COUNTING TIGERS.....

ALL INDIA TIGER ESTIMATION 2018

NATIONAL TIGER CONSERVATION AUTHORITY

Ministry of Environment, Forest and Climate Change
Government of India

CONTENTS

Disclaimer

This document brief is intended solely for broad appraisal of concerned and is in no way reflective of details and intricacies involved in country wide analysis.

INTRODUCTION

The Tiger Task Force (TTF) appointed by the Prime Minister of India realized that it is imperative to have a credible scientific national monitoring protocol that would inform policy makers and wildlife managers on;

a) Spatial extent and population size of individual tiger populations in India,

b) Welfare factors in these and neighbouring habitat (prey status, human pressures, other wildlife species status, and habitat conditions),

c) Trends in the population and area occupied over time

After discussions and consultations with national and international experts, a decision was made to mandate the Wildlife Institute of India (WII), Dehradun with the task of developing and implementing this status assessment every 4 years under direction of the NTCA and in collaboration with State Forest Departments and civil society NGO's.

This decision was based on a pilot study conducted by the WII in a large landscape (Satpura-Maikal> 20,000 sq. km in MP) wherein they had developed protocols that combine simple yet scientifically robust protocols for data collection by field forest staff in combination with rigorous statistically sound methods like camera trap based capture-mark-recapture models implemented simultaneously by trained wildlife biologists. This approach was found to be best suited for Indian field conditions wherein the field staffs provide a large manpower for survey across the 400,000 sq. km of tiger bearing forests in 18 Indian States. It was hypothesized that tiger population distribution and abundance would be determined by;

1. Habitat characteristics
2. Prey availability
3. Anthropogenic pressures

Three cycles of national tiger status assessments (2006, 2010, and 2014) have already been conducted and the results have been wildly publicized by media, used by scientists and incorporated into conservation policy and management actions. The national status assessment exercise has successfully addressed all of the objectives listed above and provides details of tiger population size, extent, covariates of prey, co-predators, habitat and human impacts. The tiger population in India has been observed to increase at a rate of about 5.8% per year since 2006.

Though the conceptual methodology has remained the same since 2006, the NTCA and WII have kept pace with latest scientific developments in the field of animal abundance estimation and used the best available science to evaluate tiger status. For the national status assessment 2014, Spatially Explicit Capture Recapture (SECR) in a joint distribution likelihood approach with ecologically relevant covariates was used.

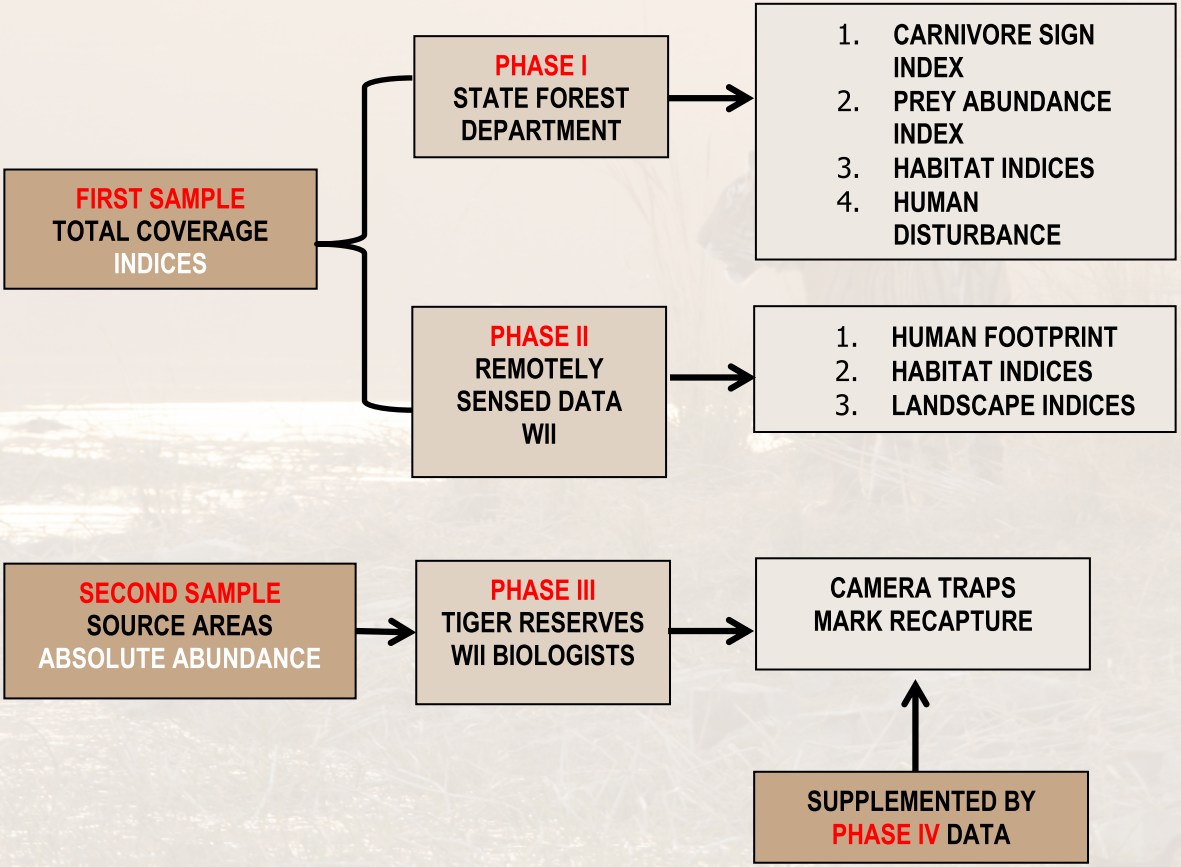
This approach consist of two samples, the first sample is collected by the forest staff of 18 tiger states and is constituted by structured protocols that are easy and economical to generate information on tiger presence and relative abundance, along with information on prey, co-predators, habitat and human impacts. The second sample is carried out by trained wildlife biologists who collect information using camera traps on tiger, leopard and prey abundance using SECR and Distance sampling. Individual tigers and leopards are identified using customized software that uses the stripe and spot patterns (akin to human fingerprints) to identify individuals.

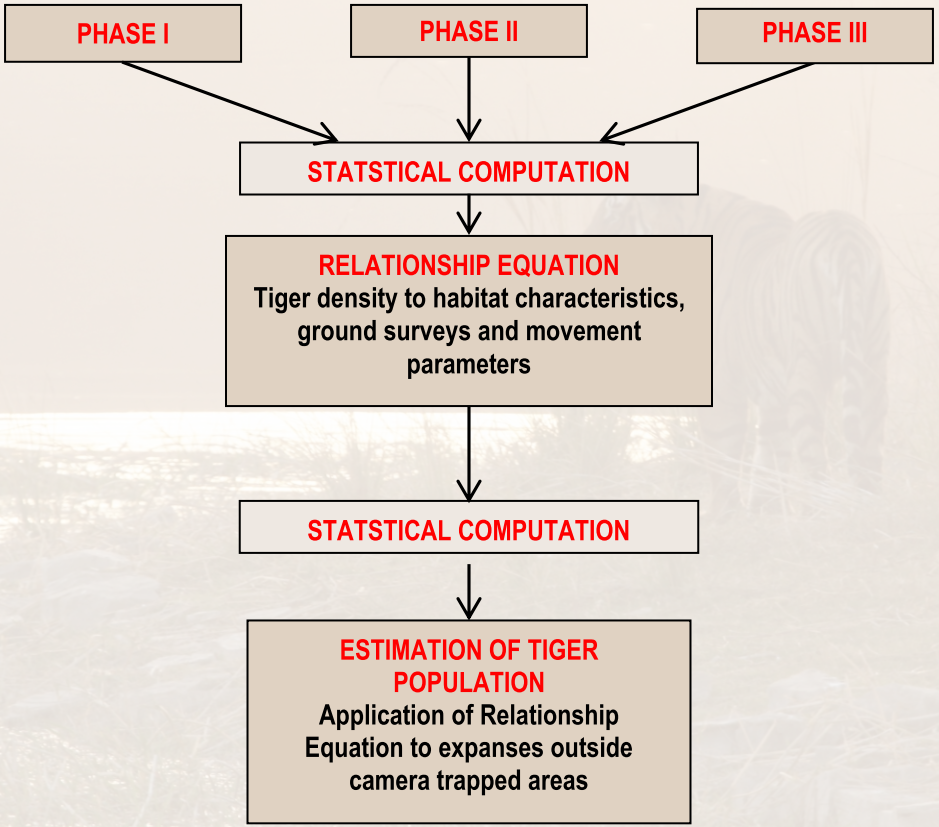
There has been an organic evolution to adopting the Spatially Explicit Capture Recapture (SECR) protocol, from ad hoc approaches like the half MMDM (mean of maximum distance moved) method, wherein tiger density was calculated by dividing the estimated population size by the effective trapping area which in turn was estimated by adding a buffer strip of half the mean maximum distance moved by recaptured tigers to the trapping grid.

In 2014, over 70% of the estimated tiger population was through camera trapping where photographs of 1686 individual tigers were obtained. The remaining 30% of the tigers from areas that had tigers but were not camera trapped were estimated by using models in Spatially Explicit Capture Recapture (SECR) where ecological covariates of prey, habitat, and human impacts along with movement parameter of tigers were used in a joint likelihood framework. This has enabled India to obtain tiger reserve/source area specific tiger densities.

The double sampling approach has proven its worth on account of its robustness as it incorporates ground reality (anthropogenic influences on tiger, co-predator, and prey and habitat status), its uniformity across landscapes, its amenability to temporal comparison, besides being based on primary data collected from the field unlike theoretical spatial models. The All India Tiger Estimation involves application of field craft and science for easy field practice by frontline forest personnel.

OUTLINE OF THE DOUBLE SAMPLING FRAMEWORK




PHASE I
PHASE II
PHASE III
STATSTICAL COMPUTATION
RELATIONSHIP EQUATION
Tiger density to habitat characteristics, ground surveys and movement parameters
STATSTICAL COMPUTATION
ESTIMATION OF TIGER POPULATION
Application of Relationship Equation to expanses outside camera trapped areas

PHASE - I

Phase I consists of the following steps;

Carnivore Sign Survey

1. **Carnivore sign survey**
   a. 5 kms walk each day for 3 days in a beat (Total effort 15 kms)
   b. To be done by field forest staff
   c. Signs of carnivores are recorded
   d. Occupancy estimation is carried out based on tiger signs recorded using program PRESENCE
2. **Transect marking**
   a. Transects are marked over a period of 2 days
   b. One transect per beat or more in case of different habitat types (grassland, woodland etc.) and extent of area
   c. Each transect should be minimum 2 kms in length
3. **Transect walking**
   a. Done for 3 days, early in the morning at dawn (0630 hours to 0830 hours)
   b. On return walk, pellet densities using a belt transect and vegetation data and human disturbance on plots, has to be recorded only on one day
   c. Data is analysed using program DISTANCE

The data so collected are attached to the beat and then to a grid of suitable size (100 sq km for landscape level analysis) in GIS domain, by the NTCA Tiger Cell at WII.

Transect for Ungulate Encounters

Vegetation Plot for Habitat Mapping

Belt Transect for Pellet Densities

PHASE - II

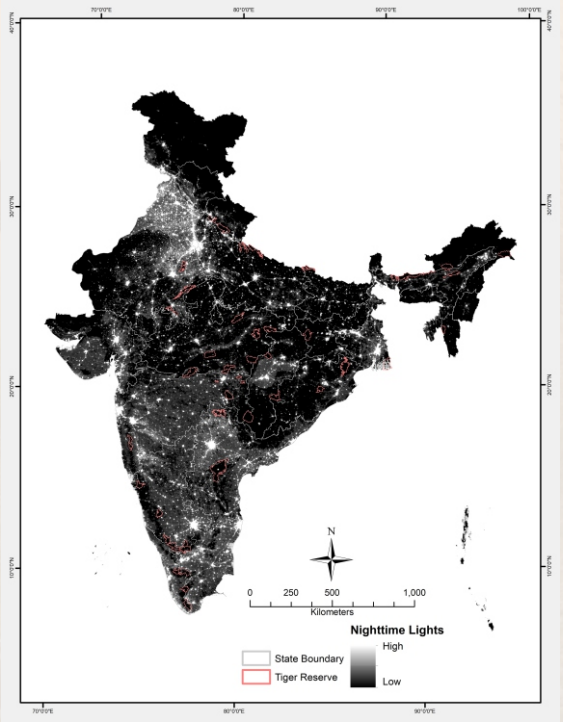
In this phase, following remotely sensed data are collected by the NTCA Tiger Cell from which secondary information is derived for landscape characterization.

Primary data;

1. Human footprint Data from SEDAC (Socioeconomic data and applications Centre) is utilized
2. NDVI (Normalized Difference Vegetation Index) from MODIS (Moderate Resolution Imaging Spectroradiometer)
3. Forest cover maps from Forest Survey of India (FSI)
4. Digital elevation model derived from Shuttle Radar Topographic Mission (SRTM)
5. Human and livestock population data from Census department, Ministry of Home Affairs
6. Road network map of India from Survey of India
7. Drainage data (rivers and water bodies) from Survey of India

Secondary data;

1. Distance from human settlement/ night lights
2. Forest patch area calculation
3. Distance from inviolate areas like PAs



Software used for the above GIS analysis includes Arc GIS, QGIS, Fragstats, Geo Spatial Modelling Environment, besides others.

This information is extracted to beat and grid level in GIS domain by the NTCA Tiger Cell at WII.

PHASE - III/IV

Phase III and IV involve intensive camera trapping, carried out as follows;

1. Based on tiger signs obtained during the carnivore sign survey, camera traps are placed in the field in a grid of 2 sq kms for a period of 25 days (closure period). In this regard, Phase IV exercise (of 2017-2018) shall be merged with the All India Tiger Estimation, as per protocol decided.
2. Individual tigers are identified using software Extract-Compare.
3. Tiger abundance is estimated using mark recapture framework, where,

N (Tiger population) =c (Unique individuals captured)/ p (Detection probability)



Courtesy : Field Director, Navegaon - Nagzira

4. Since, the 2010 estimation, Spatially Explicit Capture Recapture (SECR) models are being used for precise estimation of tiger densities in program R.
5. In areas where it is not possible to undertake camera trapping, due to very low tiger number or unfavourable law and order conditions, scat samples of tigers and other carnivores are collected in expedition mode to estimate minimum numbers through genetic analysis. This information can be used along with opportunistic camera trap photos to model suitable tiger habitat using program MaxEnt (Maximum Entropy models)
6. In areas like the Sundarbans, the traditional camera trap based mark-recpature is tailored to local conditions by making use of lures and ensuring geographical closure of the sampled area by channels wider than 1 km as tigers have shown avoidance for the same.

DEVELOPMENT OF RELATIONSHIP EQUATION (BETWEEN TIGER DENSITIES AND COVARIATES)

1. Exploratory analysis is used with each covariate to infer relationship and arrive at an equation using multivariate regression
2. Information Collected from Phase I data, remotely sensed data from Phase II as well as data from camera traps from Phase III/IV is used to determine relationship between tiger densities and covariates.
3. The basic concept for this relationship is of the following form;

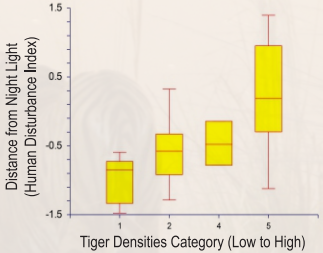
   y=a+bx

   where, y= is the tiger density (Dependent variable)

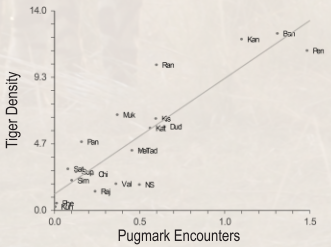
   a= Intercept

   b= Regression coefficient of the covariate

   x= Covariate (Explanatory variable)

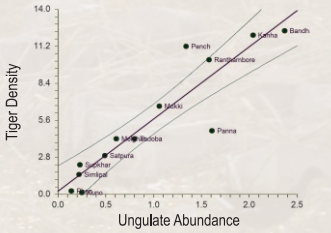


4. As there may be several covariates that impact tiger densities, such as forest cover and NDVI, night lights and human trails, etc., which may be correlated, they are reduced to a few key ones using Principal Component Analysis using software like R and SPSS (Statistical Package for Social Sciences)



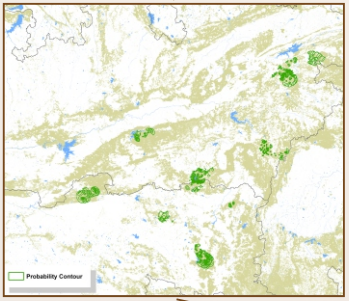
5. Tiger density function is modelled as a function of covariates such as tiger sign, prey, human disturbances etc., using SECR model in a joint likelihood framework

6. Based on the estimates of the joint distribution likelihood model, tiger numbers outside camera trapped area (tiger occupied areas, but which are not camera trapped) are estimated.

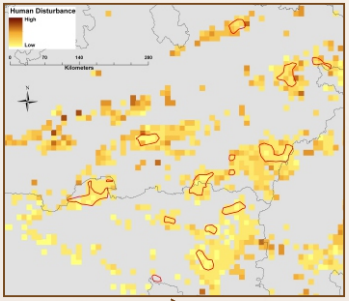


JOINT DISTRIBUTION LIKELIHOOD MODEL

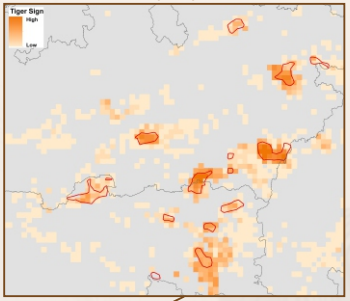
Probability Contour



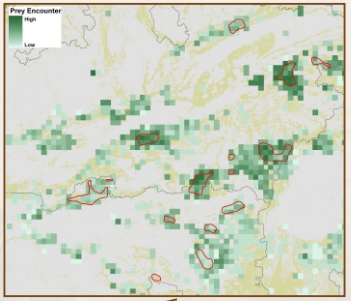
Human Disturbance

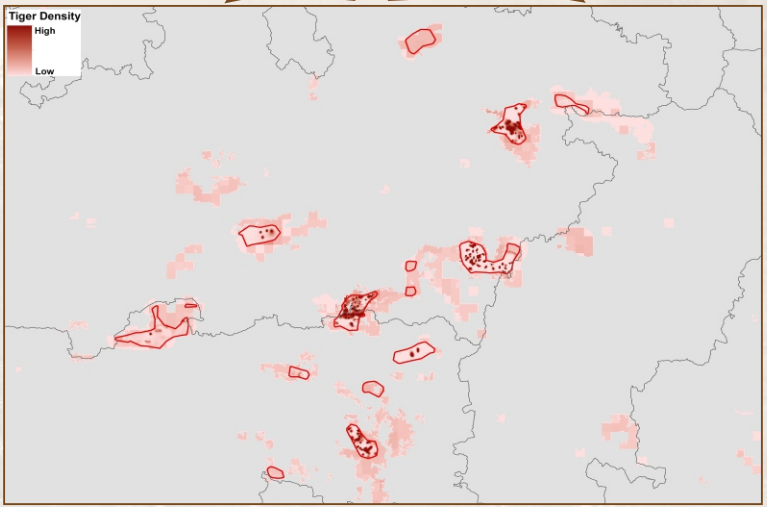


Tiger Sign



Prey Encounter





Tiger Density

SELECT REFERENCES

1. 2005, *Joining the Dots,* Union Ministry of Environment and Forests (Project Tiger), pp 70-79
2. 2011, *Status of Tigers, co-predators and prey in India*, Jhala, Y.V., Qureshi, Q., Gopal, R., National Tiger Conservation Authority and Wildlife Institute of India.
3. 2011, *Can the abundance of tigers be assessed from their signs?* Journal of Applied Ecology, 48, pp 14-24, Jhala, Y.V., Qureshi, Q., Gopal, R.
4. 2013, *Field Guide, Monitoring Tigers, co-predators, Prey and their Habitats*, National Tiger Conservation Authority and Wildlife Institute of India.
5. 2015, *Status of Tigers, co-predators and prey in India*, Jhala, Y.V., Qureshi, Q., Gopal, R., National Tiger Conservation Authority and Wildlife Institute of India.

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With inputs from NTCA - WII TIGER CELL

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