



SPEED POST

No. WII/RTI/CPIO/2017-18 (Qtr-II)/13

Dated 04.08.2017

To,

Shri Anupam Tripathi, B-55, Retreat Apartments, 20 IP Extension, Patpargani, Delhi – 110 092 Mob. # 9599349269

Sub.: Information sought under Right to Information Act, 2005- reg.

Your RTI Application dated 24.07.2017, received in this office on 01.08.2017.

Sir,

Please refer to your application cited above under RTI Act, 2005. In this regard, please note that except for point # 1 of your request, rest of the information is not available with WII but is in the domain of NTCA. For answer to your query on point # 1, a copy of the report "Executive Summary: Status of Tigers Co-predators & Prey in India, 2014" is enclosed which has the required information.

If you are not satisfied with the aforesaid reply, you may file an appeal before the First Appellate Authority i.e. "Dr. V.B.Mathur, Director, Wildlife Institute of India, P.B.18, Chandrabani, Dehradun - 248 001, Ph. 0135-2640910" within a period of one month.

Thanking you,

Yours faithfully,

(Dr. Anju Baroth)

CPIO & NO, RTI

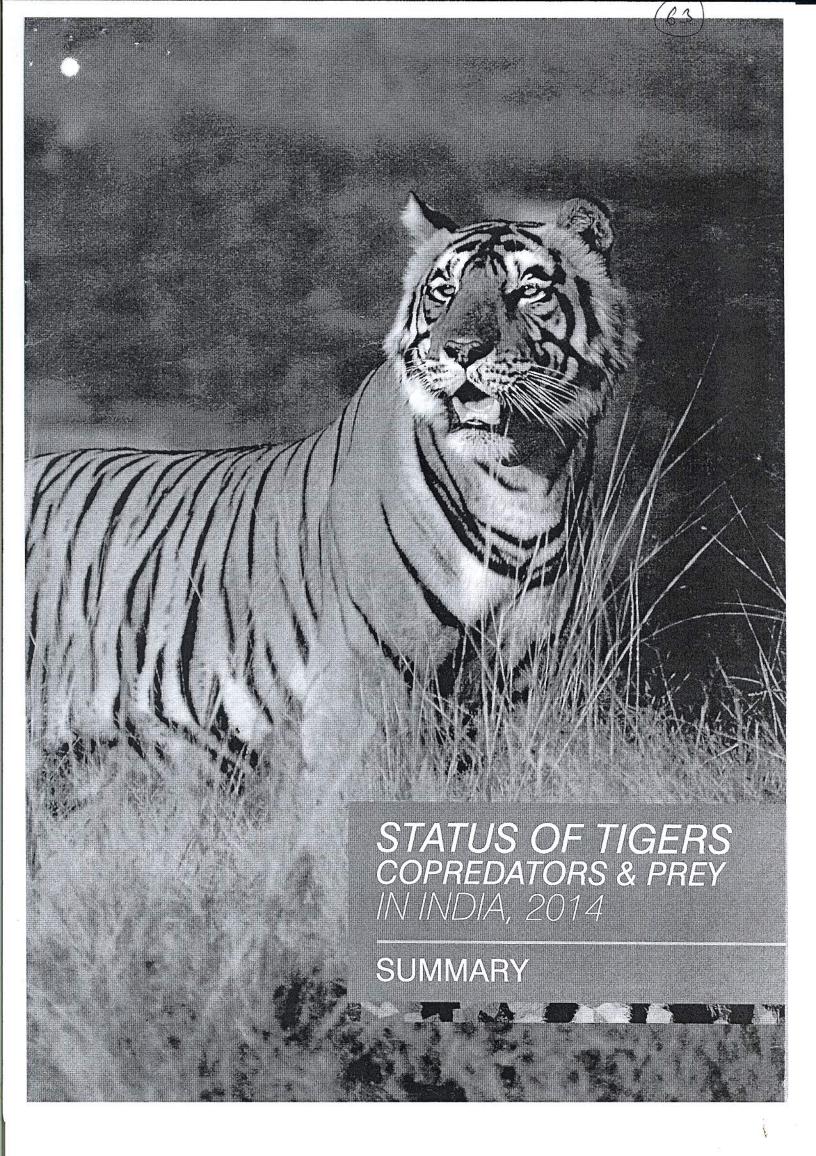
Encl: 18-pages Executive Summary.

पत्रपेटी सं0 18, चन्द्रबनी, देहरादून – 248 001, भारत

Post Box No. 18, Chandrabani, Dehra Dun - 248001. INDIA

ई.पी.ए.बी.एक्स : + 91-135-2640111 से 2640115 फैक्स : 0135-2640117, तार : WILDLIFE EPABX: + 91-135-2640111 to 2640115; Fax: 0135-2640117; GRAM: WILDLIFE

ई-मेल / E-mail : wii@wii.gov.in





मा वनं छिन्धि सव्याघ्रं मा व्याघ्राः नीनशन् वनात्। वनं हि रक्ष्यते व्याघ्रौः व्याघ्रान् रक्षति काननम्।। (महाभारत)

Tigers are a conservation dependent species that represent the health of ecosystems they inhabit.

Mahabharat

© Wildlife Institute of India & National Tiger Conservation Authority

Published by

Wildlife Institute of India
P.O. Box # 18, Chandrabani
Dehradun - 248 001 (Uttarakhand)
p. (0135) 2640111-115; f: 0135-2640117
w. www.wii.gov.in,

The Maps depicted in this report are indicative and relative. The authors are not to be held responsible for their accuracy.

Design and Realisation

Xpressions Print and Graphics Pvt Ltd, 174, Subhash Nagar, Dehradun, #9219552563 Doc. No. XPS080916702

Citation

Y. V. Jhala, Q. Qureshi, and R. Gopal (eds) 2015. The status of tigers, copredators & prey in India 2014. National Tiger Conservation Authority, New Delhi & Wildlife Institute of India, Dehradun. TR2015/021





The tiger is an icon for conservation across forested systems of Asia. The Government of India has used the charismatic nature of the tiger to promote conservation of biodiversity, ecosystem functions, goods and services by launching Project Tiger in 1972 and subsequently using legislation to gazette tiger reserves and by allocating appropriate resources for their conservation. Since 2006 the status of tigers in India is being assessed every four years across all potential habitats in 18 Indian states within the distribution range of the tiger. This document reports the results of the third country wide assessment conducted in 2013-14.

The **methodology** used consists of:

- a) Extensive and intensive surveys at high spatial resolution to determine i) occupancy and distribution of tigers and other predators, ii) distribution and relative abundance of prey species, iii) habitat condition and human impacts;
- b) Remotely sensed information on i) landscape characteristics and habitat condition and ii) human footprint;
- c) Abundance estimation of tigers and leopards through capture-mark-recapture using camera traps and of prey species through distance sampling on line transects. In extremely low tiger density areas or where camera trapping was not logistically feasible (due to militancy or other reasons), we used fecal DNA to determine tiger presence and minimum numbers.

Surveys (a) for occupancy and relative abundance estimation covered about 4,73,580 km² of wildlife habitat with an effort of 6,72,560 km walk on 87,679 spatial replicates for occupancy surveys and 90,750 transects. Habitat condition and human impacts were estimated from 1,63,292 plots sampled on line transects. We deployed remote cameras across 51 sites at 9,777 locations (c) to obtained 30,922 usable photo-captures of tigers and 17,143 photo-captures of leopards. Computer aided comparisons of stripe patterns and rosettes estimated 1686 individual tigers and 1647 individual leopards from these photographs. We used likelihood based spatially explicit capture-recapture (SECR) in a joint distribution framework with covariates of prey abundance, habitat characteristics, and human footprint in package secr (program R), to estimate tiger and leopard abundance within each landscape.

Tigers were **recorded to occupy** 89,164 km² in 2014 in India. Correction for imperfect detection of tigers resulted in a marginal increase in occupancy of 2.4 to 6% over the naïve estimate. Occupancy surveys had high detection probabilities ranging between 0.28 to 0.48. Tiger occupancy was best explained by remote





undisturbed forests with good prey populations. **Tiger population (excluding < 1 year cubs) was estimated to be 2226 (SE range 1945 to 2491) in India (Table 2.1)**. Amongst tiger reserves Corbett had the largest tiger population estimated at 215 (range 169–261) tigers, four tiger reserves (including Bandipur, Nagarhole and Kaziranga) had over 100 tigers. Tiger Reserves accounted for over 70% of all the tigers in India (Table 2.2).

Leopard population in India was estimated to be 7910 (SE range 6566 to 9181) (Table 2.3). The state of Madhya Pradesh had the highest number of leopards at 1817 followed by Karnataka at 1129 leopards. The leopard population was estimated only within forested habitats in tiger occupied states, therefore, it should be considered as a minimum number since leopards, unlike tigers, are also found outside forests. This is the first attempt to estimate leopard abundance at landscape scales. Distribution range and spatial extent of all major mammalian species are provided in the report.

Tiger occupancy and abundance has substantially increased in the **Shivalik Hills and Gangetic Plains landscape**, primarily due to improved status of tigers in the state of Uttrakhand. Rajaji-Corbett tiger population is now contiguous with Dudhwa-Pilibhit population since the intervening forests of Haldwani and Terai Divisions along with new protected areas like Nandhor Wildlife Sanctuary have tiger occupancy and reasonable tiger density. The landscape would benefit from supplementation of tigers in Western Rajaji that will assist in the occupancy of Shivalik forests in Uttar Pradesh and Kalesar Wildlife Sanctuary in Haryana. Maintaining and enhancing trans-boundary corridor connectivity between India and Nepal is an essential element of tiger, elephant and rhino conservation in this landscape. This connectivity is threatened by the new India-Nepal border road and special care is needed to ensure that proper mitigation measures are in place.

Tiger status has improved within the **Central Indian landscape** with an increase in tiger occupancy and numbers. This increase is contributed primarily by the states of Maharashtra and Madhya Pradesh. Indravati Tiger Reserve in Chhattisgarh was assessed for the first time. Sampling was limited to accessible areas of Palamau Tiger Reserve in Jharkhand. Conservation efforts need to focus on tiger populations in Orissa (Simlipal-Šatkosia tiger reserves), Palamau landscape and in Northern Andhra Pradesh (Kawal Tiger Reserve). Sanjay-Guru Gasidas-Palamau landscape holds promise for future expansion of tiger population provided planned conservation investment continues. Tiger populations in Central Indian landscape are highly fragmented and some are quite small in numbers, therefore, their survival is dependent on corridor connectivity. Corridors in this landscape are threatened by developmental activities like mining and infrastructure. Appropriate safeguards and mitigation measures need to be implemented for development projects in this region so as to ensure that corridor connectivity between tiger populations is not compromised. Madhya Pradesh has also taken initiative to provide resources for corridor restoration by implementing corridor specific management plans.

Western Ghat Landscape has maintained its tiger status across all the three states of Karnataka, Kerala and Tamil Nadu. The world's largest tiger population (Nagarhole-Bandipur-Mudumalai-Wayanad-Satyamangalam-BRT) has further increased to about 585 tigers covering 10,925 km². New Protected Areas declared by Karnataka on the boarder of Goa has assisted in tiger dispersal into Goa and their movement further north into Radhanagri and Sahayadri Tiger Reserve. This region needs more conservation focus as it



holds great potential for tiger and biodiversity conservation. It would be timely to consider declaring inter-state tiger reserve between Karnataka, Goa and Maharashtra. There is loss in tiger occupancy in the intervening habitat between Kudremukh-Bhadra and Anshi-Dandeli, threatening to disrupt connectivity between these tiger populations. Populations south of the Palghat gap (Parambikulum-Anamalai, Periyar, and Kalakad Munduntherai) have improved; attention is needed to conserve forest connectivity between these three major populations.

Only select areas were sampled in the North Eastern Hills and Brahmaputra Flood Plains landscape, therefore, tiger occupancy and numbers from this region are minimal estimates. The tiger population in Kaziranga-Karbi Anglong-Paake-Nameri-Orang is the largest source in this landscape (about 163 tigers) and should be managed as a single metapopulation with strategies to address movement corridors between these populations. Dibang and Namdapha were assessed through Scat DNA and opportunistic camera traps and show good promise for tiger and biodiversity conservation but need more conservation investment. Manas-Buxa along with areas of Bhutan landscape have potential for sustaining higher number of tigers and are currently below their carrying capacity. Enhanced protection in this region will help build prey and subsequently tiger population in the long-term. However, the management focus for these Protected Areas should be for forest biodiversity and not become tiger centric, since tiger density in many of these close canopy forests would be inherently low.

The entire **Sundarban tiger reserve** and parts of the Twenty Four Parganas were camera trapped in 2013–14. Tiger population of about 76 (62 to 92 tigers) has remained stable since 2010 and is likely to be near its carrying capacity. Sundarban tiger population is contiguous with that of Bangladesh and transboundary management including anti-poaching strategy and management of ship traffic in specific water channels needs to be implemented for long-term conservation of this unique tiger.

Genetic analysis based on a panel of 11 micro-satellites of 158 tiger individuals from across India has shown that at the country scale the tiger population of the North-East is genetically different. The most unique genetic unit of tigers are from Odisha and these need high conservation priority as their population is on a declining trend. The western-arid zone tigers of Ranthambore-Sariska showed a different genetic composition from those of terai and central Indian tigers with some genetic contribution from both these regions. At the local scale the tiger populations south of the Palghat gap differed from the Northern Western Ghat population. The tigers from Sahyadri (northern Western Ghats) shared their genetic makeup with tigers from central India. This preliminary country scale genetic analysis shall assist in planning reintroduction and supplementation strategies for tigers in the future and to prioritize conservation investments to target unique gene pools.

Reduction in tiger and prey poaching and incentivised-voluntary relocation of human settlements from core areas of tiger reserves have been the primary drivers for the improved tiger status in India. These schemes and activities need continuous resource allocation for ecosystem maintenance and restoration. The implementation of MSTrIPES, landscape scale tiger management plans inclusive of buffer and corridors, and use of green infrastructure for mitigating impacts of development especially on corridors, need to become the norm across India. Tigers are conservation dependent species, political will driven by public opinion to ensure proper resource allocation is essential for their continued survival.







Introduction & Methods

By virtue of being the top predator, the tiger functions as an umbrella species for the conservation of biodiversity in forest systems of Asia. The "Project Tiger", a pioneering conservation initiative of the Government of India, aims to harness this role of the tiger along with the tiger's charisma to garner resources and public support for conserving representative ecosystems. Securing natural systems along with their functions would ensure that their inherent values, goods and services are available for future generations of Indians.

Survival of tigers is dependent on conservation and management efforts. Major threats to tigers are poaching driven by an illegal international demand for tiger parts and products, depletion of tiger prey caused by illegal wild meat consumption, and habitat loss due to the ever increasing demand for forested lands. To gauge the success of conservation efforts as well as to guide management inputs, it is important to estimate where tigers are and how many are there. National Tiger Conservation Authority in collaboration with the State Forest Departments, Conservation NGO's and coordinated by the Wildlife Institute of India conducts a National assessment for the "Status of Tigers, Co-predators, Prey and their Habitat" every four years. The methodology used for this assessment was approved by the Tiger Task Force in 2005. The data and inferences generated by this system not only serve as a monitoring tool but also as an information base for decision making. Many protected areas in India are too small to sustain tigers in the long-term. This dilemma can be addressed by managing these "small" tiger populations as meta-populations, i.e. several small populations and a few large populations all connected with each other, can ameliorate much of the ill effects of small fragmented populations. Many tiger reserves and some Protected Areas serve as source populations of tigers while intervening forested areas act as habitat sinks and corridors. By permitting dispersing tigers to move between different tiger populations long-term persistence of individual populations is enhanced. Thus, the "tiger bearing forests" need to be fostered with protection as well as restorative inputs to ensure their source, sink, and corridor values for long-term demographic and genetic viability of tiger populations.

With the implementation of annual monitoring (Phase 4) of tiger reserves by camera traps as mandated by NTCA, the magnitude of data available for the second, statistically robust abundance estimation part, of the double sampling approach has increased substantially compared to earlier cycles of tiger status assessment. In the current assessment over 70% of the estimated tiger population was actually photo-captured providing a rigorous population estimate for the country. As we demonstrate in this report, continuous monitoring of tiger populations across the country has yielded information on successful conservation management practices. More importantly, the report also highlights places where immediate intervention is required to recover tiger populations by re-evaluating current management strategies.





The countrywide assessment of tiger status uses a double sampling approach to estimate the distribution and abundance of tigers in India. The first component of the double sampling consists of ground surveys (Phase 1) of all potential tiger occupied forests in 18 States (Table 1.1, Fig. 1.1) wherein the ground survey data is collected by the State Forest Department personnel:

State & Landscape Complex Beat	Sampled occupied	Tiger Sampled Beat	No. of Trails with Trails	Sampled Tiger signs	
detected		12			
Bihar	31	27	145	94	
Uttar Pradesh	315	129	712	244	
Uttarakhand	812	361	1810	658	
Shivalik Hills & Gangetic Plains	1158	517	2667	996	
Andhra Pradesh	2409	85	7036	172	
Chattisgarh	3562	97	9595	150	
Jharkhand	19	0	92	0	
Maharashtra	5874	614	17640	1106	
Madhya Pradesh	8580	717	25834	1493	
Odisha	3299	81	10434	135	
Rajasthan	179	84	642	180	
Central Indian Landscape & eastern Ghats	23922	1678	71273	3236	
Goa	105	7	315	10	
Karnataka	2201	506	6819	1106	
Kerala	672	208	2025	411	
Tamil Nadu	1002	206	3214	506	
Western Ghats	3980	927	12373	2033	
Assam	547	95	851	190	
Mizoram	13	3	45	3	
Arunachal Pradesh					
North Bengal	45	23	152	52	
North Eastern Hills & Brahmaputra Flood Plains	605	121	1048	245	
Sundarbans	52	31	318	190	
INDIA	29717	3274	87679	6700	

^{*} From scat DNA

Table 1.1: Country wide effort for ground surveys and camera trap sampling.

[#] From Camera trap and scat DNA



(22)

- Trails surveys for occupancy of habitat patches by tigers and other predators
- 2) Line transects to estimate prey abundance
- 3) Sample plots on the line transects to assess
 - a) Habitat characteristics,
 - b) Human impacts and
 - c) Prey dung density.

and from recent remotely sensed data (Phase 2) following variables

- a) landscape characteristics,
- b) human "foot-print", and
- c) habitat attributes

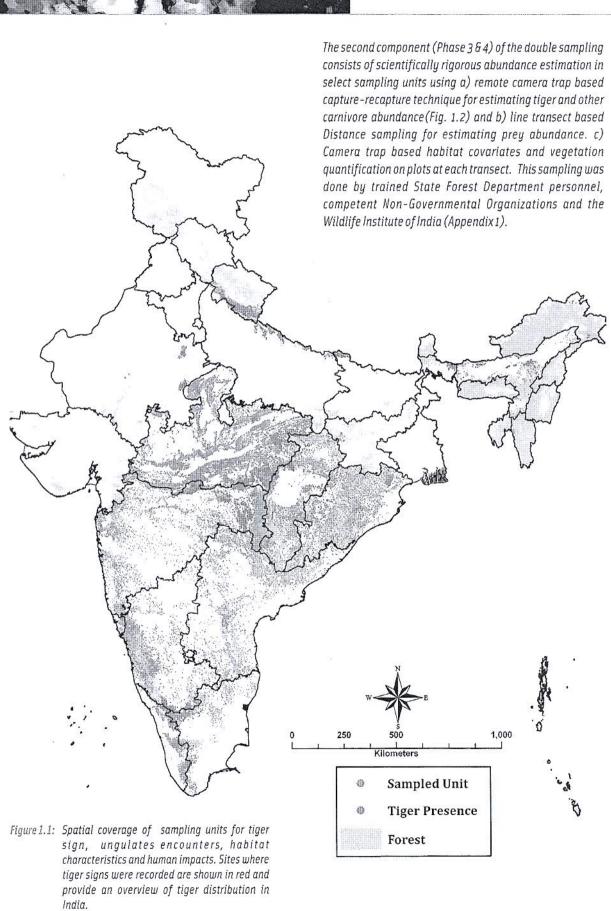
were used to model tiger abundance and occupancy.

Total Length Trails (km)	No. of Transects Walked	Total Length Sampled (km)	No. Plots Sampled	No of Camera Trap Locations	Individual Tigers Photo - captured/DNA ID
830	118	360	854	235	21
3785	683	2107	828	551	92
9755	1592	3575	3503	806	292
14370	2393	6042	5185	1592	396
32635	8436	18811	14883	505	37
45309	9664	23165	15720	0	19#
577	224	448	431	0	3*
91920	18577	46692	31116	1466	144#
145627	26556	64410	53614	2459	292
52550	10071	20910	17742	140	6#
3368	482	1003	1690	863	63
371987	74010	175439	135196	5433	558
1614	348	686	580	42	3*
34910	7200	15676	10620	577	257
11824	2031	4095	3474	399	85
17533	3375	7033	5373	578	189
65881	12954	27489	20047	1554	518
4405	872	3036	2058	806	136
205	39	78	0	0	3*
203	.55			84	15#
1437	164	349	277	0	2*
6047	1075	3462	2335	890	152
812	318	1031	529	266	62
459096	90750	213464	163292	9777	1686













For site or Reserve-wise analysis, the Initial Encounter Frequency (No), Scale parameter (O) and Density (D) are estimated for the Effective Sampled Areas (ESAs), which are larger than the individual protected areas. The parameter estimates for Bandipur correspond to the combined area of Magarahole, adjacent reserve forests and Wayanad-Tholpetty. The parameter estimates for Bandipur correspond to the combined area of Bandipur and adjacent Wayanad-KSBM. The parameter estimates for Bhadra correspond to Bhadra reserve and adjacent reserve forests and coffee plantation matrix. The Population Estimate

assumption was assessed in CAPTURE.

Spatial models of capture-mark-recapture (Spatially Explicit Capture Recapture - SECR) under a Bayesian framework using Markov-Chain Monte Carlo (MCMC) methods, implemented in program SPACECAP version 1.1.0 (Gopalaswamyet al. 2012). The models were run using 60000-70000 iterations (with initial burn-in of 20000-30000 values) and thinning rate for chains was set to 1. The augmentation value provided was 5-10 times the number of individuals used for analyses (Mt+1). Geweke diagnostic scores (Geweke 1992) built into program SPACECAP was used to check for convergence of chains. Violation of closure

(CWS). The site specific analysis for these sites was done as per the following section:

At Anshi-Dendeli, Bhadra, Nagarhole, Bandipur, and Biligiri Rangaswamy Tiger Reserves and at sites in Goa, and Wayanad Wildlife Sanctuary, the Phase 4 monitoring was done by Wildlife Conservation Society (WCS) and Center for Wildlife Studies

developed for that landscape in SECR.

Abundance Analysis: Camera traps were placed at 9,777 locations over 51 sites for mark recapture analysis (Table 1.1, Fig 1.2). Tiger/leopard photographs obtained from camera traps were digitized and analyzed using the program Extract-Compare (Hiby et al. 2009) and HotSpotter (Crall et al. 2013), a pattern recognition program specially developed to individually identify tigers and other animals from their coat pattern. We used likelihood based spatially explicit capture-recapture (Efford 2011, Brochers & Efford 2008) to estimate tiger and leopard abundance from camera trap data. Tiger and leopard sign abundance, habitat characteristics, prey availability and human footprint variables obtained from the ground surveys and remotely sensed data were used within SECR as covariates in a joint likelihood to model tiger density in program R. Covariate based abundance models were developed for each landscape to estimate tiger abundance within tiger and leopard occupied forests. Tiger/leopard population estimates from camera trapped areas were obtained from SECR, while in areas where tigers and leopard best covariate models were developed but the area was not camera trapped, their numbers were estimated using the best covariate model leopards were detected but the area was not camera trapped; their numbers were estimated using the best covariate model

in a spatiał framework. Key features of the sampling design are outlined below.

The data is also amenable to analysis in a non-spatial framework and can be used for conventional mark-recapture analysis. However, it should be noted that the reverse is not true, i.e. data collected without relevant spatial information cannot be used

or "location" information of animal photo-captures and camera deployment.

Camera trap surveys are now a well established methodology for abundance/density estimation of elusive carnivores. Development of Spatial capture-recapture methods have led to greater clarity in density estimation by integrating the spatial

Abundance estimation of carnivores by camera trap surveys.

carnivores and herbivores.

Detection probability of tiger sign was likely to be a function of tiger abundance and was therefore modelled with tiger sign encounter rate as a covariate. Model selection and occupancy estimation was done in program PRESENCE (MacKenzie et al. 2006) using AIC. This analysis helps in understanding spatial extent of tiger populations, factors that influence tiger distribution and habitat connectivity between tiger populations. Naive estimates of occupancy were also arrived at for major

accounted for imperfect detections (Yumnam et al. 2014).

Data from replicate ground surveys (phase 1) were transferred to 10 x 10 km grids in a Geographic Information System. Since data from habitat, prey, and human foot print were likely to be correlated, we extracted principal components (PC's) from all covariates used in modeling occupancy of tigers. The PC's were then used as covariates to modeling occupancy of tigers. The PC's were then used as covariates to modeling occupancy of tigers.

Occupancy Modelling





(N) for the Protected Area in each case refers to the estimated population size strictly within the administrative boundaries of the respective protected areas.

Camera trap data from the WCS and CWS sites along with data from all the other collaborators (WWF, AARANYAK, WCT, WRCS and State Forest Departments) were provided to WII and used for the landscape scale analysis in joint likelihood framework along with covariates in package secr (Efford 2015) (program R) to estimate tiger density in all tiger occupied habitat.

Genetic Sampling: At sites where it was not possible to undertake camera trapping due to very low tiger numbers or unfavourable law and order conditions, scat samples of carnivores were collected to estimate minimum number of tigers through genetic analysis. DNA was extracted from samples and then first screened for species identification using a tiger specific cytochrome-b marker that amplifies a 162 base pair fragment. Tiger positive samples were confirmed after samples were run along with a positive and negative control. Tiger positive samples were subsequently identified to individual tigers using a panel of 11 microsatellite markers. Details of the methodology and results of this analysis are provided in Chapter 8. Number of individual's tigers was used as an estimate of minimal population size.

Maximum Entropy Models (MaxEnt): In the states of Mizoram and Arunachal Pradesh except Pakke Tiger Reserve, we could not sample with appropriate mark recapture method due to logistic constraints. In these states we used confirmed tiger presence locations from tiger scat (confirmed by DNA profile) and opportunistic camera trap photos to model suitable tiger habitat using program MaxEnt. Minimal tiger density obtained from individually identified tigers within small intensively searched areas was extrapolated to suitable tiger habitat so as to provide a crude estimate of tiger numbers in these states.

Prey density

Distance sampling (Buckland et al. 2001) on foot line transects of 2-4 km was used at several of the sites sampled for phase 3 and 4. Line transects were systematically distributed by sampling each forest beat by one or two transect sample depending on the size and habitat type of the beat (Jhala et al 2013). Each transect was walked with minimum of three temporal replicates mostly in the morning (6:30 to 8:30 am). Data was recorded on 1) species sighted, 2) group size, 3) the number of adult and young in each group 4) radial distance to the center of the group by a laser range finder, 5) bearing of the group using a see through compass, 6) walk bearing of the transect and 7) location of each sighting. Data were subsequently analysed in program DISTANCE verion 6.

For the sites sampled by CWS and WCS (Anshi-Dendeli, Bhadra, Nagarhole, Bandipur, and Biligiri Rangaswamy Tiger Reserves and at sites in Goa, and Wayanad Wildlife Sanctuary) systematically designed line transects with square sampler geometry applicable to large terrestrial herbivores (Buckland et al. 2001; Karanth, Thomas & Kumar 2002) were marked and sampled to uniformly cover the area sampled. Each of the square transect was walked twice a day for a two hour duration (Morning walk was from 0600 to 0800 hours; Evening walk was from 1600 to 1800 hours). The temporal replicates ranged between 4 to 6 walks for each transect.

For phase 1 transect data, that was conducted across all tiger habitats, data on animal bearing and radial distance of sighted groups using a range finder were not collected. Thereby, providing information only on encounter rates of prey.

Analysis

Program DISTANCE version 6.0 was used to carry out all analyses. We first carried out exploratory analyses of the data to look for evidence of evasive movement prior to detection, 'rounding' and 'heaping' of data, and to truncate outlier observations to improve subsequent model-fitting. Detection probabilities were then estimated based on models of the detection process fit to the data. If the key function did not fit the data adequately, cosine adjustment terms were added sequentially to improve the fit. The fit of possible alternative models to each specific dataset was assessed using Akaike's Information Criterion (AIC) values, which trade-off the bias of simple models against the higher variance of more complex models. The goodness-of-fit tests generated by program DISTANCE, visual assessments of the fit of the proposed model to the observed distance data close to the transect line and the precision of estimated detection probabilities also helped guide model selection. Using the selected model in the program DISTANCE, the estimates of the following parameters were generated: group encounter rate (n/1), where n is the total number of clusters detected and l the total length of transects walked; probability of detection between the transect and truncation distance (P); effective strip width (ESW); cluster density (Ds); expected cluster size (Es)





and animal density (D). As there can be a tendency to detect relatively larger than smaller clusters farther away from the line, we expected the average of our cluster sizes to be a (positively) biased estimate of mean cluster size. We tested for this bias by assessing if the slope of a regression of log cluster size against detection probability was significantly different from zero (at an P of 0.15). If the regression was found to be significant, the average cluster size was corrected using the estimated slope parameter. Variance of mean density was estimated as a composite of the variances of group size, encounter rate and the probability of detection (Jathanna et al. 2008). Site-specific sampling efforts together with the parameter estimates are described in individual site sections.

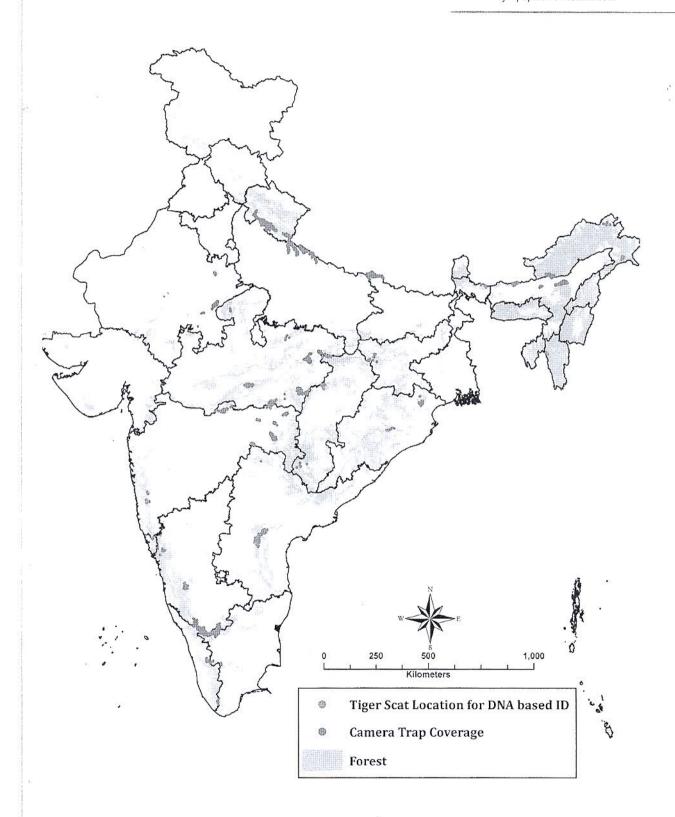
© Nilanjan Chatterjee







Figure 1.2: Camera trap locations and tiger scat locations (DNA based ID) for population estimation.







Results at a Glance

A total of 4,73,580 km² of forests in 18 tiger states were surveyed (Table 1.1, Fig.1.1). An unprecedented effort was invested in camera trapping and scat collection of tigers across India (Fig. 1.2) by a combined effort of Tiger Reserves managers, NGO partners and WII resulting in Photo Capture of 1686 tigers and 1647 leopards.

Tigers were observed to have expanded their occupied area substantially in the Shivalik-Gangetic plains with the overall habitat occupancy of 89,164 km² in India (Table 2.1; Fig. 1.1).

Table 2.1: Estimated tiger numbers (>1.5 years of age) and area occupied by tigers in 2014 for landscapes and States compare with estimates for 2006 and 2010. Numbers in parenthesis are standard error limits.

State		Tiger Population			Tiger km²	
	2006	2010	2014	2006	2010	2014
Shivalik Hills & Gangetic Plain La	ndscape					
Uttarakhand	178 (161-195)	227 (199-256)	340 (299-381)	1,901	3,476	6,576
Uttar Pradesh	109 (91-127)	118 (113-124)	117 (103-131)	2,766	2,511	2,519
Bihar	10 (7-13)	8	28(25-31)	510	750	922
Shivalik-Gangetic	297 (259-335)	353 (320-388)	485 (427-543)	5,177	6,737	10,017
Central Indian Landscape and Eas	tern Ghats Landscape					
Andhra Pradesh	95 (84-107)	72 (65-79)	68 (58-78)	14,126	4,495	4,686
Chattisgarh	26 (23-28)	26 (24-27)	46 (39-53)*	3,609	3,514	4,735
Madhya Pradesh	300 (236-364)	257 (213-301)	308 (264-352)*	15,614	13,833	15,156
Maharashtra	103 (76-131)	168 (155-183)	190 (163-217)*	4,273	11,960	11,643
Odisha	45 (37-53)	32 (20-44)	28 (24-32)*	9,144	3,398	3,981
Rajasthan	32 (30-35)	36 (35-37)	45 (39-51)	356	637	1,147
Jharkhand	⊕ 0	10 (6-14)	3*	1,488	1,180	626
Central India	601 (486-718)	601 (518-685)	688 (596-780)	48,610	39,017	41,974
Western Ghats Landscape						
Karnataka	290 (241-339)	300 (280-320)	406 (360-452)	18,715	14,414	14,523
Kerala	46 (39-53)	71 (67-75)	136 (119-150)	6,168	6,804	7,137
Tamil Nadu	76 (56-95)	163 (153-173)	229 (201-253)	9,211	8,389	7,229
Goa	70	75	5*			622
Western Ghats	402 (336-487)	534 (500-568)	776 (685-861)	34,094	29,607	29,511
North Eastern Hills and Brahmap	utra Flood Plains					
Assam	70 (60-80)	143 (113-173)	167 (150-184)	1,164	2,381	3,848
Arunachal Pradesh	14 (12-18)	×	28*	1,685	1,304	1,169
Mizoram	6 (4-8)	5	3*	785	416	100
Northern West Bengal	10 (8-12)	2	3*	596	799	704
North East Hills, and Brahmaputr	a 100 (84-118)	148 (118-178)	201 (174-212)	4,230	4,900	5,821
Sunderbans	*	70 (64-90)	76 (62-96)	1,586	1,645	1,841
TOTAL	1,411 (1,165-1,657)	1,706 (1,507-1,896)	2,226 (1,945-2,491)	93,697	81,906	89,164

^{*} From camera trap data and scat DNA



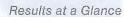




Table 2.2: Population estimates of tigers in tiger reserves in the year 2014.

Tiger Reserve	State	Tiger Population	Lower 5E Limit	Upper SE Limit	
Achanakmar	Chhattisgarh	11	10	12	
Annamalai	Tamil Nadu	13	11	14	
Bandhavgarh	Madhya Pradesh	63	55	71	
Bandipur	Karnataka	120	107	134	
Bhadra	Karnataka	22	20	25	
B R Temple	Karnataka	68	60	75	
Bor	Maharashtra	5	3	6	
Виха*	West Bengal	2	2	2	
Corbett	Uttarakhand	215	169	261	
Dampa*	Mizoram	3	3	3	
Dandeli-Anshi	Karnataka	5	3	6	
Dudhwa	Uttar Pradesh	58	46	69	~i
Indravati	Chhattisgarh	12	11	13	
Kalakad-Mundanthurai	Tamil Nadu	10	9		
Kanha	Madhya Pradesh	80	71	90	
Kaziranga	Assam	103	91	115	
Manas	·` Assam	11	9	12	
Melghat	Maharashtra	25	21	30	
Mudumalai	Tamil Nadu	89	79	99	
Nagarahole	Karnataka	101	90	113	
Nagarjunsagar	Andhra Pradesh	54	40	67	
Namdapha	Arunachal Pradesh	11	5	11	
Nameri	Assam	5	. 4	5	(
Nawegoan-Nagzira	Maharashtra	7	4	10	
Pakke	Arunachal Pradesh	7	6	8	
Palamau*	Jharkhand	3	3	3	
Panna	Madhya Pradesh	17	17	17	
Parambikulam	Kerala	19	17	21	
Pench	Madhya Pradesh	43	36	49	
Pench	Maharashtra	35	28	42	
Periyar	Kerala	20	18	22	
Pilibhit	Uttar Pradesh	25	19	30	
Ranthambore	Rajasthan	37	30	41	
Sahyadri*	Maharashtra	7	7	7	
Sanjay-Dubri	Madhya Pradesh	8	7	10	
Sariska	Rajasthan	9	, g		
Sathyamangalam	Tamil Nadu	72	64	9 80	
Satkosia	Odisha	3	2	4	
Satpura	Madhya Pradesh	26	22	30	
Similipal	Odisha	17	14	19	8 II (P-16-
Sunderban	West Bengal	68	57	86	
Tadoba-Andhari	Maharashtra	51			- 1141
Udanti-Sitanadi	Chhattisgarh		44	58	
Valmiki	Bihar	4	3	4	
· withing	DITIUT	22	17	26	

 $[\]star$ Minimum number of tigers recorded through scat DNA, in these cases a standard error on their estimate was not possible.



(h7)

Notable improvements in tiger occupancy have occurred in the states of Uttrakhand, Madhya Pradesh, Goa, and Assam. While tiger population has significantly increased in the states of Uttrakhand, Bihar, Karnataka, Kerala, Tamil Nadu, and Assam. States that require more conservation investments are Odisha and Jharkhand.

Since the current analysis (2014) of tiger abundance was done in a spatially explicit framework, it was possible to provide abundance estimates for individual tiger reserves (Table 2.2). Corbett tiger reserve had the largest population at about 215 tigers, Bandipur, Nagarhole and Kaziranga each had over a hundred tigers, while Mudumalai, Kanha, Sundarban, and Satyamangalam had over 70 tigers each. These tiger reserves are important source populations for their landscapes. The remaining tiger reserves have smaller tiger populations and need to be managed in a metapopulation framework for their long-term survival. In these tiger reserves connecting habitat corridors need to become an integral part for their management strategy. Some reserves like Simlipal, Nagarjunasagar Sri Sailam, Palamau, Sanjay-Dubri, Manas, Buxa, and Kawal are below their potential and require resources and targeted management inputs.

Leopard population in the forested habitats of 14 Indian tiger states was estimated at 7910 (SE range 6566 to 9181; Table 2.3). These estimates are minimal estimates since leopards occur outside of sampled forests as well in each state. For the North East, Phase I sampling was not done and therefore leopard population could not be estimated. The estimates provided in Table 2.3 for the North East Landscape are the number of leopards actually photocaptured. The leopard population for Rajasthan is reported only for the tiger occupied forests i.e. the Ranthambore and Sariska Landscapes. The state of Madhya Pradesh had the largest leopard population followed by Karnataka.

Table 2.3: Leopard population estimates in forested habitats of tiger states.

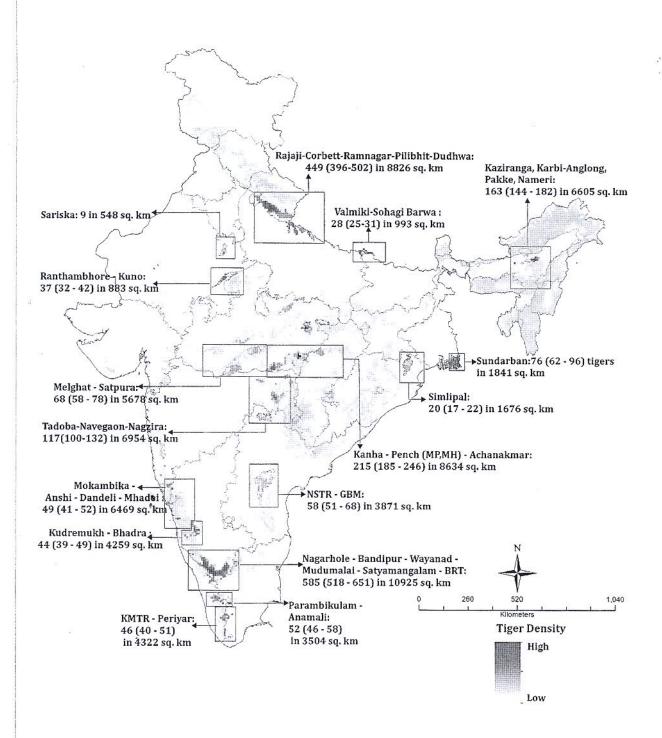
	Shivalik Hills and Gangetic Plains						
	STATE	Population Estimate	Lower SE Limit	Upper SE Limit			
	Uttar Pradesh	194	185	203			
	Uttarakhand	703	633	773 ***********************************			
	Bihar	mal per need my 2 32 mg a	28	37 mil . pr 8 v az mi (187 - 114) 8A			
	Total	929	846	1013			
	Western Ghats						
	Kerala	472	367	577			
	Karnataka	1129	831	1427			
	Tamil Nadu	815	587	1043			
	Goa	71	61	81 (ACC) (VAA-0			
	Total .	2487	1846	3128			
	Central India						
	Andhra Pradesh	343	303	383			
	Chhattisgarh	846	689	1004			
	Jharkhand	30	26	32			
	Odisha	345	296	394			
	Rajasthan	171	138	204			
	Madhya Pradesh	1817	1615	2019			
	Maharashtra	905	807	1004			
	Total	4457	3874	5040			
98	North East *	37	NA	NA			
	Country Total	7910	6566	9181			

^{*}Only the camera trapped number of individual leopards is provided as systemetic Phase I data for covariates across forested habitats was not done in the States of North East India.





Figure 1.3: Tiger density and major population across India.

























XPRESSIONS: 9219552563 Doc. XPS080916702