examination conducted
15	Communication with PE, regarding status of Phase I and 3	8th September, 2022	It was informed that sampling for Phase 1 and 3 is inadequate, therefore researchers will sample areas from second week of October as per protocol

16	Reminder letter from Project Elephant for appropriate dung collection of elephant population estimation to all state	15th September, 2022	2nd reminder sent to all states emphasising the lack of appropriate dung sample collection
17	Review meeting for Phase I at WII by NTCA	14th October, 2022	It was presented that timeline is of two years, from the receipt of fund, i.e., September, 2022, and since dung collection is not happening according to protocol, researchers will be sent to field to collect samples in the 20 sites
18	Deputed genetics and field team to Bandhavgarh for deployment of camera traps and genetic sample collection	23rd November, 2022	Permission received, and team deployed - Sampling completed in January, 2023
19	After due process of exam, and interview, lab researchers have joined	December, 2022	After exam and interview, researchers have joined
20	Deployment of team to Bandipur(and permission requested for Bhadra and Nagarhole, Karnataka - as season for sampling in Western Ghats)	19th December, 2022	Team received permission on 27th January, 2023
21	Data receipt completed and cleaned	January, 2023	All Phase I data, cleaned, crosschecked
22	Completed sampling in Bandipur	March 1st Week, 2023	Camera trapping and genetic sampling completed, data organisation is in progress
23	Nagarhole Sampling initiation	Mid march	On removal of cameras from Bandipur, team is moving to Nagarhole

Phase 1: Phase 1 data was received by December, 2022 and cross-checked, cleaned by February, 2023. A total of 11,004 grids of 100 sq.km were sampled (figure 1) during this cycle of Phase 1, of which 1,562 were occupied by elephants (figure 2), i.e., 14.19% of sampled area was occupied by elephants.

Phase 2: The remotely sensed co-variates were collected for use in occupancy analysis

Phase 3: A total of 579 dung samples were collected from two intensive sites and processed for genetic analysis (figure 3 & 4). The team is currently in the process of sampling Nagarhole, once camera traps are completely removed from Bandipur.

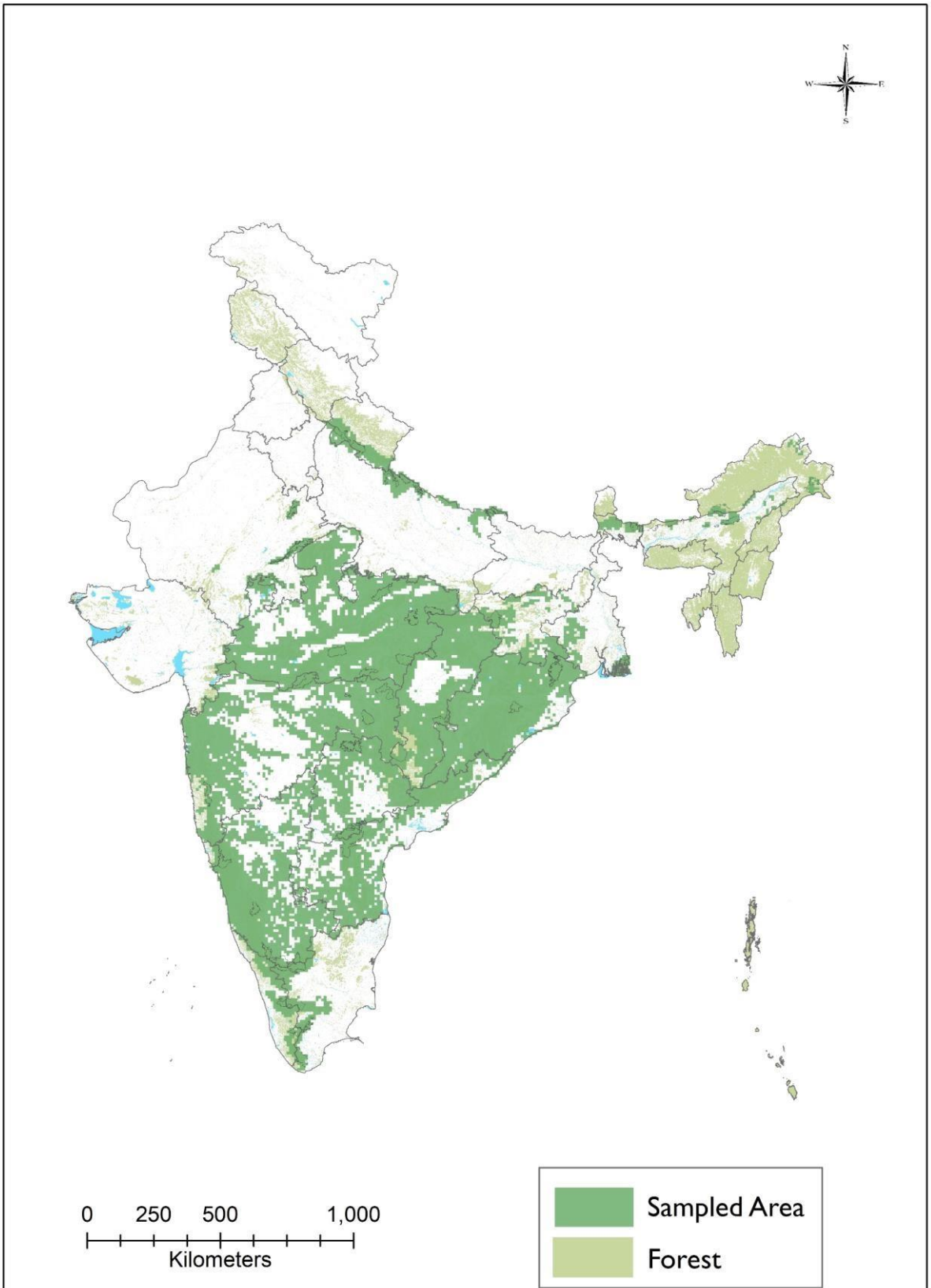

N
W
E
S
0 250 500 1,000
Kilometers
Sampled Area
Forest

Figure 1: Sampled area under Phase 1 of AITE cycle 2022

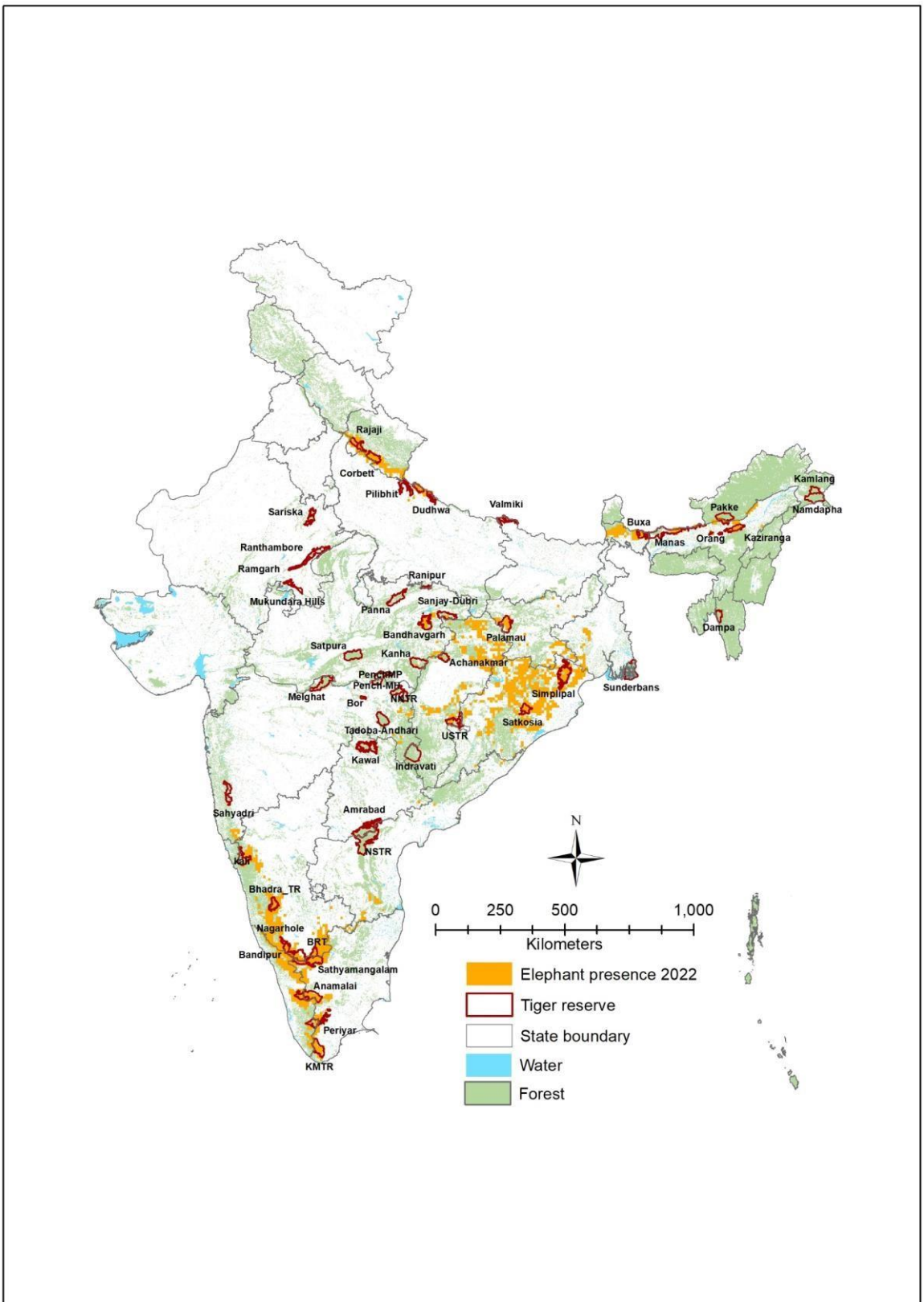

Rajaji
Corbett
Pilibhit
Dudhwa
Valmiki
Sariska
Ranthambore
Ramgarh
Mukundara Hills
Ranipur
Panna
Sanjay-Dubri
Bandhavgarh
Palamau
Satpura
Kanha
Achanakmar
Pench MP
Pench-MH
NKTR
Melghat
Bor
Simplipal
Satkosia
Tadoba-Andhari
USTR
Kawal
Indravati
Sahyadri
Amrabad
NSTR
Kali
Bhadra_TR
Nagarhole
BRT
Bandipur
Sathyamangalam
Anamalai
Periyar
KMTR
Kamlang
Pakke
Namdapha
Buxa
Manas
Orang
Kaziranga
Dampa
Sunderbans
N
0
250
500
1,000
Kilometers
Elephant presence 2022
Tiger reserve
State boundary
Water
Forest

Figure 2: Elephant presence in the sampled grids during Phase I of AITE – 2022

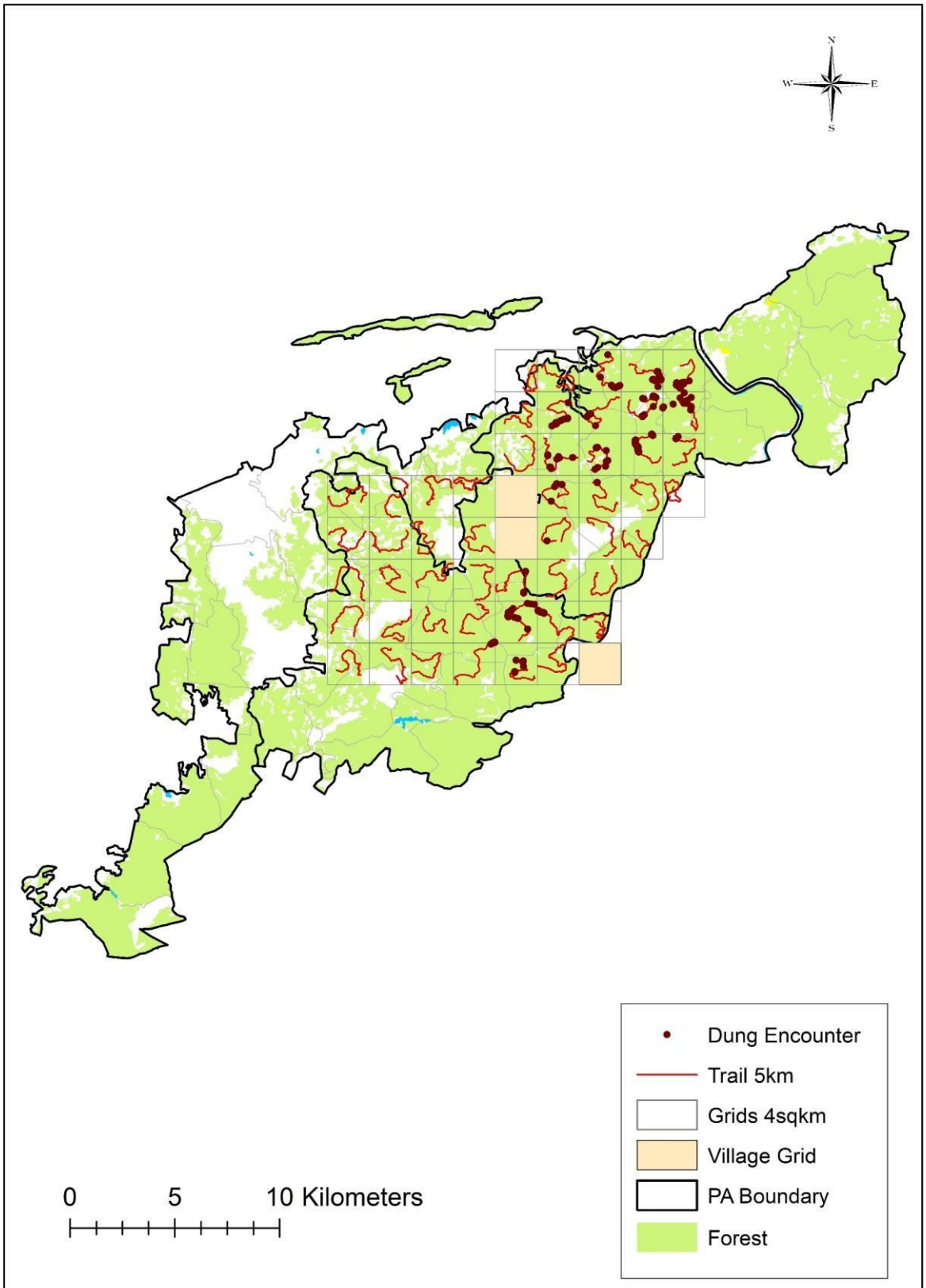

N
W
E
S
Dung Encounter
Trail 5km
Grids 4sqkm
Village Grid
PA Boundary
Forest
0
5
10 Kilometers

Figure 3: Survey effort on trail walks, grids sampled and dung encounter in Bandhavgarh during December, 2022 – January, 2023

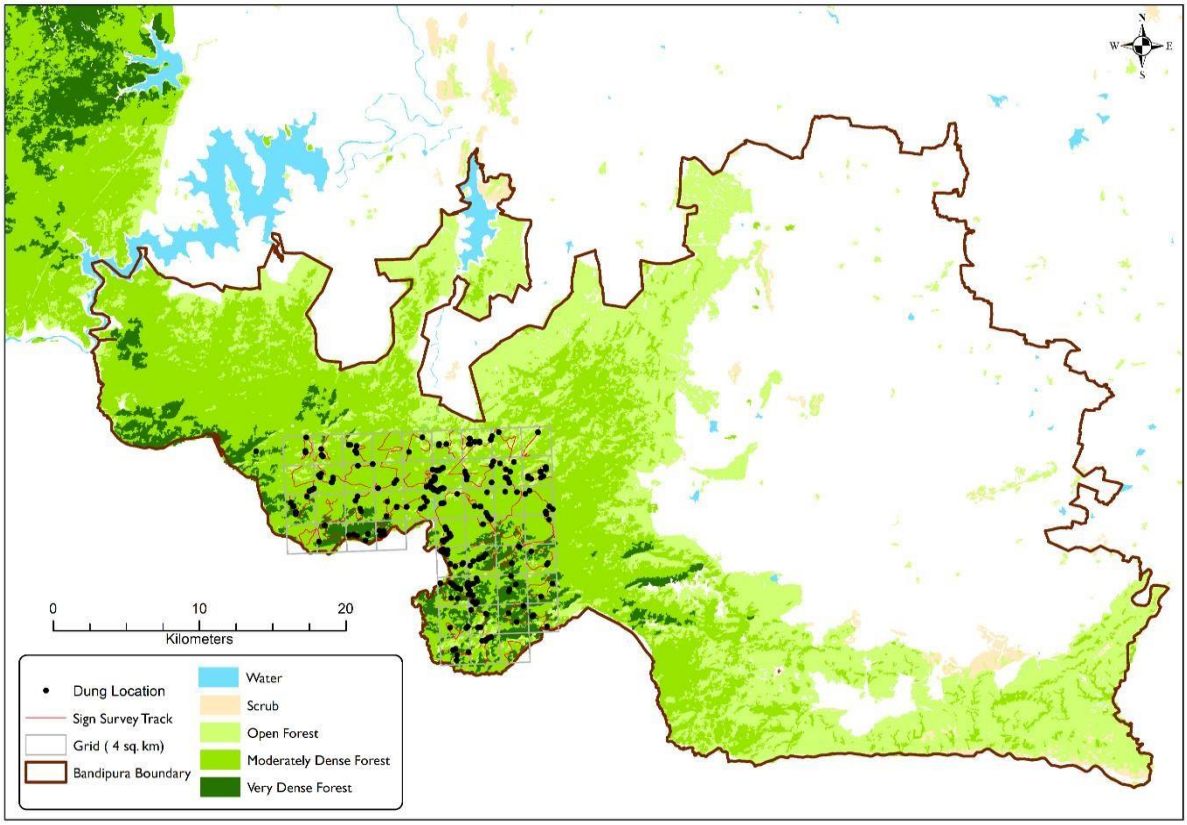


Figure 4: Survey effort on trail walks, grids sampled and dung encounter in Bandipur, during January – February, 2023

Way ahead:

As per plan, 20 more sites need to be sampled for Phase 3 data collection, which amounts to 4,000 sq.km of sampling area. We have planned to sample area in April - May 2023 and October – December, 2023. Elephant movements are largely regulated by the availability and distribution of water, which in turn influence the cropping pattern and availability of food plants in the landscape (Williams et al. 2006). It has been observed that, in the onset of monsoon, elephant populations are distributed over larger landscape, while in summer, elephants are congregated in larger groups, restricted in smaller areas (Sukumar 1989). This movement will substantially influence the abundance of elephants locally. Thus, it is prudent to align Phase 1 data collection time period, with that of Phase 3. Monsoon data collection is not appropriate as availability of water everywhere changes the distribution and density of elephants locally, hence, modelling this aspect will not be possible to arrive at population estimation.

Following is the plan for Phase 3 data collection:

It takes a total of 66 man months to complete the work involved for population estimation. With adequate manpower and timely funding, this can be ideally completed by June, 2024. However, after completion of first half of the sampling by June, we will be in a better position to revise the timeline as necessary and evaluate whether there is a possibility of completion of this work earlier than stated. We will seek equipment and field manpower resource from forest department to assist our research team in timely completion of data collection.

Table 2: Timeline of Elephant estimation activities planned

Sno	Activity	Time	Remarks	Caveats
1	Sampling in 8 sites parallely	15 April - May(last), 2023	It takes 45 days to complete one site	Conditional on timely permissions and facilitation by local park, given it is fire season
2	Completion of data sorting of 10 sites, and genetic analysis	June - September, 2023	In this time period, the data collected will be sorted and used for analysis, it takes 45 man days for each site for genetic analysis, and camera trap data	Adequate manpower and timely release of funds to engage additional researchers
3	Sampling in 10 sites	October – February, 2023	It takes 45 days to complete one site	Conditional on timely permissions and facilitation by local park
4	Completion of data sorting of 10 sites, and genetic analysis	February - June, 2024	Data sorting, genetic analysis and report writing	
5	Status report	July, 2024	Status report	

References:

- Sukumar, R. (1989). Ecology of the Asian elephant in southern India. I. Movement and habitat utilization patterns. Journal of tropical Ecology, 5(1), 1-18.
- Williams, A. C., Johnsingh, A. J., Krausman, P. R., & Qureshi, Q. (2008). Ranging and habitat selection by Asian elephants (Elephas maximus) in Rajaji National Park, north-west India. Journal of the Bombay Natural History Society, 105, 24-33.