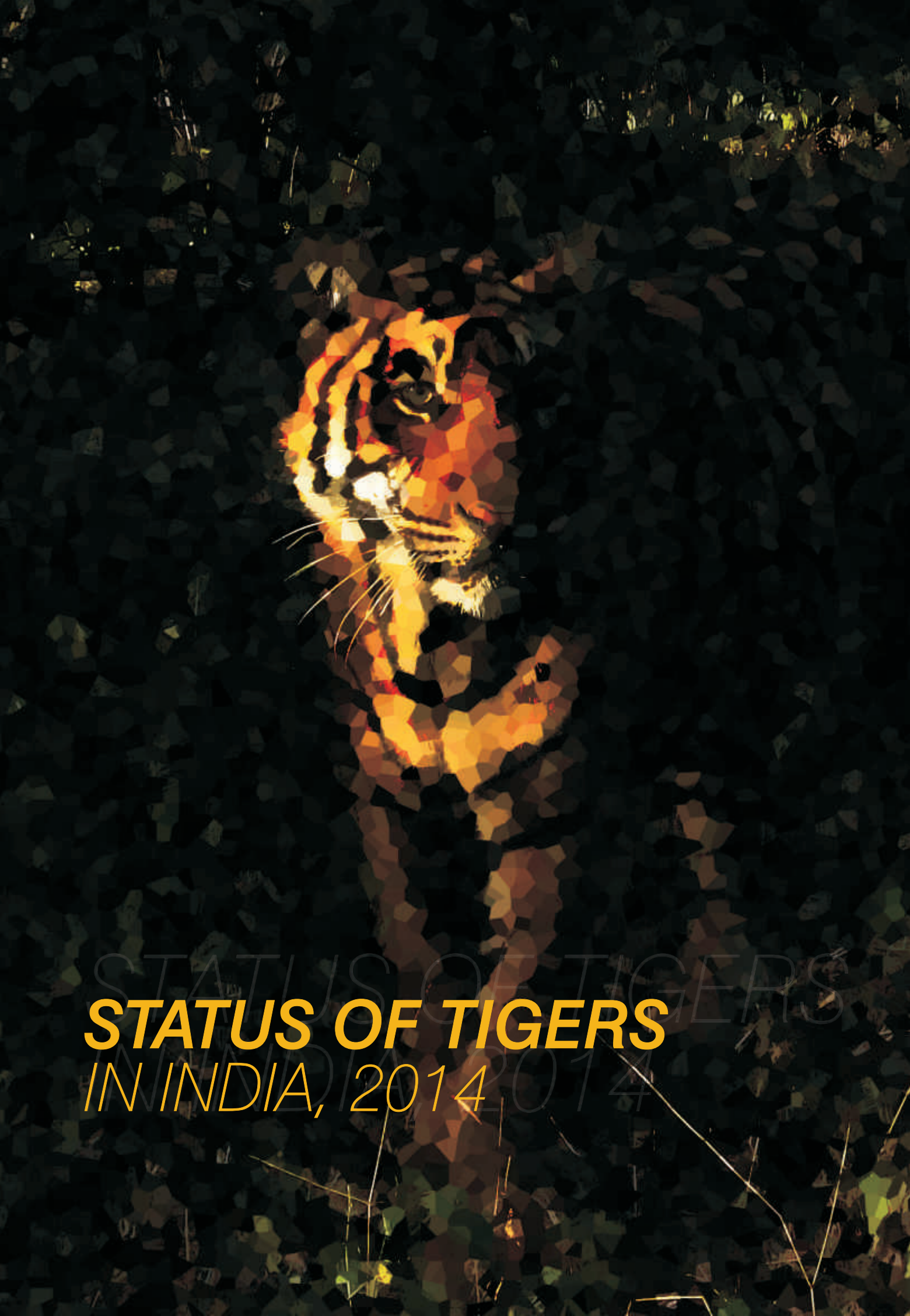


STATUS OF TIGERS
IN INDIA, 2014

Citation

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

This is the third round of the country level assessment of Tigers, Co-predators and Prey, using the refined methodology. As a country having the maximum number of tigers and their source area, India also has the unique distinction of embarking on this refined methodology across all forested habitats and tiger States within the country. The state of the art technology has been put to use, involving remotely sensed data, geographical information system and camera traps, besides extensive ground survey. The latest computer application have been used for obtaining the results.

This science based monitoring and assessment would further strengthen our efforts to conserve our national animal.

I compliment the tiger States, National Tiger Conservation Authority, Wildlife Institute of India and collaborators outside the goverment system for this commendable effort.

Prakash Javadekar
Minister of State (Independent Charge)
Environment, Forests & Climate Change
Government of India

Introduction 01

By virtue of being the top predator, the tiger functions as an umbrella species for the conservation of biodiversity, ecosystem functions, goods, and services 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 tigers' charisma to garner resources and public support for conserving representative intact ecosystems. Securing natural systems along with their functions would ensure that their inherent values, goods and services are available for future generations of Indians.

Tigers are a conservation dependent species. Major threats to tigers are poaching that is driven by an illegal international demand for tiger parts and products, depletion of tiger prey caused by illegal bush 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 have a finger on the pulse of tiger populations and their ecosystems, the National Tiger Conservation Authority in collaboration with the State Forest Departments, National Conservation NGO's, and 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 first assessment based on this scientific methodology was done in 2006 and subsequently in 2010. In 2006, the tiger population was estimated at 1,411 (1,165 to 1,657) which was much lower than the earlier official estimates. This brought about major changes in tiger conservation policy, legislation, and management. Subsequently, these concerted actions resulted in an upward trend in the tiger population as documented by the 2010 population estimates of 1,706 (1,520 to 1,909). However, the 2010 assessment also showed a decline in tiger occupied area. This decline in tiger occupancy was recorded in areas outside of tiger reserves, indicating loss of habitat quality and extent - a crucial element essential for maintaining genetic connectivity between individual tiger populations. To address this vital conservation concern, the NTCA in collaboration with the WII delineated the minimal tiger habitat corridors connecting tiger reserves for implementing landscape scale tiger conservation. Now all tiger reserves manage their tiger populations based on a tiger conservation plan (TCP), which addresses specific prescriptions for core, buffer, and corridor habitats. Herein, we report the summary results of the tiger status assessment done for 2014.

02 Methods

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 of all potential tiger bearing forests in 18 States (table 1) wherein the following information is collected by the State Forest Department personnel:

State	Sampled Beat	Tiger occupied Beat	No. of Sampled Trails	Samples Trails with Tiger Signs detected
Bihar	31	27	145	94
Uttar Pradesh	315	129	712	244
Uttrakhand	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
Maharastra	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 & Bhramaputra Flood Plain	**605**	**121**	**1048**	**245**
Sundarbans	**52**	**31**	**318**	**190**
INDIA	**29717**	**3274**	**87679**	**6700**

1) Ground surveys for determining occupancy of habitat patches by tigers and other predators
2) Line transects to estimate prey abundance
3) Sampling plots on the line transects to assess
   a) habitat characteristics,
   b) human impacts and
   c) prey dung density.

Along with the information generated by ground surveys, latest remotely sensed data on

a) landscape characteristics,
b) human "foot-print", and
c) habitat attributes were subsequently used to model tiger occupancy and abundance.

Total Length trails (km)	No. of Transects Walked	Total Length Sampled (km)	No. Plots Sampled	No of Camera Trap Locations	Individual Tigers Photo-captured
830	118	360	854	235	28
3785	683	2107	828	551	99
9755	1592	3575	3503	806	267
14370	**2393**	**6042**	**5185**	**1592**	**387**
32635	8436	18811	14883	505	34
45309	9664	23165	15720	0	6
577	224	448	431	0	0
91920	18577	46692	31116	1466	116
145627	26556	64410	53614	2459	286
52550	10071	20910	17742	140	6
3368	482	1003	1690	863	51
371987	**74010**	**175439**	**135196**	**5433**	**491**
1614	348	686	580	0	0
34910	7200	15676	10620	577	260
11824	2031	4095	3474	399	87
17533	3375	7033	5373	578	159
65881	**12954**	**27489**	**20047**	**1554**	**464**
4405	872	3036	2058	806	134
205	39	78	0	0	0
				84	15
1437	164	349	277	0	0
6047	**1075**	**3462**	**2335**	**890**	**136**
812	**318**	**1031**	**529**	**266**	**62**
459096	**90750**	**213464**	**163292**	**9735**	**1540***

***Table 1**: Country wide sampling effort for ground surveys, camera trap sampling and number of unique tigers photo captured in each state.*

The second component of the double sampling consists of scientifically rigorous abundance estimation in select sampling units using a) remote camera trap based capture-recapture technique for estimating tiger and other carnivore abundance and b) line transect based Distance sampling for estimating prey abundance. This sampling was done by trained State Forest Department personnel, competent National Non-Governmental Organizations and the Wildlife Institute of India (Table 1 & Fig 1).

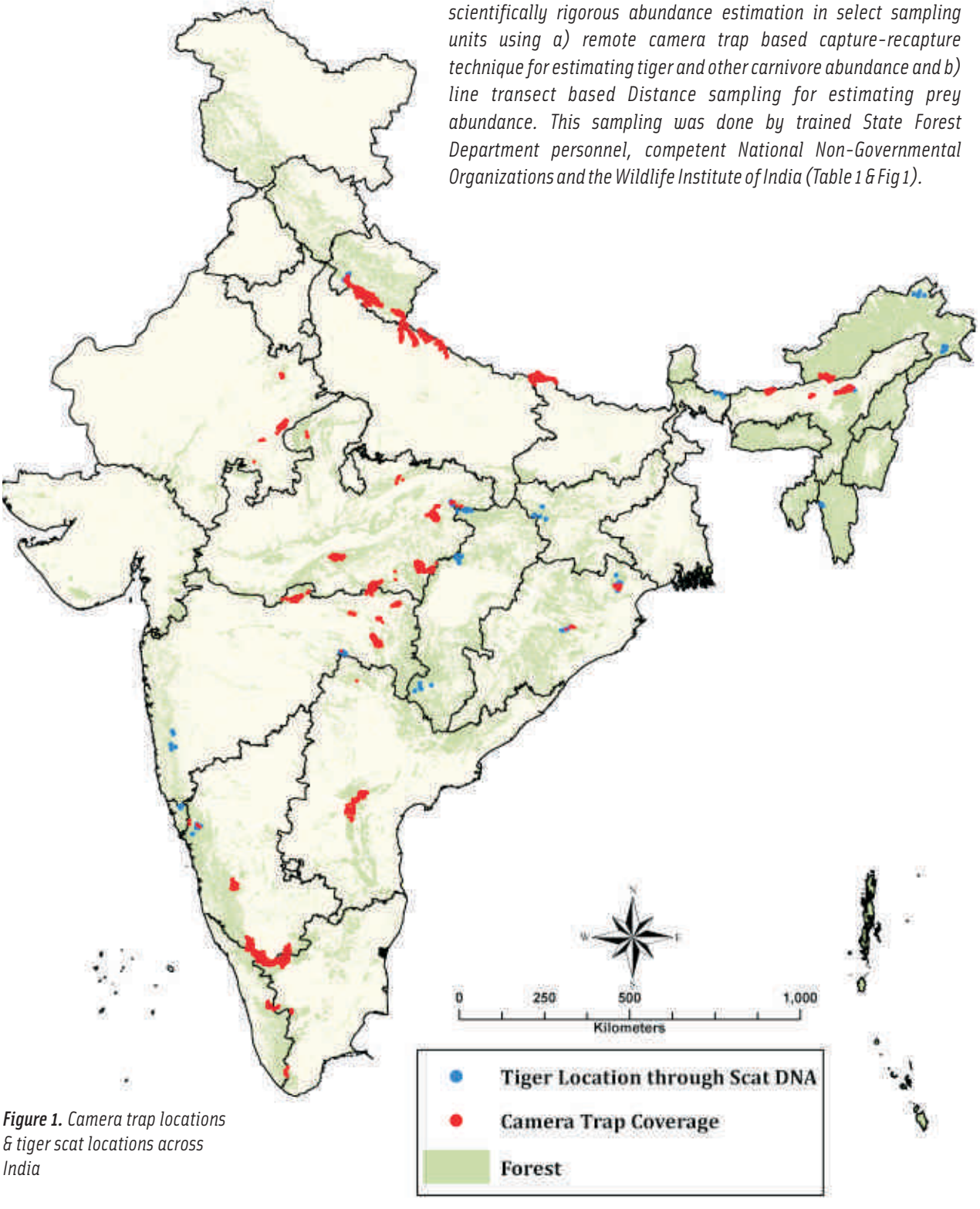


Figure 1. *Camera trap locations & tiger scat locations across India*

Data Analysis 03

Occupancy Analysis : *Data from replicate ground surveys were transferred to 10 x 10 km grids in a geographic information system. Occupancy of a grid by tigers was then modeled as a function of habitat characteristics, prey availability and human footprint while addressing imperfect detection of tiger signs from spatially replicated surveys. This analysis helps in understanding factors responsible for presence of tigers, spatial extent of tiger populations, and habitat connectivity between tiger populations.*

Abundance Analysis: *We use likelihood based spatially explicit capture-recapture (SECR) to estimate tiger abundance from camera trap data. Tiger photographs obtained from camera traps were digitized and analyzed using the program ExtractCompare, a pattern recognition program specially developed to individually identify tigers from their striped coat pattern. We used habitat characteristics, prey availability and human footprint variables obtained from the ground surveys and remotely sensed data within SECR as covariates to model tiger density in program R. Covariate models were then used to estimate tiger numbers across landscapes within tiger occupied forests.*

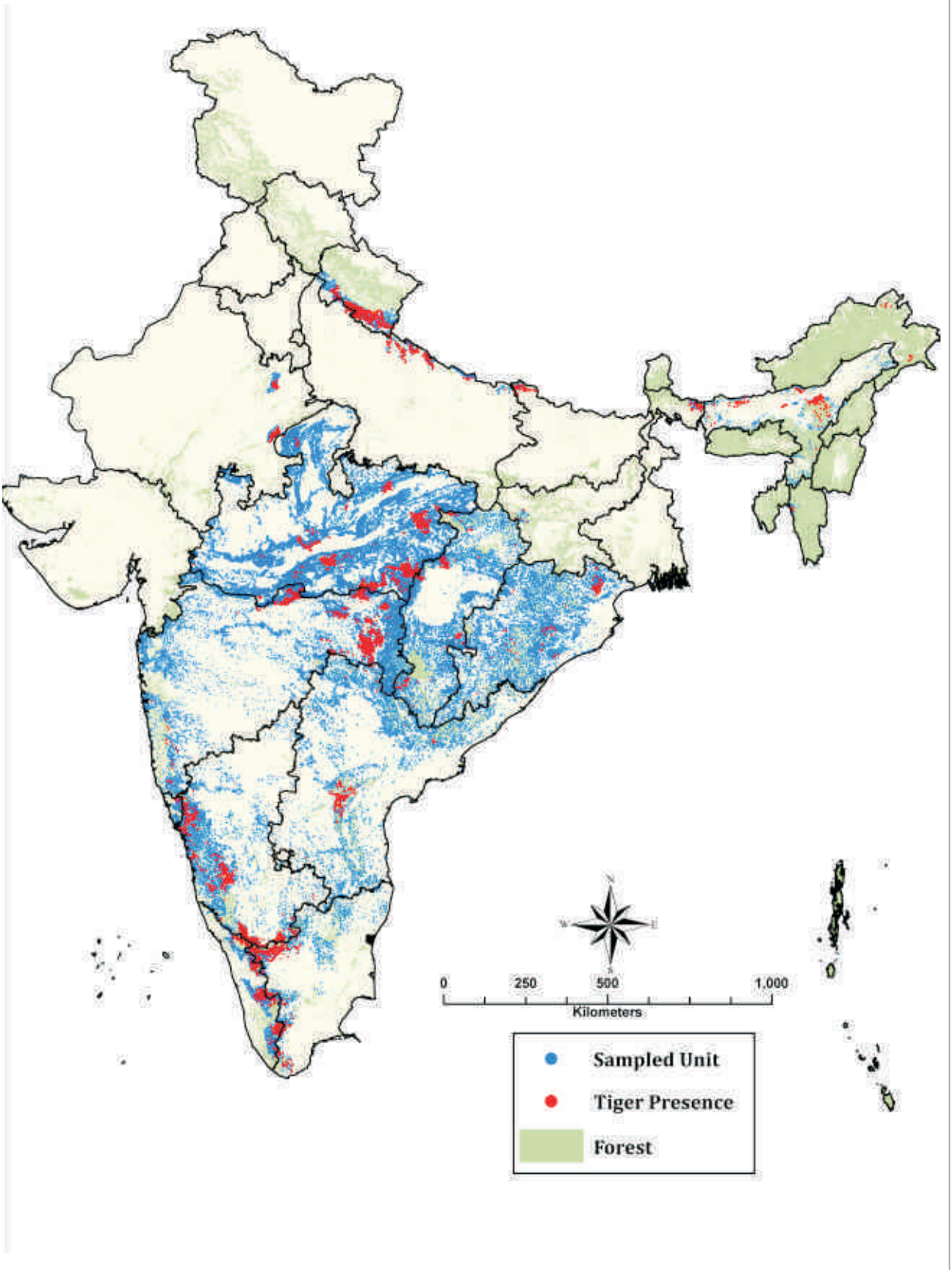
Genetic Sampling: *In areas where it was difficult to sample with camera traps and/or conduct ground surveys, we used non-invasive genetic sampling of tiger scats to detect tiger presence and in some cases the minimum number of tiger individuals. DNA was extracted from scat samples collected from field and identified by a tiger specific mitochondrial DNA marker (cytochrome-b, 162 base pair fragment). Tiger positive samples were subsequently identified to individual tigers using a panel of 11 microsatellite markers.*

Maximum Entropy Models (MaxEnt): *In the states of Arunachal Pradesh and Mizoram we could not infer tiger abundance using robust SECR approach from camera trap data 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 tiger habitat using program MaxEnt. Minimal tiger density obtained from individually identified tigers within small intensively searched areas at these sites were used to provide a crude estimate of tiger numbers in these states.*

04 Results

A total of 3,78,118 km^2 of forests in 18 tiger states were surveyed (table 1, figure 2). An unprecedented effort was invested in camera trapping tigers across India (figure 1) resulting in a total of 1540 unique tigers photo-captures by a consorted effort of Tiger Reserves, NGO partners and WII.

Figure 2. *Spatial coverage of sampling for tiger sign, ungulate encounters, habitat characteristics and human impacts. Sites where tiger sign was recorded is shown and provides an overview of tiger distribution in India.*



The total number of tigers (>1.5 years of age) estimated in India in 2014 was 2226 (1945 to 2491)

State	Tiger Population		
	2006	2010	2014
Shivalik-GangeticPlain Landscape Complex			
Uttarakhand	178 (161-195)	227 (199-256)	340
Uttar Pradesh	109 (91-127)	118 (113-124)	117
Bihar	10 (7-13)	8 (-)	28
Shivalik-Gangetic	***297 (259-335)***	***353 (320-388)***	***485(427-543)***
Central Indian Landscape Complex and Eastern Ghats Landscape Complex			
Andhra Pradesh (Including Telengana)	95 (84-107)	72 (65-79)	68
Chhattisgarh	26 (23-28)	26 (24-27)	46
Madhya Pradesh	300 (236-364)	257 (213-301)	308*
Maharashtra	103 (76-131)	169 (155-183)	190
Odisha	45 (37-53)	32 (20-44)	28
Rajasthan	32 (30-35)	36 (35-37)	45
Jharkhand	-	10 (6-14)	3+
Central India	601 (486-718)	601 (518-685)	688(596-780)
Western Ghats Landscape Complex			
Karnataka	290 (241-339)	300 (280-320)	406
Kerala	46 (39-53)	71 (67-75)	136
Tamil Nadu	76 (56-95)	163 (153-173)	229
Goa	-	-	5
Western Ghats	402 (336-487)	534 (500-568)	776(685-861)
North Eastern Hills and Brahmaputra Flood Plains			
Assam	70 (60-80)	143 (113-173)	167
Arunachal Pradesh	14 (12-18)	-	28*
Mizoram	6 (4-8)	5	3+
Northern West Bengal	10 (8-12)	-	3
North East Hills, and Brahmaputra	100 (84-118)	148 (118-178)	201 (174-212)
Sunderbans	-	70 (64-90)	76 (62-96)
TOTAL	***1,411 (1,165-1,657)***	***1,706 (1,520-1,909)***	***2226(1945-2491)***

* *Likely to be revised as sampling is ongoing in the state*
\+ *From scat DNA*
♣ *From camera trap data and scat DNA*

Table 2 : *Estimated tiger numbers for States and landscapes in 2014 in India compared to earlier estimates reported for 2006 and 2010.*

05 Shivalik-Gangetic Plains Landscape

The State of Uttarakhand has shown a remarkable increase in tiger population and occupancy. Valmiki Tiger Reserve in Bihar too has recorded a substantial improvement in tiger status. In Uttar Pradesh, Pilibhit Tiger Reserve and adjoining areas of Uttarakhand have improved, while tiger status has either showed a slight decline or remained status quo in the protected areas of Uttar Pradesh terai habitat (figure 3).

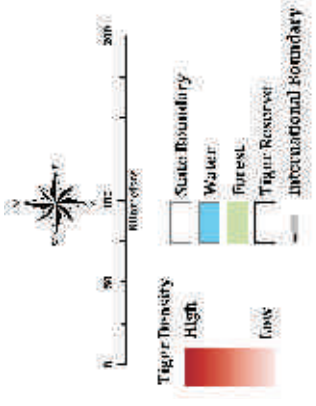


Fig 3. *Tiger density gradient in occupied habitat of the Shivalik-Gangetic Plains Landscape.*

Central Indian & Eastern Ghat Landscape Complex 06

Tiger populations have increased in and around tiger reserves where existing habitat contiguity has permitted dispersing tigers to establish territories and reproduce. Notable improvements are observed in the state of Madhya Pradesh, while tiger populations of Maharashtra and Rajasthan have marginally increased. However northern Andhra Pradesh, most parts of Odisha and Jharkhand continue to loose tiger occupied habitat and tiger abundance has declined (figure 4).

Chhattisgarh has shown an increase, but this is due to a commendable effort in surveying parts of Indravati Tiger Reserve which was assessed for the first time in 12 years by sign surveys and genetic sampling.

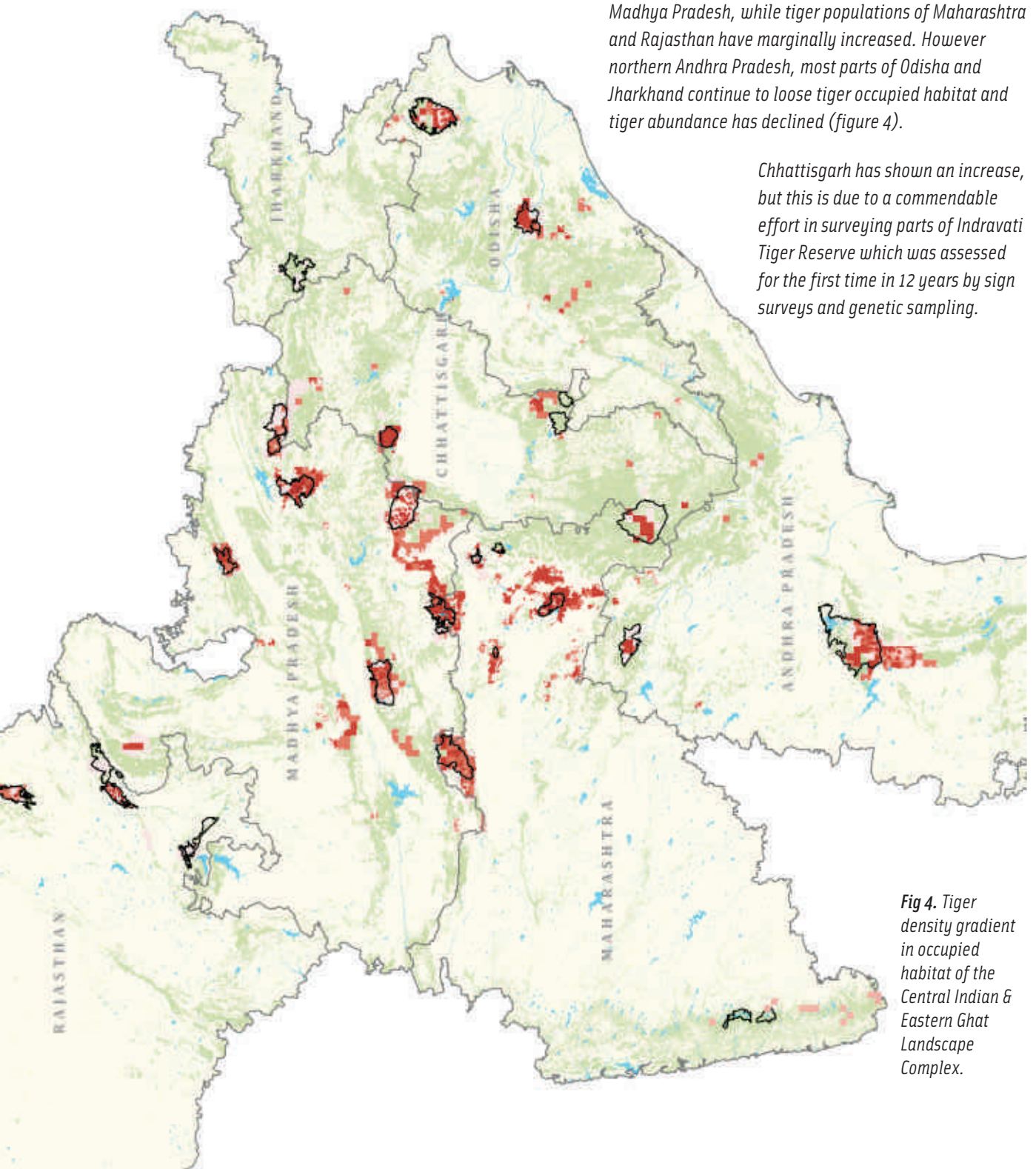


Fig 4. *Tiger density gradient in occupied habitat of the Central Indian & Eastern Ghat Landscape Complex.*

07 Western Ghat Landscape

Tiger population and occupancy has shown a substantial increase within this landscape. States of Karnataka, Kerala and Tamil Nadu have all registered an increase in tiger abundance. Goa now has a persistent tiger presence with about 3-5 tigers. The Mudumalai-Bandipur-Nagarhole-Wayanad complex holds the world's single largest tiger population currently estimated over 570 tigers. The Sahyadri Tiger Reserve has between 5-8 tigers based on scat DNA and model based predictions. The Sahyadri tiger population though a part of the Western Ghat Landscape is accounted for in the Central Indian Landscape in the state of Maharashtra.

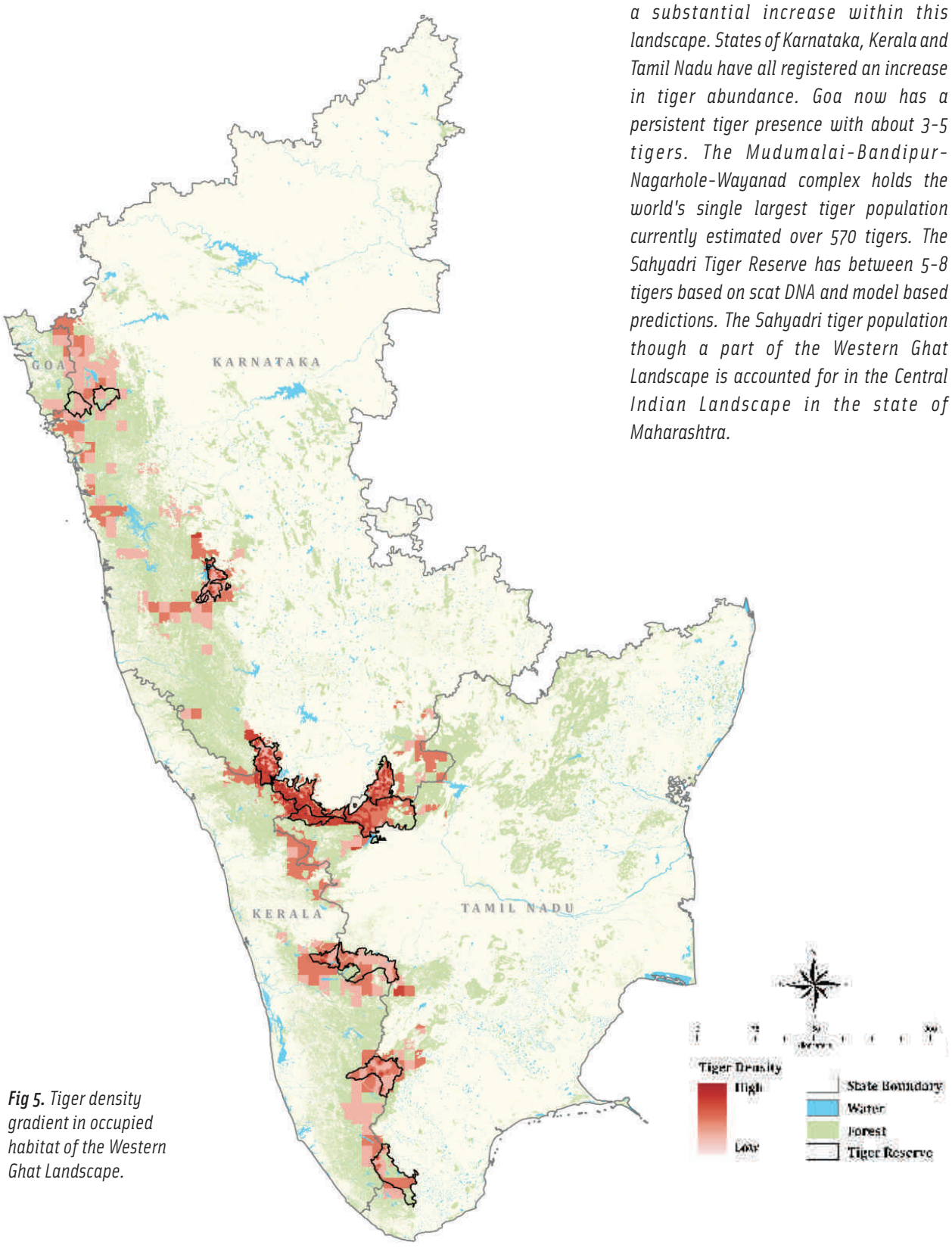


Fig 5. *Tiger density gradient in occupied habitat of the Western Ghat Landscape.*

Sundarbans 08

Tiger population in the Sundarbans has remained stable and is estimated to be about 76 (62 to 96) tigers. Major part of the Sundarbans has now been camera trapped with 62 unique individual tigers photo-captured.

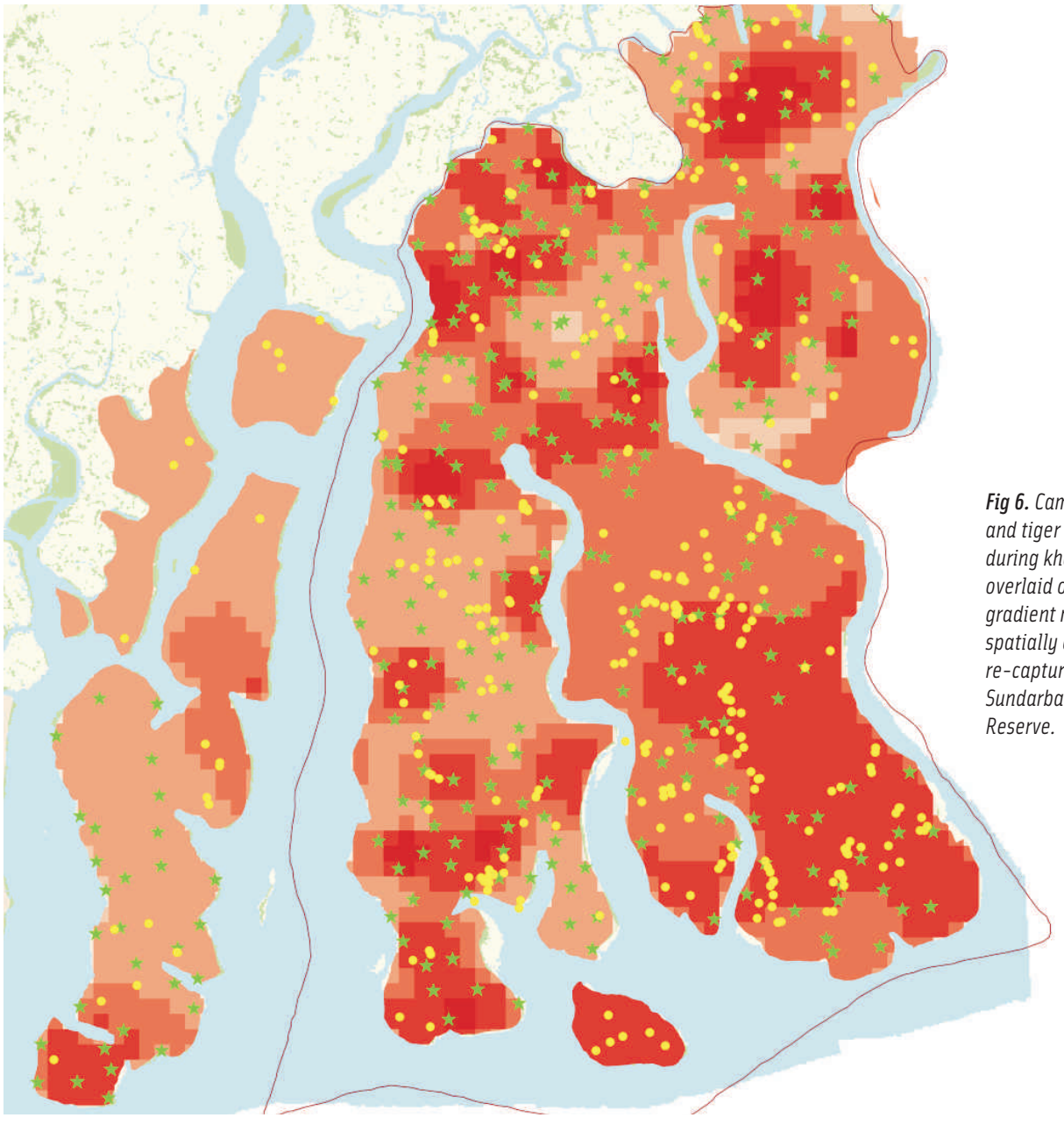


Fig 6. *Camera trap coverage and tiger sign recorded during khal surveys overlaid on tiger density gradient modeled by spatially explicit capture re-capture across Sundarbans Biosphere Reserve.*

09 North East Hills and Brahmaputra Flood Plains

Tiger population status has shown improvement in the State of Assam with Kaziranga having the maximum number of tigers in the landscape. Tiger occurrence in the Karbi hills, Dibang valley and Namdapha Tiger Reserve are encouraging. The minimum numbers of tigers recorded in Namdapha and Dibang were four each based on genetic sampling within a confined search area, yielding a minimum tiger density of about 0.77(SE0.1) tigers per 100 km^2. Extrapolating this density to tiger habitat estimated by MaxEnt gave a potential tiger population of about 20 in Namdapha and Dibang valley.

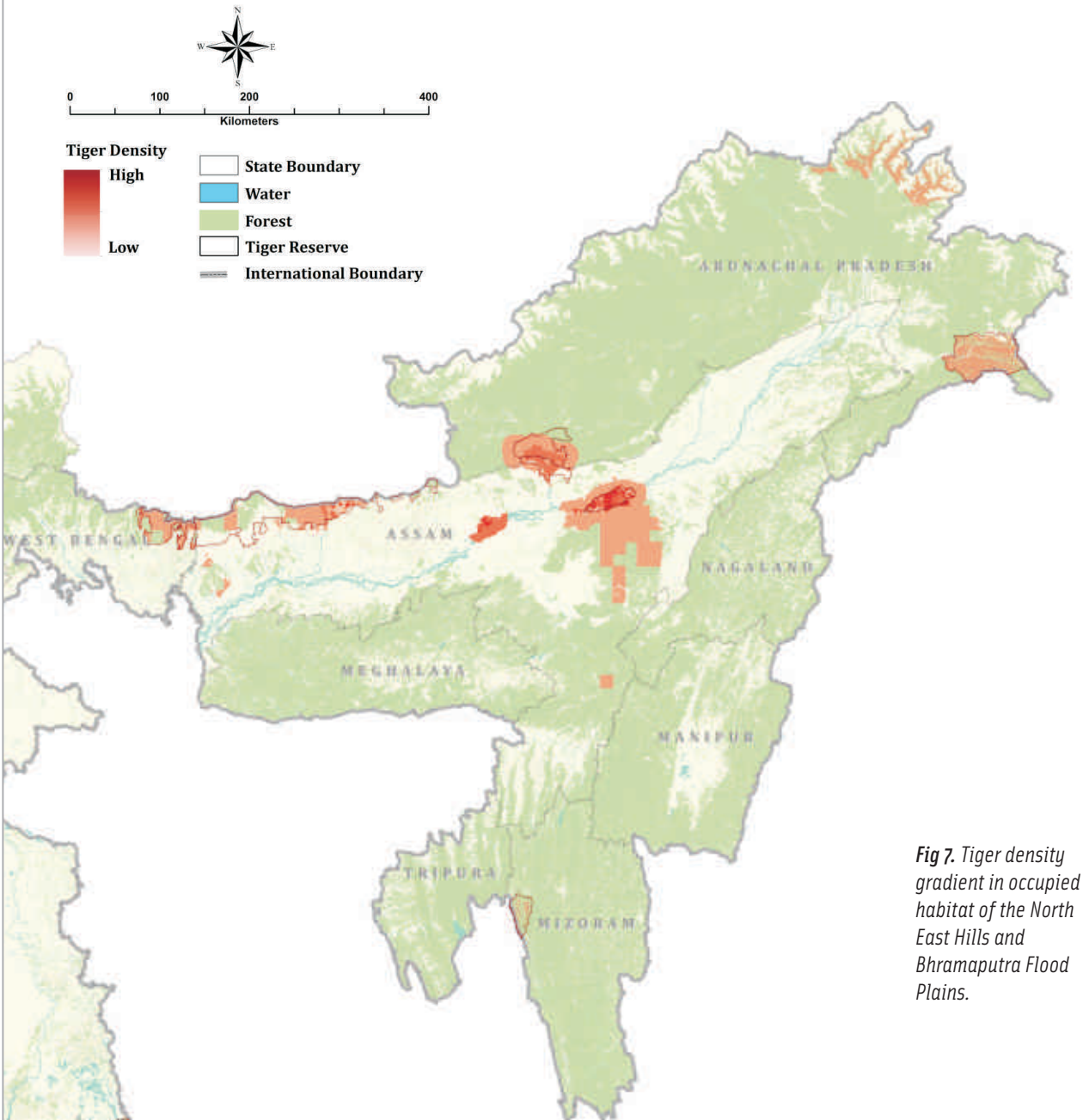


Fig 7. *Tiger density gradient in occupied habitat of the North East Hills and Bhramaputra Flood Plains.*

Conclusions 10

An unprecedented effort of camera trapping and field surveys across tiger occupied habitats was undertaken for this assessment . This effort has resulted in photo-capture of 1540 unique individual tigers, constituting nearly 70% of the total estimated population of 2226 tigers. It is now clear from three cycles of country wide assessment that tiger populations, indicative of intact functioning ecosystems, respond well to reduction in human pressures, protection, prey availability and good quality habitats. The political will, conservation commitment by wildlife managers and improved protection have paid dividends.

Tiger populations have increased in several states. Notable amongst them are the states of Uttrakhand, Karnataka, Tamil Nadu, Kerala and Madhya Pradesh.

Areas where there is a potential for increasing tiger populations are Sanjay-Guru Ghasidas landscape shared by Madhya Pradesh and Chattisgarh, Kawal and Srisailam Tiger Reserve in Andhra Pradesh and Telangana, Simlipal and Satkosia Tiger Reserves in Odisha, Manas Tiger Reserve in Assam, Buxa Tiger Reserve in West Bengal, Palamau Tiger Reserve in Jharkhand, Achanakmar and Indravati Tiger reserves in Chhattisgarh. These Protected Areas would benefit from conservation inputs that restore habitat, prey populations and in extreme cases supplementation of tigers so as to ensure that these PAs continue to deliver ecosystem services at their optimal levels. Future of tigers in India depends on maintaining inviolate core habitats for breeding tiger populations, habitat connectivity for genetic exchange and protection from poaching of tigers and their prey.

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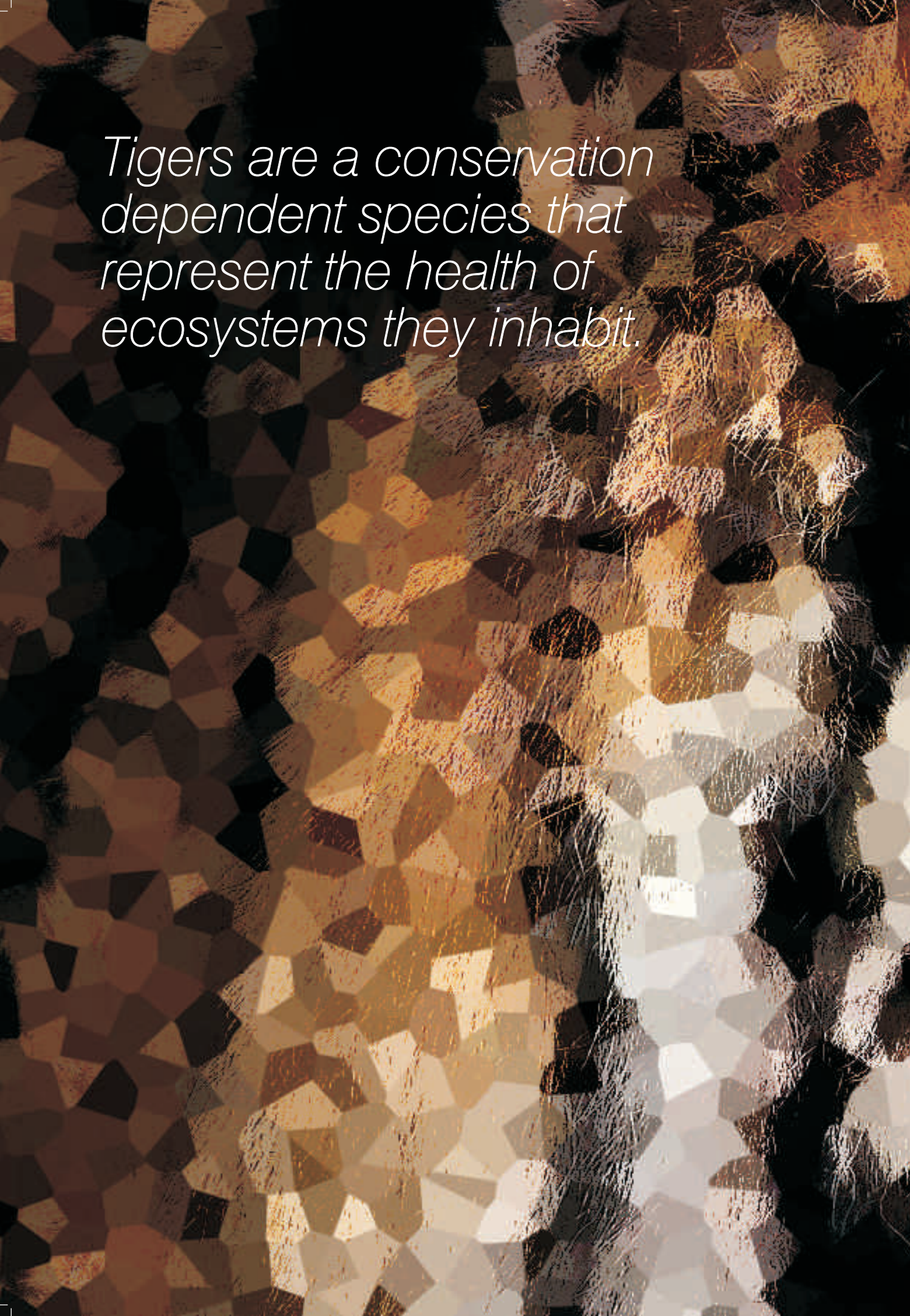
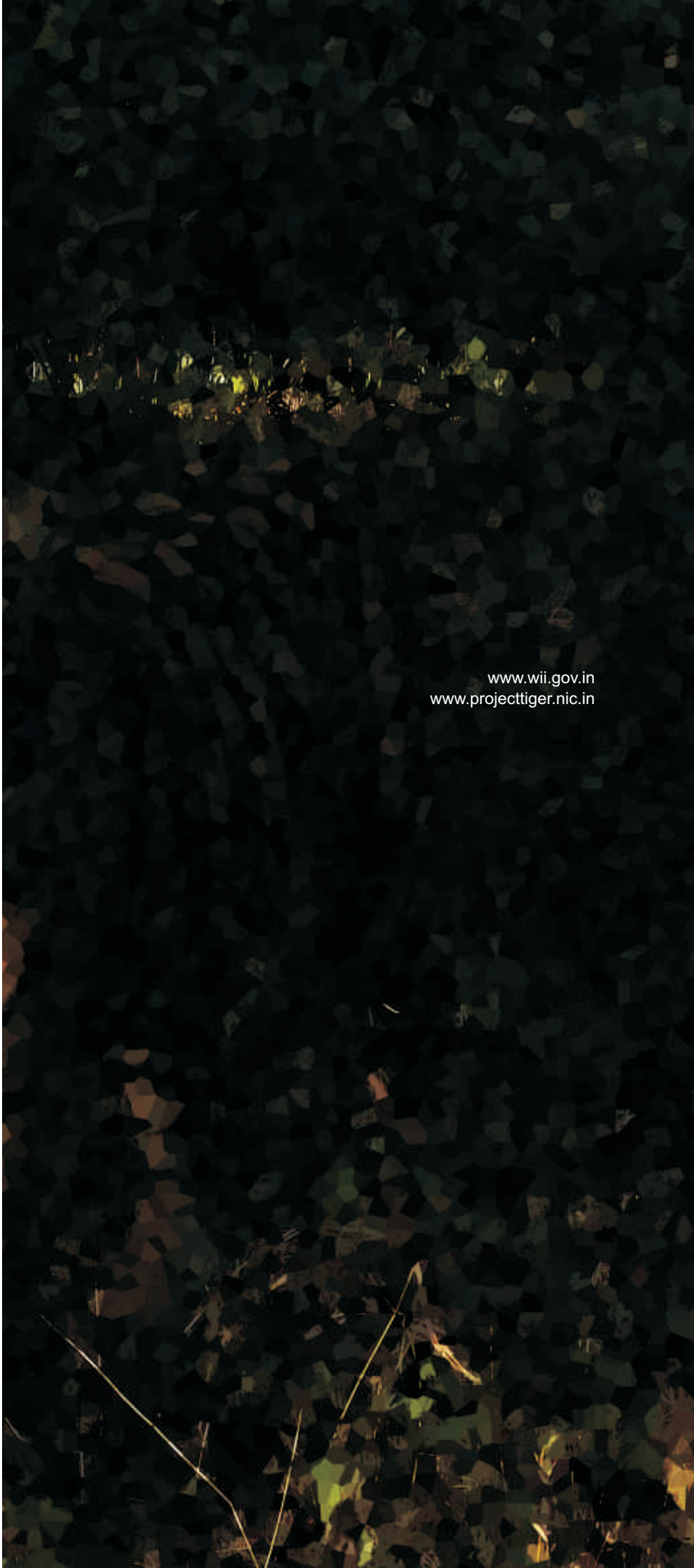

Tigers are a conservation dependent species that represent the health of ecosystems they inhabit.



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