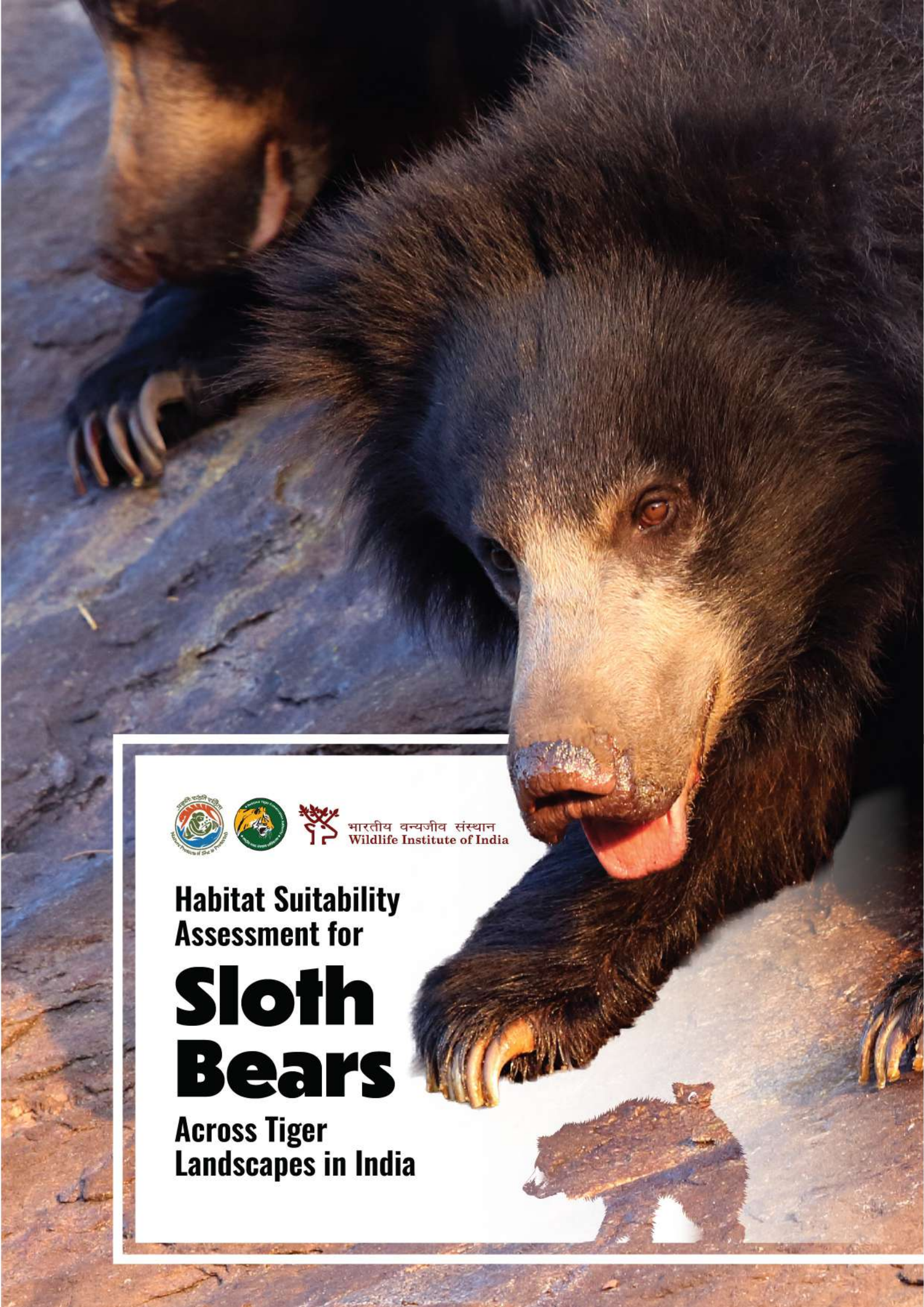

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Wildlife Institute of India

Habitat Suitability Assessment for Sloth Bears

Across Tiger Landscapes in India

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Wildlife Institute of India (WII)
Post Box # 18, Chandrabani
Dehradun - 248001 INDIA
Tel: +91-135-640111 to 115
Website: https://wii.gov.in/

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Further Contact:
Member Secretary
National Tiger Conservation Authority
B-1 Wing, 7th Floor, Pt. Deendayal
Antyodaya Bhawan, CGO Complex
New Delhi, 110003
ms-ntca@nic.in

Nodal Officer,
NTCA-WII Tiger Cell
Wildlife Institute of India, Chandrabani
Dehradun, Uttarakhand 248001
bh@wii.gov.in

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Sloth Bears

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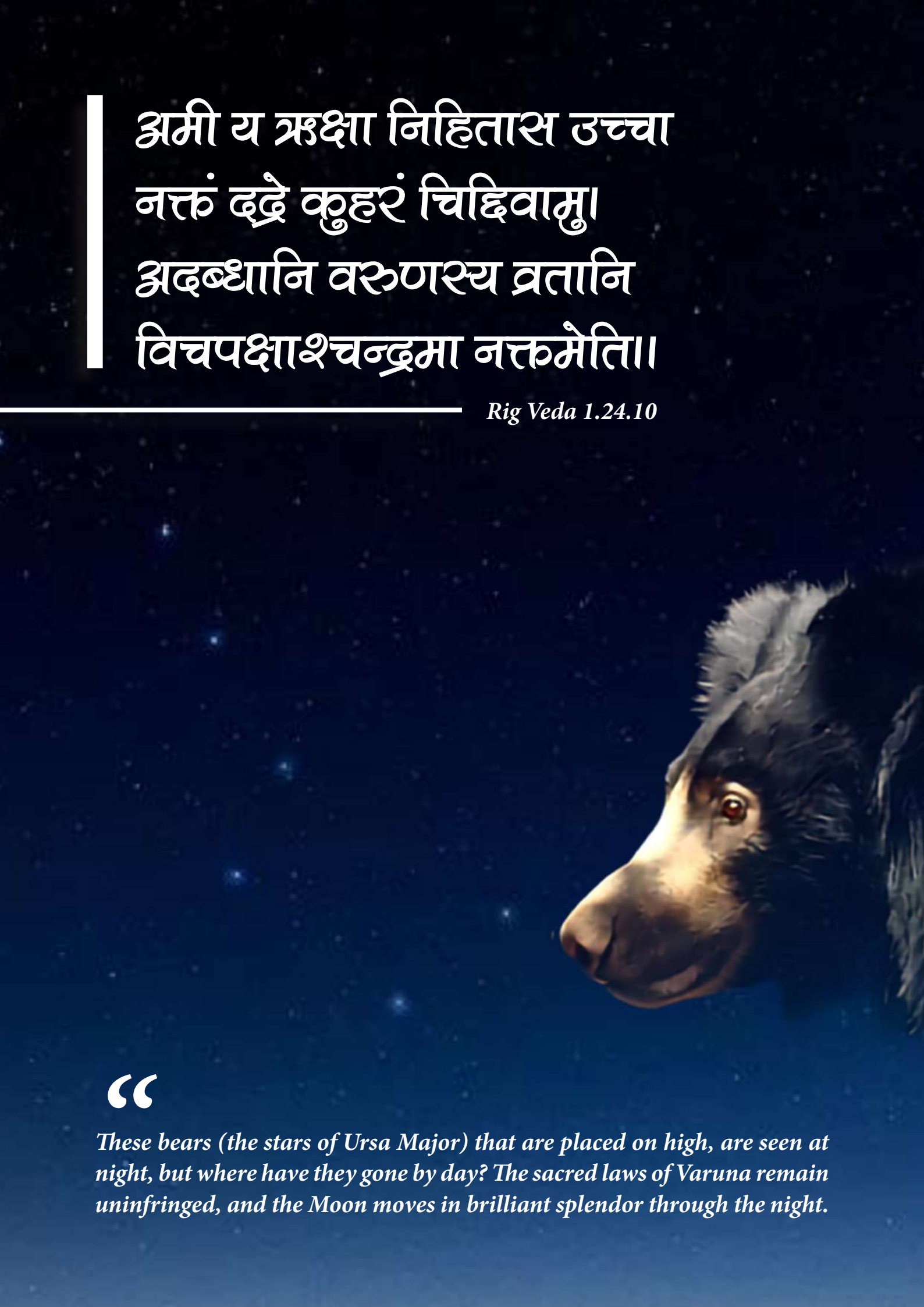
अमी य ऋक्षा निहितास उच्चा
नक्तं ददृश्रे कुहरं चिद्दिवामु।
अदब्धानि वरुणस्य व्रतानि
विचपक्षाशचन्द्रमा नक्तमेति।।

Rig Veda 1.24.10



"

These bears (the stars of Ursa Major) that are placed on high, are seen at night, but where have they gone by day? The sacred laws of Varuna remain uninfringed, and the Moon moves in brilliant splendor through the night.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Guidance

Sh. Bhupender Yadav
Hon'ble Minister
Ministry of Environment, Forest & Climate Change, Govt. of India

Sh. Kirti Vardhan Singh
Hon'ble Minister of State
Ministry of Environment, Forest & Climate Change, Govt. of India

Sh. Tanmay Kumar, IAS
Secretary
Ministry of Environment, Forest & Climate Change, Govt. of India

Sh. Sushil Kumar Awasthi, IFS
DG & Special Secretary
Ministry of Environment, Forest & Climate Change, Govt. of India

National Tiger Conservation Authority

Sh. Sanjay Kumar
ADGF (Project Tiger) & Member Secretary (NTCA)

Dr. Sanjayan Kumar
IGF (NTCA)

Dr. Vaibhav C. Mathur
IG PT&E

Sh. Shivakumar
IGF (NTCA)
RO Bengaluru

Ms. Harini Venugopal
AIGF (NTCA)
RO Bengaluru

Sh. Md. Sajid Sultan
AIGF (NTCA)

Sh. Pawan Jeph
AIGF (NTCA)

Sh. Nandkishore Kale
AIGF (NTCA)
RO Nagpur

Wildlife Institute of India (WII)

Dr. G. S. Bhardwaj
Director, WII

Dr. Bilal Habib
Nodal Officer
NTCA-WII Tiger Cell

Dr. Vishnupriya Kolipakam
Associate Nodal Officer
NTCA-WII Tiger Cell

Dr. Ujjwal Kumar
Research Scientist

Dr. Ayan Sadhu
Research Scientist

Dr. Shaheer Khan
Project Scientist I

Sh. Deb Ranjan Laha
Principal Project Associate

Sh. Jayanta Kumar Bora
Principal Project Associate

Sh. Dhruv Jain
Sr. Project Associate

Ms. Monika Saraswat
Sr. Project Associate

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We also express our sincere gratitude to the present and former officers of the National Tiger Conservation Authority (NTCA), the current and former Directors and Deans of the Wildlife Institute of India (WII), and the State Forest Departments and their field staff across the tiger-range states. Their sustained commitment, technical support, and dedicated efforts in planning, coordinating, and implementing the All India Tiger Estimation exercises have made this report possible.

Executive SUMMARY

The sloth bear (*Melursus ursinus*), the only bear species endemic to the Indian subcontinent, is an ecologically important omnivore that functions as a keystone species, ecosystem engineer, and seed disperser in tropical forest ecosystems. This report presents the first comprehensive national-scale habitat suitability assessment for sloth bears across India's tiger landscapes using data generated under the 2018 & 2022 cycles of the All India Tiger Estimation (AITE).

Based on data from the All India Tiger Estimation assessments, sloth bear occupied habitat expanded from 170,094 km^2 in 2018–19 to 188,357 km^2 in 2022–23 across India's tiger landscapes. Predictive MaxEnt modelling identified approximately 231,899 km^2 of total suitable habitat nationwide, with 28% situated within protected areas and 19.6% (45,441 km^2) falling within tiger reserves. Human pressure emerged as the primary environmental determinant governing habitat suitability.

At the landscape scale, the Central India & Eastern Ghats complex constitutes the primary global stronghold, comprising 176,870 km^2 of suitable habitat (74% located outside protected areas). The Western Ghats offers 35,250 km^2 of suitable habitat, whereas the Shivalik Hills & Gangetic Plains (7,930 km^2) and North East Hills & Brahmaputra Floodplains (7,610 km^2) contain smaller, highly fragmented suitable areas restricted mainly to foothill forests. Addressing ongoing habitat fragmentation and human–bear conflicts outside protected zones remains vital for long-term conservation.

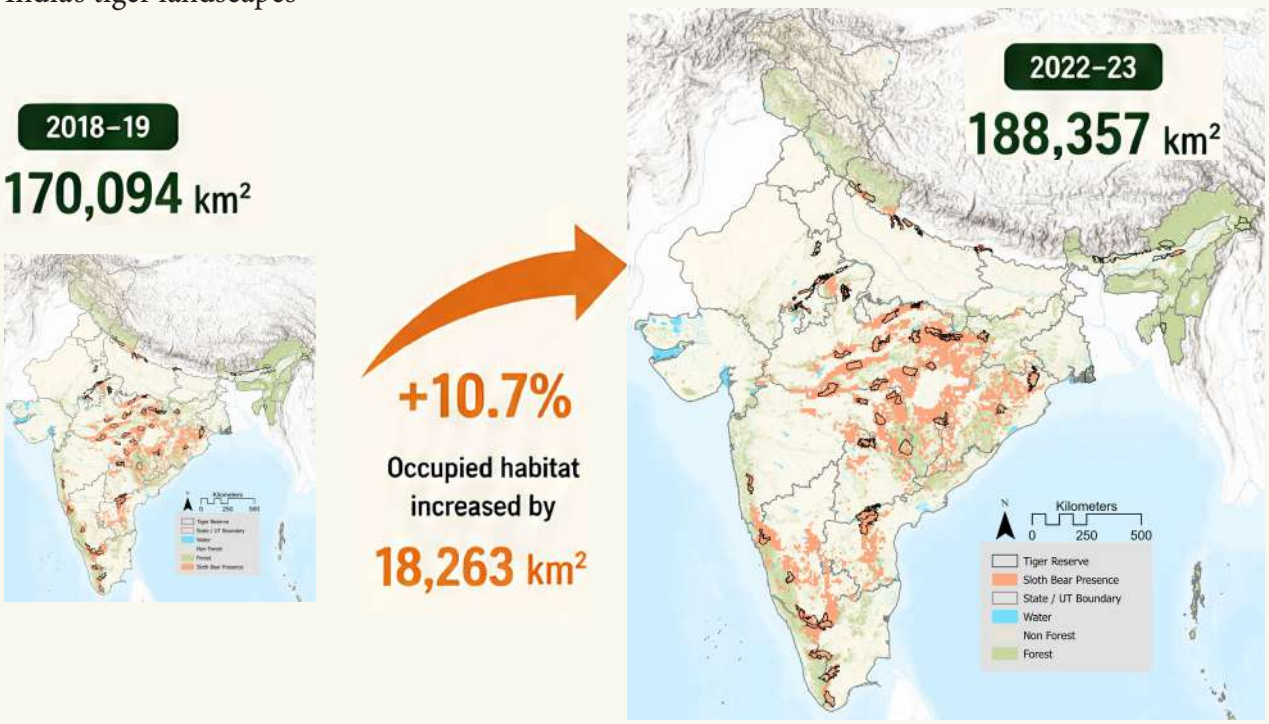
NATIONAL SURVEY EFFORT

Comparing All India Tiger Estimation Cycles

TRAIL SURVEYS (Distance Covered)	HABITAT PLOTS SURVEYED	CAMERA TRAP LOCATIONS	PHOTOGRAPHS CAPTURED	SLOTH BEAR IMAGES	PERSON-DAYS INVESTED
2018–19	2018–19	2018–19	2018–19	2018–19	2018–19
522,996 km	317,958	26,838	34,858,623	37,600	620,795
2022–23	2022–23	2022–23	2022–23	2022–23	2022–23
641,449 km	324,003	32,588	47,081,881	55,898	641,102
↑ 22.7% INCREASE	↑ 1.9% INCREASE	↑ 21.4% INCREASE	↑ 35.0% INCREASE	↑ 48.7% INCREASE	↑ 3.3% INCREASE

OCCUPIED HABITAT EXPANSION

Sloth bears are occupying more of India's tiger landscapes



LANDSCAPE DISTRIBUTION

	SUITABLE HABITAT AREA (km²)	SUITABLE AREA WITHIN TR (km²)
Central India & Eastern Ghats	176,871 km²	31,769 km²
Western Ghats	35,252 km²	10,199 km²
Shivalik & Gangetic Plains	7,932 km²	3,195 km²
North East Hills & Brahmaputra Floodplains	7,572 km²	278 km²

Values are rounded

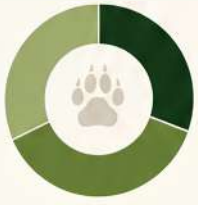
CONSERVATION PRIORITIES

Habitat Connectivity
Protect critical habitat and ecological corridors to maintain landscape connectivity and enable movement of sloth bears across fragmented landscapes.

Habitat Restoration & Conflict Mitigation
Prioritize habitat restoration, improved livelihoods and targeted conflict mitigation in vulnerable landscapes for coexistence.

Long-term Genetic Resilience
Maintain genetic exchange and resilient populations through connected landscapes, secure habitats and effective long-term monitoring.

HABITAT SUITABILITY ACROSS INDIA



VERY HIGH ~24%	HIGH ~30–40%	MODERATE ~20–25%	LOW ~20–25%
Core habitat with optimal conditions	Good quality habitat supporting populations	Habitat with moderate suitability	Least suitable habitat

Proportion represents overall pattern across states (based on AITE 2018–19 & 2022–23 data)

Sloth bears use a wide range of habitats, with core populations concentrated **in high and very high** suitability areas.

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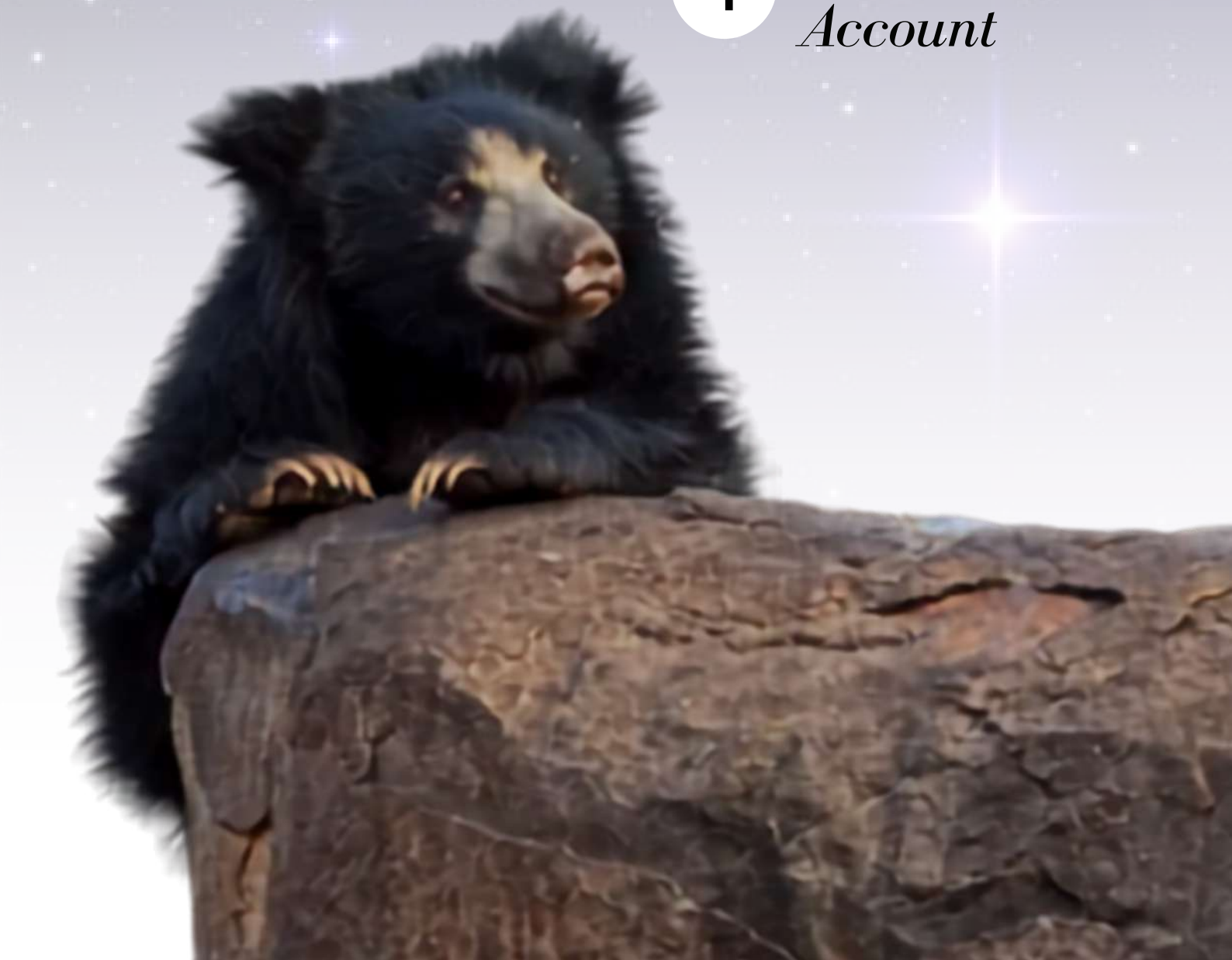

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INTRODUCTION

Bears, a relatively small family within the order Carnivora, perform a wide range of ecological functions (Singh *et al.*, 2026). As ecological indicators, keystone species, ecosystem engineers, and seed dispersers, they play vital roles in maintaining ecosystem structure, functioning, and resilience (Tattoni *et al.*, 2025; Singh *et al.*, 2026).

Beyond their ecological importance, bears symbolize the cultural ethos of many civilizations and religions. In South Asia, bears are portrayed as important characters in numerous epics and folklore. In Vaishnavism, they are regarded as integral members of forest ecosystems, while the Puranas depict them as inhabitants of the wilderness, emphasizing their presence in, or absence from, particular environments.

Bears belong to the family Ursidae and comprise eight extant species distributed across five genera and four continents. The Indian subcontinent harbours four bear species representing three genera, making it one of the most significant regions for bear diversity (Figure 1). These species include the Asiatic black bear (*Ursus thibetanus*), brown bear (*Ursus arctos*), Malayan sun bear (*Helarctos malayanus*), and sloth bear (*Melursus ursinus*) and, in the northeast, the sun bear occur largely within tiger landscapes, whereas the Himalayan brown bear (*U. a. isabellinus*), extends across the Himalayan arc beyond them. Although Gujarat harbors viable sloth bear populations across its eastern dry deciduous forests (Yoganand *et al.*, 2006; Dharaiya *et al.*, 2020), the state was excluded from this habitat suitability assessment as it fell outside our designated sampling area. Despite their ecological significance, bear species face a wide range of conservation challenges across their respective geographic ranges (Penteriani & Melletti, 2021). Their long-term persistence is increasingly threatened by habitat loss, habitat fragmentation, human–bear conflict, and the growing impacts of climate change, which are projected to drive population declines among both habitat specialists and generalists (Chhetri *et al.*, 2018; Fordham *et al.*, 2013; Wilkening *et al.*, 2019), particularly among Asian bear species (Garshelis *et al.*, 2022a).

Figure 1: Bears of India

Over the past two decades, the All India Tiger Estimation (AITE) programme has evolved into one of the world's largest standardized wildlife monitoring initiatives. Implemented collaboratively by the National Tiger Conservation Authority (NTCA), the Wildlife Institute of India (WII), State Forest Departments, and associated institutions, the programme combines systematic field surveys, camera trapping, occupancy sampling, and habitat assessments to monitor tiger populations across the country.

Although the principal objective of AITE is to assess tiger populations, the survey methodology simultaneously records evidence of numerous sympatric species. The resulting datasets provide an invaluable resource for assessing the distribution and occupancy of carnivores, herbivores, omnivores, and other wildlife inhabiting India's tiger landscapes.

Among these associated species, the sloth bear represents an ecologically important mammal that has historically received comparatively less attention in national-scale monitoring programmes. Assessing sloth bear occupancy (proportion of habitat occupied by sloth bears) within tiger landscapes provides valuable insights into habitat quality, landscape connectivity, and the effectiveness of conservation measures across India's protected area network and surrounding forested landscapes

Landscape-scale assessments are particularly important for sloth bears because the species frequently utilizes forest edges, degraded forests, and human-modified habitats while simultaneously depending on secure forest refugia for breeding and denning. Seasonal movements between fruiting areas, termite-rich foraging areas, and denning sites often extend beyond protected area boundaries, exposing bears to anthropogenic threats, including agricultural expansion, livestock grazing, forest fires, mining, road development, railway infrastructure, and increasing human–bear interactions. These pressures are especially pronounced in regions where forests have become fragmented into small, isolated patches separated by agricultural lands or rapidly expanding human settlements.

Effective conservation planning, implementation, and evaluation require reliable information on the status, distribution, and population trends of target species. For sloth bear conservation, understanding species-specific distribution patterns, habitat use, and ecological requirements is fundamental to designing targeted management interventions. This report evaluates the habitat suitability of sloth bears based on sloth bear presence information using data generated from sign surveys and camera-trap surveys conducted under the Status of Tigers, Co-predators, and Prey in India assessments (2018 and 2022).

From a conservation and wildlife management perspective, robust information on sloth bear habitat suitability is essential for developing evidence-based strategies for habitat management, landscape-scale conservation, and the mitigation of human–bear conflict. This report provides comprehensive insights into the habitat suitability patterns of sloth bear across India's tiger landscapes, thereby supporting informed conservation planning and adaptive management. The findings provide a scientific foundation for policy formulation and conservation decision-making aimed at ensuring the long-term persistence of India's sloth bear populations. By integrating habitat conservation, ecological research, landscape connectivity, and effective human–bear conflict mitigation, India can strengthen the conservation of its ecologically significant and diverse bear species.

The present report evaluates the habitat suitability of sloth bears across the four major tiger conservation landscapes of India: Central India & Eastern Ghats, Western Ghats, Shivalik Hills & Gangetic Plains Landscape and North East Hills and Brahmaputra Floodplains. Collectively, these landscapes encompass the majority of the species' extant distribution in the country while representing a broad range of ecological conditions, climatic regimes, forest types, and conservation challenges. They differ substantially in their physiography, habitat heterogeneity, protected area networks, landscape connectivity, and the intensity of anthropogenic pressures, resulting in considerable variation in habitat suitability, occupancy, and population connectivity.

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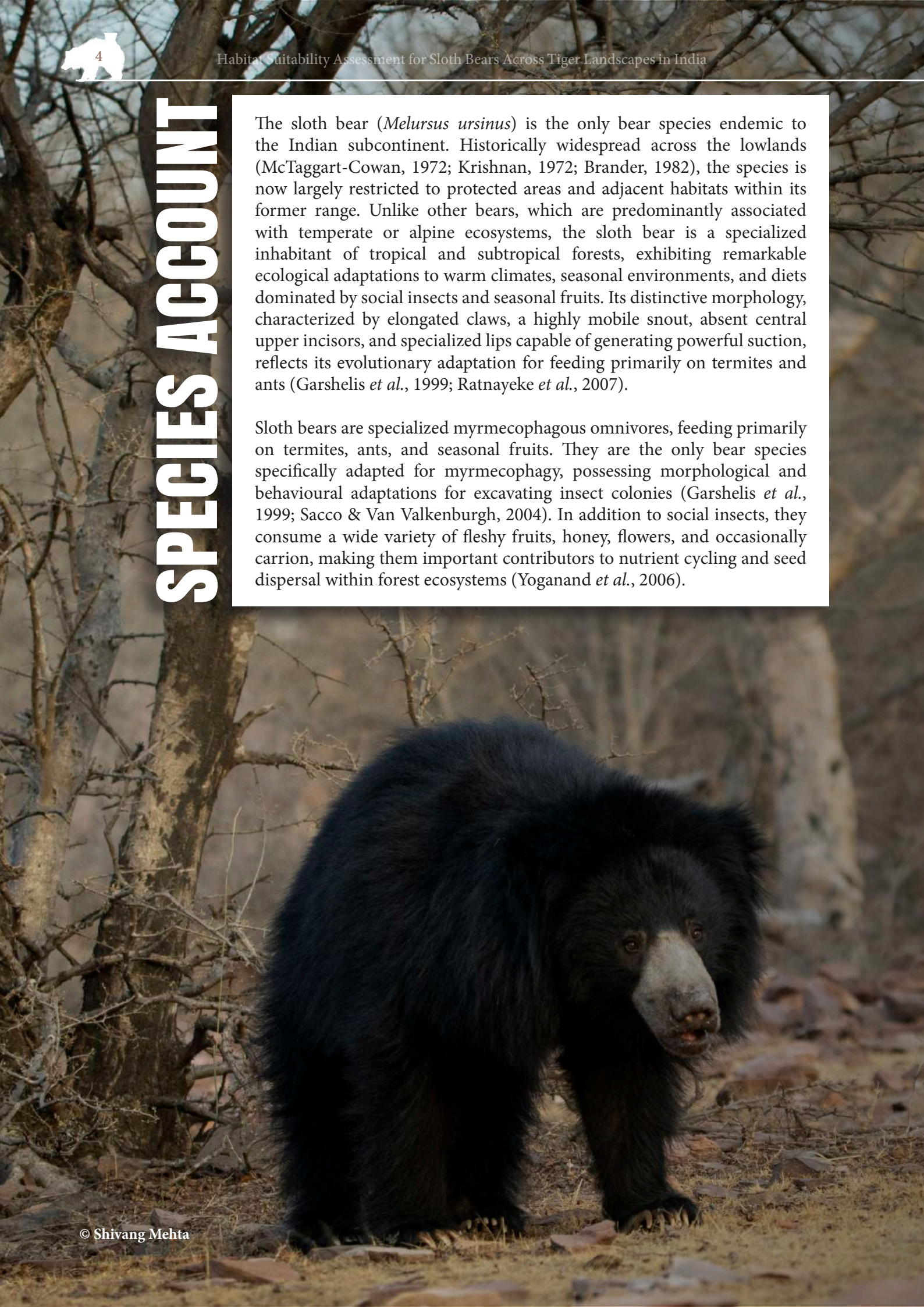
SPECIES ACCOUNT

The sloth bear (*Melursus ursinus*) is the only bear species endemic to the Indian subcontinent. Historically widespread across the lowlands (McTaggart-Cowan, 1972; Krishnan, 1972; Brander, 1982), the species is now largely restricted to protected areas and adjacent habitats within its former range. Unlike other bears, which are predominantly associated with temperate or alpine ecosystems, the sloth bear is a specialized inhabitant of tropical and subtropical forests, exhibiting remarkable ecological adaptations to warm climates, seasonal environments, and diets dominated by social insects and seasonal fruits. Its distinctive morphology, characterized by elongated claws, a highly mobile snout, absent central upper incisors, and specialized lips capable of generating powerful suction, reflects its evolutionary adaptation for feeding primarily on termites and ants (Garshelis *et al.*, 1999; Ratnayeke *et al.*, 2007).

Sloth bears are specialized myrmecophagous omnivores, feeding primarily on termites, ants, and seasonal fruits. They are the only bear species specifically adapted for myrmecophagy, possessing morphological and behavioural adaptations for excavating insect colonies (Garshelis *et al.*, 1999; Sacco & Van Valkenburgh, 2004). In addition to social insects, they consume a wide variety of fleshy fruits, honey, flowers, and occasionally carrion, making them important contributors to nutrient cycling and seed dispersal within forest ecosystems (Yoganand *et al.*, 2006).



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Diet composition varies seasonally and geographically, with fruits dominating during the fruiting season and termites and other insects constituting the bulk of the diet throughout the remainder of the year (Baskaran *et al.*, 1997; Ratnayeke *et al.*, 2007; Seidensticker *et al.*, 2011). Reflecting the localized distribution of their principal food resources, sloth bears generally maintain relatively small home ranges compared with other ursids (Joshi *et al.*, 1995; Akhtar *et al.*, 2004; Ratnayeke *et al.*, 2007).

The species occupies a broad range of habitats, including tropical moist and dry deciduous forests, scrublands, savannahs, and grasslands, primarily below 1,500 m elevation, although it may occur up to 2,000 m in the Western Ghats (Johnsingh, 2003; Seidensticker *et al.*, 2011). Activity patterns vary according to habitat condition and the degree of human disturbance. While sloth bears may exhibit diurnal activity in well-protected forests, they are predominantly nocturnal or crepuscular in fragmented and human-dominated landscapes, often sheltering in rock crevices, dense vegetation, and tree cavities during the day (Joshi *et al.*, 1999; Akhtar *et al.*, 2004; Bargali *et al.*, 2012).

Although sloth bears generally avoid areas with high levels of human disturbance, localized crop raiding of maize, groundnut, and fruit crops has been reported, particularly in degraded landscapes where natural food resources are limited (Akhtar *et al.*, 2004; Bargali *et al.*, 2005). Breeding typically occurs between May and July, with females giving birth to one or two cubs between November and January. Cubs are characteristically carried on their mother's back during early development and remain with the female for 1.5–2.5 years, resulting in an inter-birth interval of two to three years (Joshi *et al.*, 1999; Yoganand *et al.*, 2013).

In India, the species is distributed across five broad geographic regions: northern, northeastern, central, southeastern, and southwestern India (Johnsingh, 2003; Yoganand *et al.*, 2006; Sathyakumar *et al.*, 2012). The northern population, occurring in Uttarakhand, Uttar Pradesh, Bihar, and adjoining Nepal, is geographically isolated because of extensive forest fragmentation driven by agricultural expansion, urbanization, and industrial development (Bargali *et al.*, 2012). In Northeastern India, Assam supports the largest population, although the species also occurs in Manipur, Mizoram, Meghalaya, and Arunachal Pradesh (Yoganand *et al.*, 1999; Choudhury, 2011; Dharaiya *et al.*, 2020), where its range overlaps with those of the Asiatic black bear (*Ursus thibetanus*) and the Malayan sun bear (*Helarctos malayanus*).

METHODOLOGY

Habitat Suitability Modelling

Species distribution modelling (SDM) was conducted using MaxEnt v3.4 (Phillips *et al.*, 2017), a presence-only machine learning algorithm that estimates species distributions by identifying the probability distribution of maximum entropy constrained by environmental conditions at known occurrence locations. MaxEnt is particularly well suited for modelling species distributions when reliable absence data are unavailable, making it an appropriate framework for predicting habitat suitability for the sloth bear (*Melursus ursinus*) using occurrence records and environmental covariates.

Environmental predictor variables were selected based on their ecological relevance to sloth bear distribution while minimizing multicollinearity among predictors. Pairwise correlation analysis was used to assess collinearity among candidate variables, and only variables with $|r| < 0.7$ were retained for model development. This approach reduces redundancy among explanatory variables, improves model interpretability, and minimizes the influence of highly correlated predictors on model parameterization. Correlation analyses were performed using Pearson correlation coefficient in corrplot package in R (Wei & Simko, 2024).

The final predictor set comprised the Global Human Modification Index (Kennedy *et al.*, 2019), representing cumulative anthropogenic modification of the landscape; distance from forest (Forest Survey of India, 2017), representing proximity to the primary habitat of the species; elevation derived from the Shuttle Radar Topography Mission Digital Elevation Model (Farr *et al.*, 2007), representing topographic variation; the Aridity Index (Zomer *et al.*, 2008), representing long-term climatic water availability; and the Normalized Difference Vegetation Index (NDVI) for April derived from MODIS (Didan *et al.*, 2015), representing vegetation greenness and primary productivity. All predictor layers were prepared at 1 km^2 projected to EPSG:7755, and aligned to a common raster extent prior to model development.

Model performance and prediction uncertainty were evaluated using 100 bootstrap replicates, with 70% of occurrence records randomly selected for model training and the remaining 30% reserved for independent model testing during each iteration. Model complexity was constrained by enabling only linear and quadratic feature classes, allowing the model to capture both linear and simple nonlinear relationships while reducing the likelihood of overfitting. To ensure model robustness and interpretability, the MaxEnt algorithm was executed utilizing linear and quadratic feature classes, incorporating product features through a complementary log-log (cloglog) transformation, while maintaining a regularization multiplier of 1 to balance model complexity and predictive performance. Continuous habitat suitability predictions were converted to binary suitable and unsuitable habitat using a threshold value, corresponding to the maximum training sensitivity plus specificity criterion (Phillips *et al.*, 2017). This threshold optimizes the balance between omission and commission errors and is widely used to convert continuous habitat suitability predictions into binary habitat classes.

Model performance was evaluated using the Area Under the Receiver Operating Characteristic Curve (AUC), calculated from independent test data. To ensure robustness, 100 bootstrap replicates were conducted, and the mean test AUC along with its standard deviation (SD) was computed. This approach provided a reliable measure of the model's discriminatory ability and predictive performance in distinguishing suitable from unsuitable habitat.

RESULTS

The fourth cycle of the All India Tiger Estimation (AITE 2018–19) covered forested habitats across 20 states of India. The survey involved 522,996 km of trail survey to record sloth bear signs, alongside the assessment of 317,958 habitat plots for vegetation characteristics and anthropogenic pressures. Camera traps were deployed at 26,838 locations, generating 34,858,623 photographs, including 37,600 images of sloth bears, with an effective camera-trapped area of approximately 121,337 km². The survey required an overall effort of more than 620,795 person-days. Building on this effort, the fifth cycle of AITE (2022–23) surveyed forested habitats across 19 states, covering 641,449 km of trail survey and sampling 324,003 habitat plots. Camera traps were deployed at 32,588 locations, yielding 47,081,881 photographs, of which 55,898 were of sloth bears, with a total survey effort of 641,102 person-days. Based on these extensive field surveys, sloth bears were estimated to occupy 170,094 km² and 188,357 km² of the tiger landscape during the 2018–19 and 2022–23 assessments, respectively, indicating an increase in the documented extent of occupied habitat across India's tiger-bearing landscapes.

Habitat Suitability Modelling

The MaxEnt model demonstrated high predictive performance in distinguishing suitable from unsuitable habitat for the sloth bear, achieving a mean test Area Under the Receiver Operating Characteristic Curve (AUC) of 0.8 across 100 bootstrap replicates. The low standard deviation among replicate models indicates a high degree of consistency in model performance and suggests that habitat suitability predictions were robust to variation in the training and testing datasets.

The contribution of individual environmental variables varied considerably. The Global Human Modification Index emerged as the most influential predictor of habitat suitability, indicating a strong negative relationship between increasing anthropogenic modification and the probability of sloth bear occurrence. The relative contributions of the remaining environmental variables, including distance to forest, elevation, aridity index, and April NDVI, are presented in Table 1.

Table 1: Contribution Percentage of Covariates (± SD) to the best model explaining Habitat suitability of Sloth Bear in India

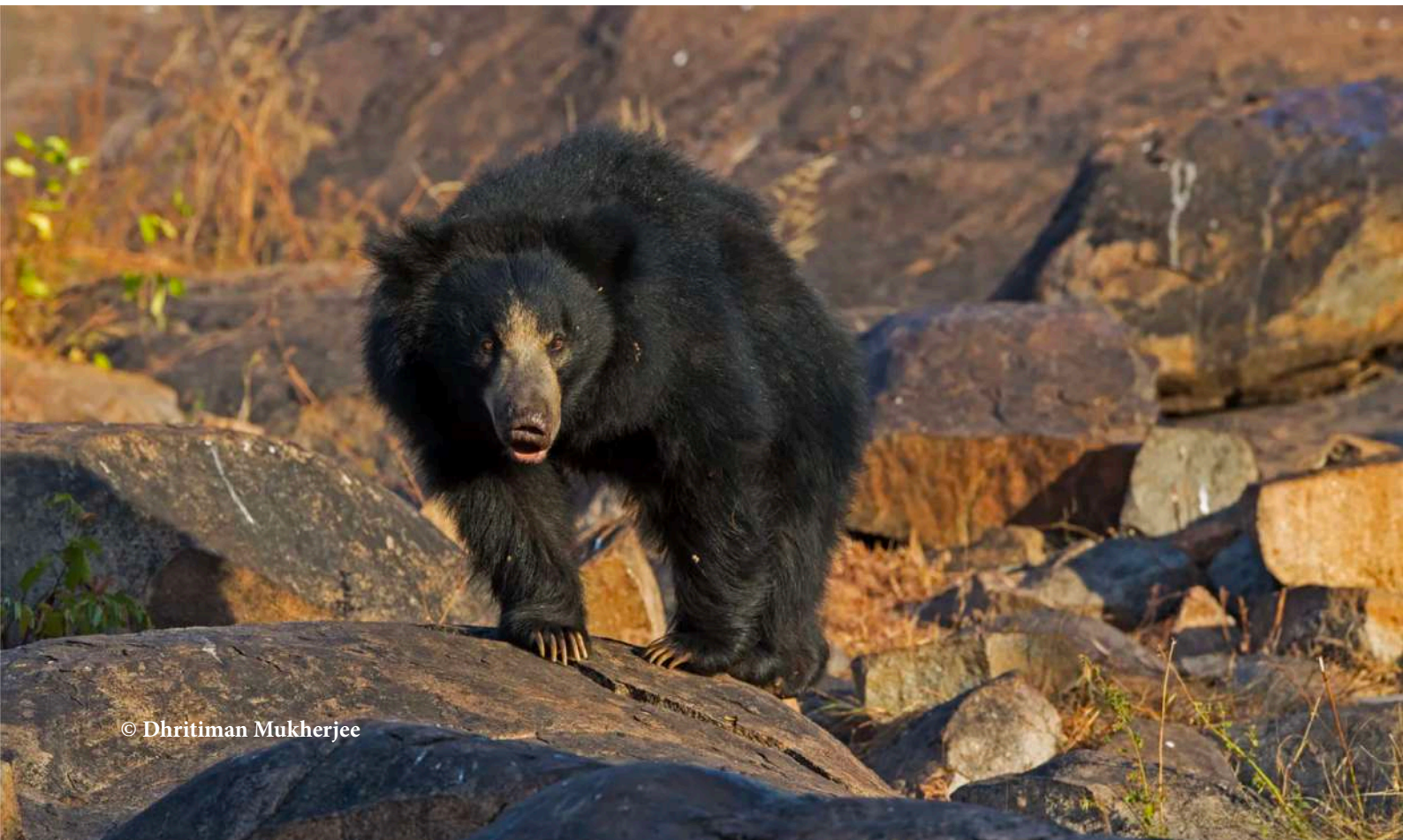
Environment Covariate	Percent Contribution (SD)	Permutation Contribution(SD)
Global Human Modification Index	60.4(± 1.93)	48.5(± 1.50)
Distance from Forest	15.65(± 1.41)	14.7(± 2.3)
Elevation	8.2(± 0.94)	8.0(± 0.70)
NDVI April	7.95(± 1.2)	7.12(± 0.8)
Aridity Index	7.80(± 0.7)	5.0(± 0.94)

The predicted habitat suitability map revealed substantial spatial variation in habitat suitability across the study area (Fig. 2). Extensive areas of highly suitable habitat were concentrated within the Central India & Eastern Ghats landscape, where large, contiguous tracts of deciduous forest continue to provide relatively intact habitat for sloth bears. Moderate to high habitat suitability was also predicted across portions of the Western Ghats and selected forest patches in North East Hills and Brahmaputra Floodplains landscape, although the spatial extent and continuity of suitable habitat varied among landscapes.

In contrast, suitable habitat within the Shivalik Hills and Gangetic Plains was largely confined to protected areas and a limited number of adjoining forested corridors. Outside these areas, habitat suitability declined substantially, corresponding with regions characterized by intensive agriculture, expanding human settlements, infrastructure development, and other forms of anthropogenic land-use modification. These results suggest that increasing human disturbance has fragmented formerly continuous habitat into relatively isolated patches, potentially constraining landscape connectivity and long-term population persistence.

The binary habitat suitability map generated using the maximum training sensitivity plus specificity threshold identified approximately 2,31,899 km² of suitable habitat, of which 28% occurred within the protected area network, and 19.60% which is 45,441 km² occurred within tiger reserves of India, while the remaining suitable habitat was distributed across reserved forests, territorial forests, and other forested landscapes outside formally protected areas. The distribution of suitable habitat within Tiger Reserves is summarized in Table 2.

Model uncertainty was generally low across most predicted suitable habitats, with higher uncertainty observed primarily along the margins of the predicted distribution and in landscapes where occurrence records were relatively sparse (Fig 2.). The consistency of predictions across bootstrap replicates indicates that the selected environmental predictors adequately captured the broad-scale ecological factors governing sloth bear distribution across India.



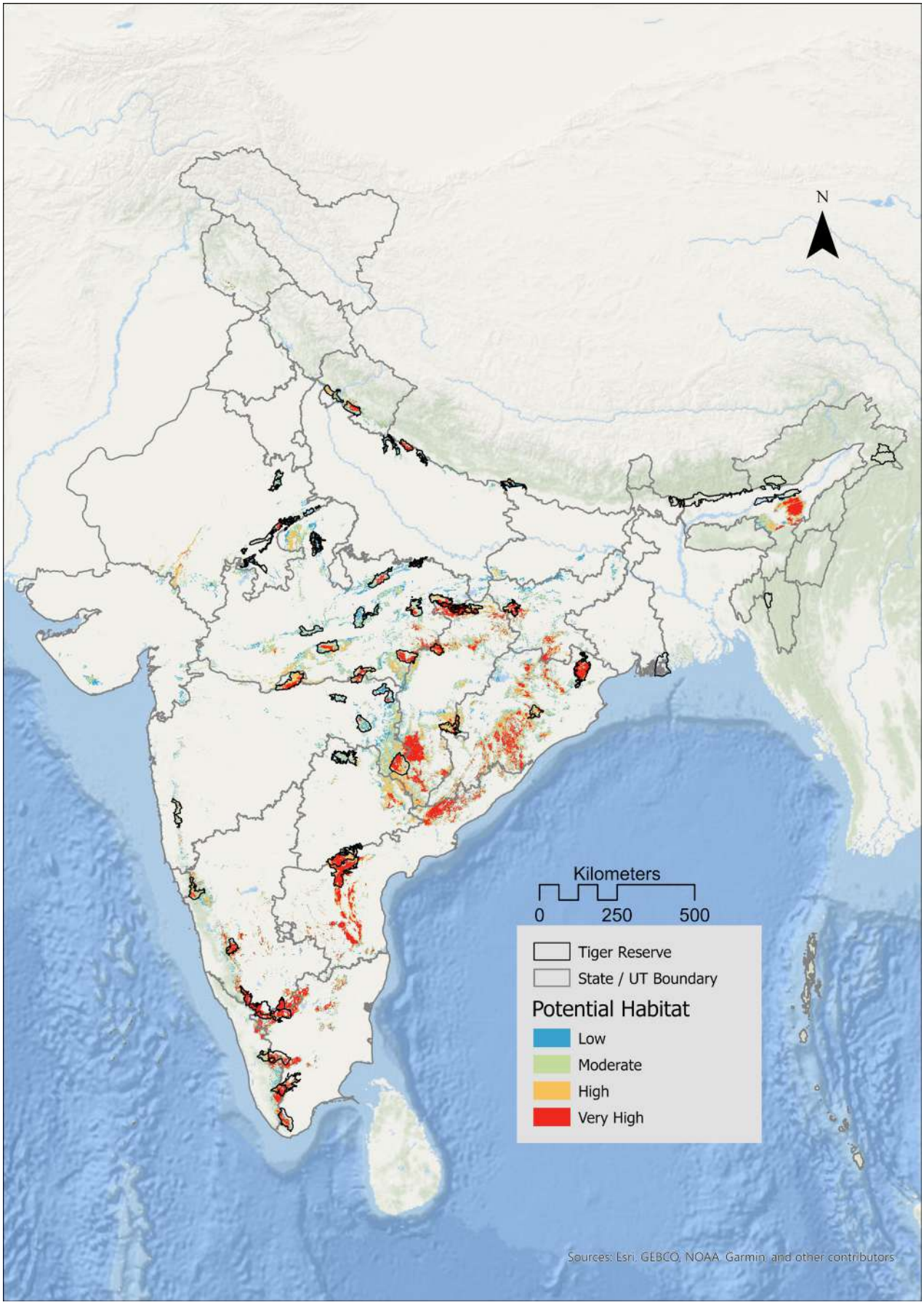


Figure 2: Modelled habitat suitability of Sloth Bears in India's tiger bearing landscape derived from All India Tiger Estimation (2018 and 2022).

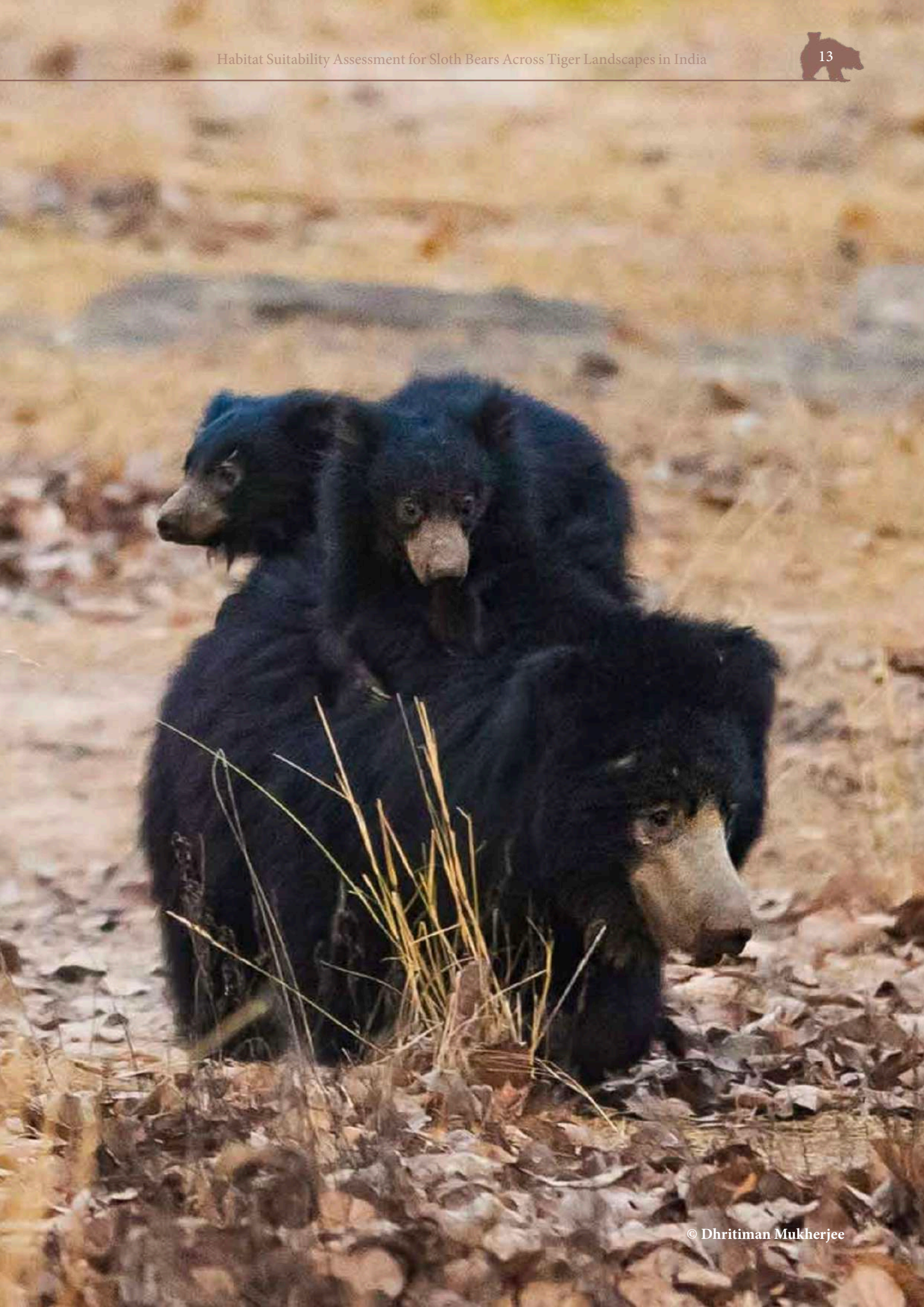
Table 2: Suitable habitat for Sloth Bears across tiger reserves in India based on the 2018 and 2022 All India Tiger estimation data.

Landscape	State	Tiger Reserve	Area (in km^2)
Central India & Eastern Ghats Complex	Andhra Pradesh	NSTR	3169
	Chhattisgarh	Achanakmar TR	851
		Guru Ghasidas-Tamor Pingla	2272
		Indravati TR	2052
		USTR	1394
	Jharkhand	Palamau TR	1200
	Madhya Pradesh	Bandhavgarh TR	833
		Kanha TR	1191
		Madhav TR	824
		Panna TR	1175
		Pench MP TR	676
		Ratapani TR	597
		Sanjay-Dubri	951
		Satpura TR	1507
		Veerangana Durgavati TR	1234
	Maharashtra	Bor TR	189
		Melghat TR	1936
		NNTR	562
		Pench TR	530
		Sahyadri TR	516
		Tadoba-Andhari TR	801
	Odisha	Satkosia TR	739
		Similipal TR	2324
	Rajasthan	Mukundara Hills TR	302
		Ramgarh-Vishdhari TR	121
		Ranthambore TR	662
		Sariska TR	445
	Telangana	Amrabad TR	2047
		Kawal TR	669
Central India & Eastern Ghats Complex Total			**31769**

North East	Assam	Kaziranga	108
		Manas TR	42
		Nameri TR	126
		Orang TR	2
North East Total			**278**
Shivalik Hills and Gangetic Plains complex	Bihar	Valmiki TR	516
	Uttar Pradesh	Dudhwa TR	523
		Katerniaghat WLS (Dudhwa TR)	158
		Kishenpur WLS (Dudhwa TR)	138
		Pilibhit TR	375
		Ranipur TR	128
	Uttarakhand	Corbett TR	855
		Rajaji TR	502
Shivalik Hills and Gangetic Plains complex Total			**3195**
Western Ghats	Karnataka	Bandipur TR	955
		Bhadra TR	784
		BRT	594
		Kali TR	987
		Nagarhole TR	755
	Keralam	ParambikulamTR	481
		Periyar TR	884
	Tamil Nadu	Anamalai TR	1088
		KMTR	979
		Mudumalai TR	679
		Sathyamangalam TR	1209
		SMTR	804
Western Ghats Total			**10199**

Table 3: Area under different habitat suitability categories for Sloth Bears across tiger states in India based on the 2018 and 2022 All India Tiger estimation data.

Sloth Bear Habitat Suitability						
Landscape	**State**	**Habitat suitable for Sloth Bears (km^2)**	**Very Highly Suitable (km^2/ %)**	**Highly Suitable (km^2/ %)**	**Moderately Suitable (km^2/ %)**	**Low Suitable (km^2/ %)**
Central India & Eastern Ghats	Chhattisgarh	35562	3484/9.8	11121/31.27	12293/34.57	8664/24.36
	Jharkhand	10414	2569/24.67	2632/25.27	2617/25.13	2596/24.93
	Madhya Pradesh	38908	9753/25.07	9971/25.63	9738/25.03	9446/24.28
	Maharashtra	16350	1922/11.76	6231/38.11	4114/25.16	4083/24.97
	Odisha	34821	8544/24.54	8794/25.25	8768/25.18	8715/25.03
	Rajasthan	7067	1743/24.66	1779/25.17	1811/25.63	1734/24.54
	Andhra Pradesh	23924	2982/12.46	9036/37.77	5958/24.90	5948/24.86
	Telangana	9825	2431/24.74	2510/25.55	2470/25.14	2414/24.57
Western Ghats	Goa	357	37/10.36	149/41.74	28/7.84	143/40.06
	Karnataka	14770	860/5.82	6507/44.06	3799/25.72	3604/24.40
	Keralam	6867	959/13.97	2417/35.20	37/0.54	3454/50.30
	Tamil Nadu	13258	1576/11.89	5019/37.86	3385/25.53	3278/24.72
Shivalik Hills & Gangetic Plains	Bihar	1986	480/24.17	493/24.82	518/26.08	495/24.92
	Uttar Pradesh	2943	728/24.74	737/25.04	744/25.28	734/24.94
	Uttarakhand	3003	283/9.42	1220/40.63	757/25.21	743/24.74
North East Hills & Brahmaputra Floodplains	Assam	7572	823/10.87	2942/38.85	1927/25.45	1880/24.83



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CENTRAL INDIA & EASTERN GHATS

The Central India & Eastern Ghats landscape constitutes the largest, most contiguous, and ecologically significant stronghold for the sloth bear in India. Extending across the central Indian highlands and the Deccan Plateau, this landscape supports the most extensive network of suitable habitats for the species and is widely regarded as the core of its global distribution (Dutta *et al.*, 2015). The landscape encompasses a mosaic of tropical deciduous forests, rugged hill systems, plateaus, river valleys, and rocky escarpments that collectively provide the diverse habitat attributes required for the species throughout its annual life cycle. Owing to its extensive forest cover, relatively high habitat connectivity, and well-established protected area network, the Central India Landscape sustains several large and demographically viable sloth bear populations and plays a pivotal role in ensuring the long-term persistence of the species in the Indian subcontinent (Yoganand *et al.*, 2006; Ratnayeke *et al.*, 2007).

The Central India Landscape contains the highest concentration of Tiger Reserves in India and forms the backbone of the country's tiger conservation programme. It also supports some of the most important source populations of sloth bears. Major tiger reserves include Kanha, Pench, Satpura, Bandhavgarh, Panna, Sanjay-Dubri, Melghat, Tadoba-Andhari, Navegaon-Nagzira, Bor, Ranthambhore, Achanakmar, Indravati, Udanti-Sitanadi, Similipal, Satkosia, Kawal, Amrabad, and Nagarjunasagar–Srisailam Tiger Reserves, together with numerous Wildlife Sanctuaries and Conservation Reserves distributed across the landscape.

Although protected areas constitute the core habitats for sloth bears, a substantial proportion of the regional population occurs in Reserve Forests, Protected Forests, territorial forest divisions, and other multiple-use forest landscapes outside protected area boundaries. These forests function as ecological corridors that facilitate seasonal movements, dispersal, and gene flow among populations. Long-term conservation of sloth bears in the Central India Landscape depends not only on the effective management of protected areas but also on maintaining the integrity and connectivity of the surrounding forest matrix.

Sloth bears are widely distributed across the Central India Landscape, representing one of the most continuous populations within the species' global range. Occupancy is highest in extensive deciduous forests characterized by rugged terrain, abundant rocky denning sites, rich termite resources, and relatively low levels of habitat fragmentation. The species occurs throughout most Tiger Reserves and adjoining forest divisions, frequently extending into reserve forests and community-managed forests where suitable habitat persists.

However, the distribution is spatially heterogeneous. Habitat suitability declines in areas affected by intensive agriculture, mining, urban expansion, and linear infrastructure, resulting in fragmented and isolated populations. Despite these pressures, sloth bears exhibit greater tolerance of modified landscapes than many sympatric large mammals, enabling them to persist in human-dominated forest mosaics where sufficient food resources and shelter remain available.

The binary habitat suitability map (Fig. 3) was generated by applying the maximum training sensitivity-plus-specificity threshold to the continuous habitat suitability predictions. This classification identified approximately 176,870 km^2 of suitable habitat across the Central India and Eastern Ghats landscape. Of the total suitable habitat, 26% was located within the protected area network, whereas the remaining 74% occurred outside protected areas, primarily within reserved forests, territorial forests, and other forested landscapes. A summary of the distribution of suitable habitat across Tiger reserves is presented in Table 2.

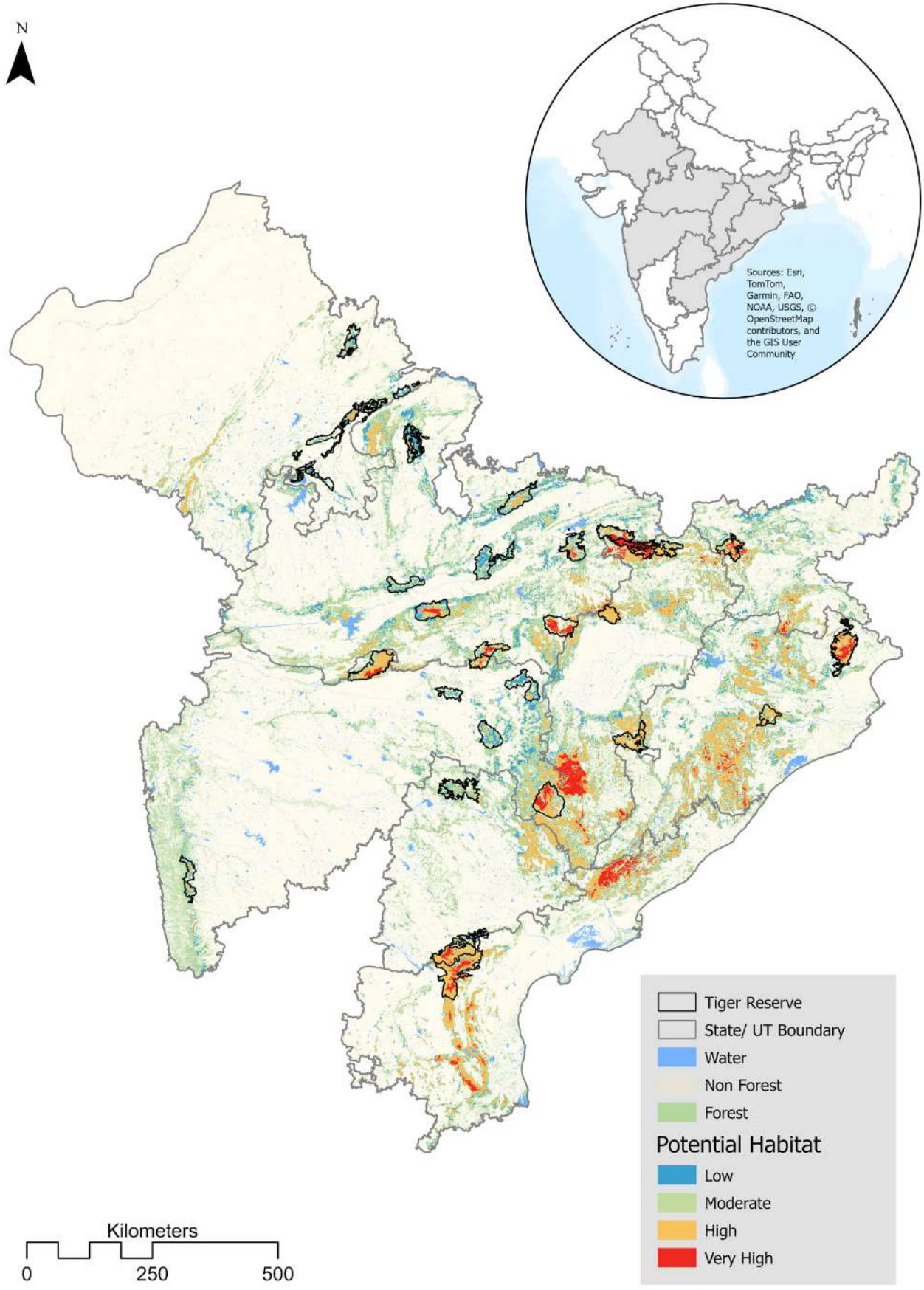

Figure 3: Modelled habitat suitability of Sloth Bears in Central India and Eastern Ghats region of India's tiger bearing Landscape derived from All India Tiger Estimation (2018 and 2022).

CHHATTISGARH

Chhattisgarh contains some of the largest contiguous sal-dominated forest tracts in central India, characterized by tropical moist and dry deciduous forests interspersed with extensive bamboo thickets and dense riverine vegetation. Tiger reserves such as Achanakmar and Guru Ghasidas-Tamor Pingla function as important wilderness corridors linking Peninsular India with the Eastern Ghats, thereby maintaining landscape-scale ecological connectivity. These forests support abundant termite colonies and a diversity of fruit-bearing tree species, enabling sloth bears to occupy both protected areas and reserve forests outside the protected area network. Despite the widespread availability of suitable habitat, increasing forest degradation, expansion of mining activities, and associated infrastructure development threaten habitat continuity, potentially restricting movement and fragmenting bear populations across the state.

The state supports approximately 35,562 km² of suitable habitat for sloth bears, of which 3,484 km² is classified as very highly suitable (Fig. 4). The western parts of Guru Ghasidas and Indravati Tiger Reserves, together with adjacent forested patches hold the largest contiguous areas of highly suitable habitat, while Achanakmar and Udanti-Sitanadi have moderate to highly suitable habitat.

HABITAT SUITABLE FOR SLOTH BEARS (KM²)
35,562

Very Highly Suitable (km²)	Highly Suitable (km²)	Moderately Suitable (km²)	Low Suitable (km²)
3,484	11,121	12,293	8,664

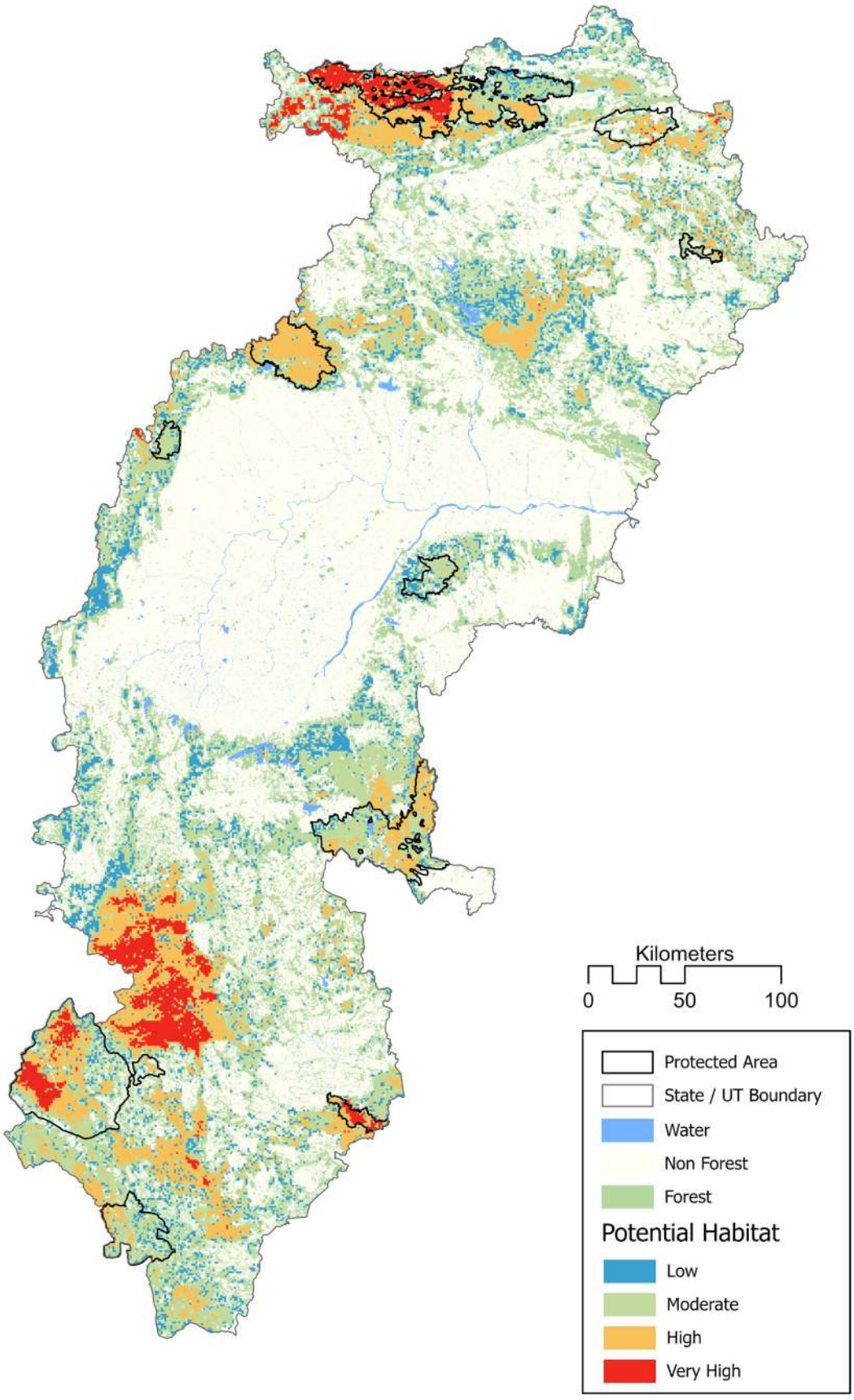

Figure 4: Modelled habitat suitability of Sloth Bears in Chhattisgarh, India derived from All India Tiger Estimation (2018 and 2022).

JHARKHAND

The Chhota Nagpur Plateau of Jharkhand is dominated by tropical dry and moist deciduous forests characterized by Sal (*Shorea robusta*), Terminalia species, and associated scrubland habitats. Palamau Tiger Reserve forms an important ecological stepping stone within this plateau, supporting diverse floral and faunal communities while contributing to regional landscape connectivity. Sloth bears persist across fragmented forest patches distributed throughout the plateau, occupying habitats that provide seasonal fruits, insects, and rocky refuges. However, progressive habitat fragmentation caused by encroachment, recurrent forest fires, and extraction of forest resources in areas adjoining human settlements has increased habitat degradation and intensified localized human–bear conflicts across the state.

Habitat suitability modelling indicates that the state contains approximately 10,414 km² of suitable habitat for sloth bears, including 2569 km² of very highly suitable habitat (Fig. 5). Very highly suitable areas are primarily associated with Palamau Tiger Reserve and Saranda reserve forest.

HABITAT SUITABLE FOR SLOTH BEARS (KM²)
10,414

Very Highly Suitable (km²)	Highly Suitable (km²)	Moderately Suitable (km²)	Low Suitable (km²)
2,569	2,632	2,617	2,596

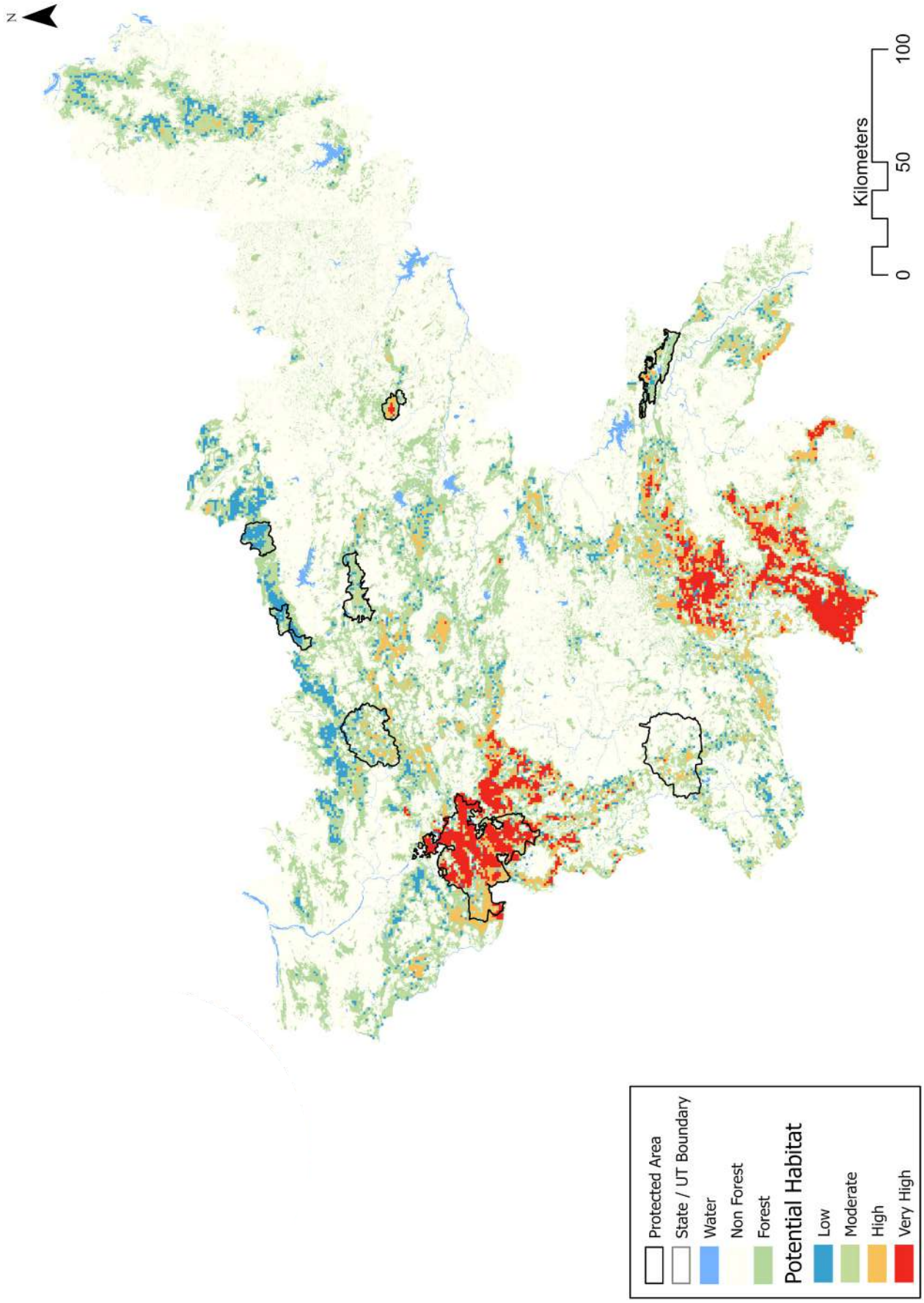

Figure 5: Modelled habitat suitability of Sloth Bears in Jharkhand, India derived from All India Tiger Estimation (2018 and 2022).

MADHYA PRADESH

Madhya Pradesh represents one of the most significant strongholds for sloth bear conservation in India, owing to its extensive and contiguous deciduous forest landscapes. The state comprises tropical moist deciduous forests dominated by *Shorea robusta* in eastern landscapes such as Kanha and Bandhavgarh, while tropical dry deciduous forests characterized by *Tectona grandis* and *Anogeissus latifolia* dominate western landscapes including Satpura and Pench. Open scrub habitats further extend across the northern Kuno-Madhav-Gandhisagar region. As the state supports the country's largest tiger population, its well-connected protected areas and reserve forests provide critical habitat for large carnivores across the Central Indian landscape. Sloth bears occur at high densities throughout these forests, supported by abundant seasonal food resources, particularly Mahua (*Madhuca longifolia*) flowers and Tendu (*Diospyros melanoxylon*) fruits, together with extensive termite colonies. However, intensive collection of non-timber forest products by local communities during peak fruiting seasons frequently overlaps with bear foraging activity, resulting in elevated levels of seasonal human–bear interactions and posing an important conservation and management challenge.

The state has approximately 38,900 km² of suitable habitat, of which 9753 km² has been identified as very highly suitable for sloth bears (Fig. 6). In Madhya Pradesh, tiger reserves such as Sanjay Dubri, Kanha, Pench, and Satpura have extensive areas of highly suitable habitat. In contrast, parts of the Kuno landscape and the Kanha-Pench-Achanakmar landscape are characterized by moderately suitable habitat for the species.

HABITAT SUITABLE FOR SLOTH BEARS (KM²)
38,908

Very Highly Suitable (km²) 9,753

Highly Suitable (km²) 9,971

Moderately Suitable (km²) 9,738

Low Suitable (km²) 9,446

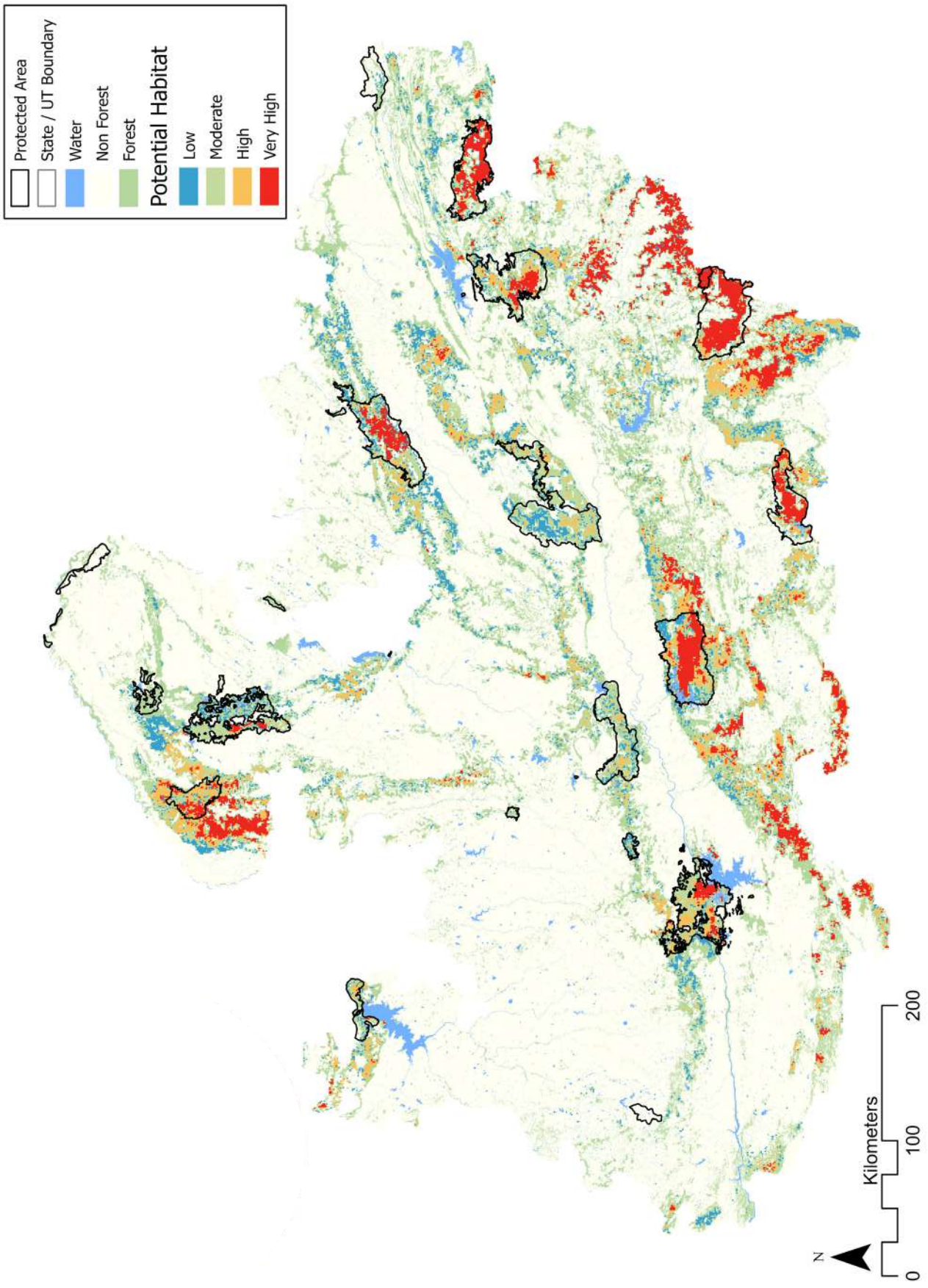

Figure 6: Modelled habitat suitability of Sloth Bears in Madhya Pradesh, India derived from All India Tiger Estimation (2018 and 2022).

MAHARASHTRA

Maharashtra forms an important transitional zone linking the Western Ghats with the Central Indian highlands, supporting a diverse range of forest ecosystems from tropical wet evergreen and semi-evergreen forests of the Sahyadri ranges to extensive tropical dry deciduous teak forests and thorn scrub habitats across the Deccan Plateau. Tiger reserves such as Tadoba–Andhari and Melghat constitute major conservation areas that also provide ecological connectivity between central and southern tiger habitats. Sloth bears are widely distributed across these dry deciduous forests, where rocky terrain, abundant insect prey, and seasonal fruiting trees create highly suitable habitat conditions. Significant populations occur within Melghat and Tadoba-Andhari, although increasing habitat fragmentation outside protected areas has forced bears to utilize agricultural landscapes, including sugarcane fields and fruit orchards. Such movements have intensified interactions with people, making human–bear conflict one of the principal conservation concerns across the state.

The state has approximately 16,350 km² of suitable habitat, of which 1,922 km² has been identified as very highly suitable for sloth bears (Fig. 7). Parts of Melghat and Pench tiger reserves have been characterized by highly suitable habitat for sloth bear, while parts of Tadoba, Navegaon-Nagzira and Sahyadri have been characterized by moderately suitable habitat in the state.

HABITAT SUITABLE FOR SLOTH BEARS (KM²)
16,350

Very Highly Suitable (km²)	Highly Suitable (km²)	Moderately Suitable (km²)	Low Suitable (km²)
1,922	6,231	4,114	4,083

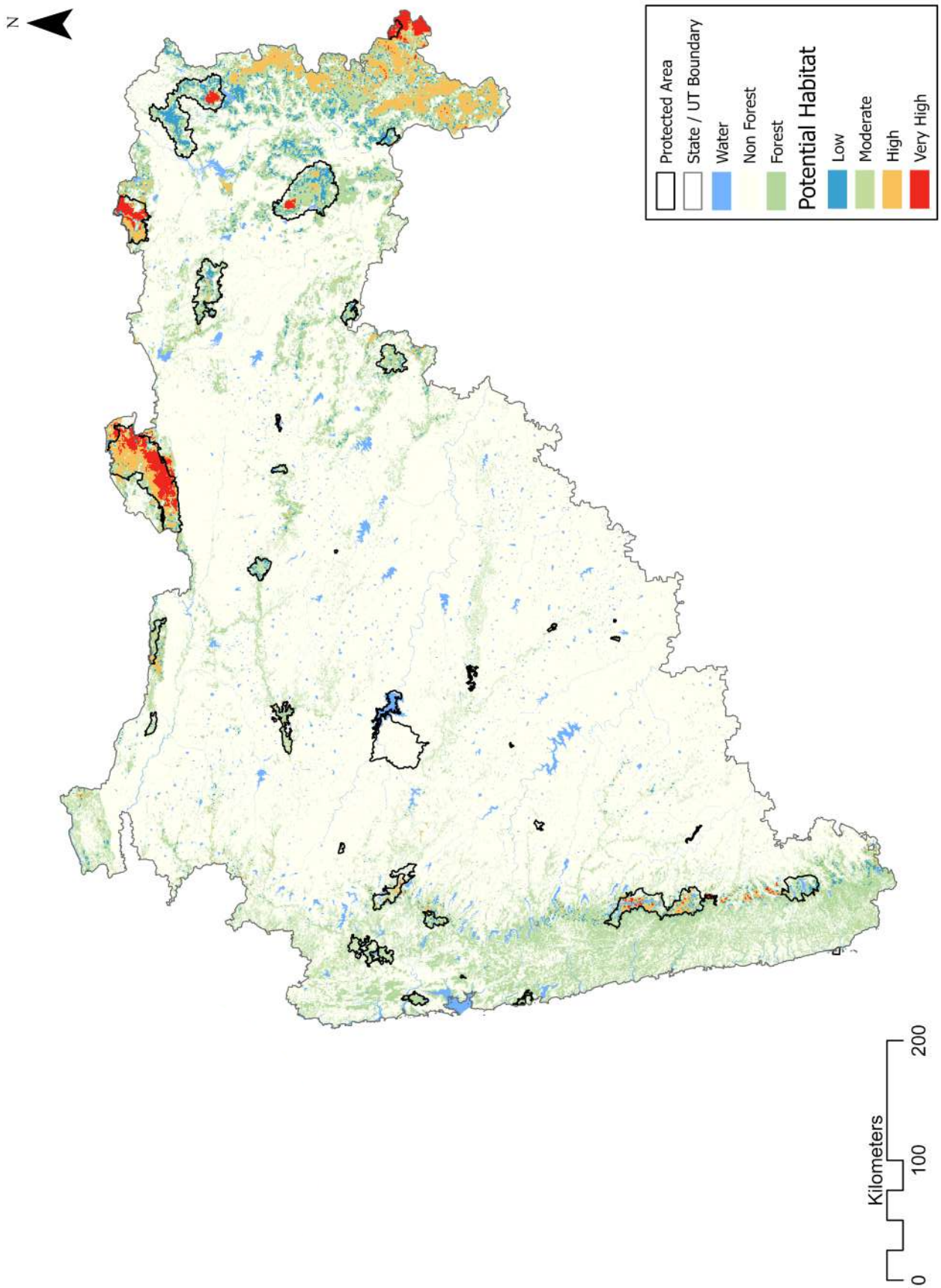

Figure 7: Modelled habitat suitability of Sloth Bears in Maharashtra, India derived from All India Tiger Estimation (2018 and 2022).

ODISHA

Odisha supports a heterogeneous mosaic of tropical moist deciduous sal forests, moist mixed deciduous forests, semi-evergreen coastal vegetation, and localized mangrove ecosystems. The state's forests are internationally recognized for their biodiversity, including Similipal, which supports the world's only naturally occurring pseudo-melanistic tiger population, alongside important populations of elephants and leopards. Sloth bears are widely distributed throughout Odisha's rocky hill systems and interconnected dry and moist forest corridors, where rugged terrain, natural denning sites, and diverse food resources provide suitable habitat. Nevertheless, extensive open-cast mining for iron ore and bauxite, together with increasing fragmentation of habitat corridors, represents one of the most significant challenges for maintaining long-term population connectivity and conservation of the species.

The state retains approximately 34,820 km² of suitable habitat for sloth bears, with 8,544 km² categorized as very highly suitable (Fig. 8). Habitat suitability is highest across Similipal tiger reserve and parts of Ghumsur, Bonai and Deogarh forest divisions.

HABITAT SUITABLE FOR SLOTH BEARS (KM²)
34,821

Very Highly Suitable (km²) 8,544

Highly Suitable (km²) 8,794

Moderately Suitable (km²) 8,768

Low Suitable (km²) 8,715

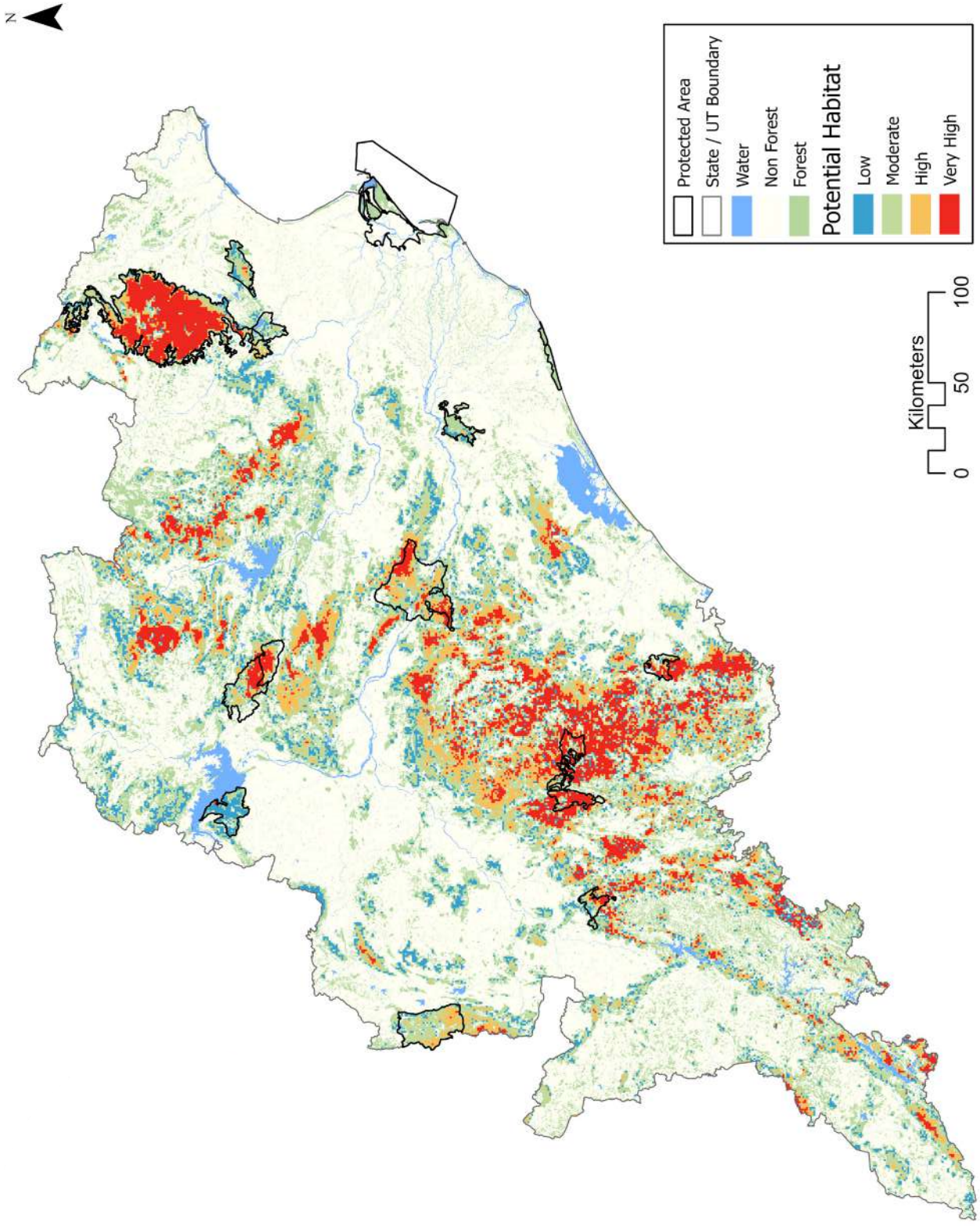

Figure 8: Modelled habitat suitability of Sloth Bears in Odisha, India derived from All India Tiger Estimation (2018 and 2022).

RAJASTHAN

Rajasthan represents the northwestern extremity of sloth bear distribution in India. The state's forests comprise tropical dry deciduous vegetation dominated by Anogeissus pendula, extensive thorn scrub communities, and rugged ravine ecosystems associated with the Aravalli and Vindhyan hill ranges. These dry landscapes also support the northwestern limit of Bengal tiger distribution in reserves such as Ranthambore and Sariska. Sloth bears occurring in Rajasthan are highly dependent on rocky boulder formations that provide essential denning and shelter sites under arid climatic conditions. Their diet relies heavily on seasonal fruits, including *Ziziphus* spp. and *Ficus* spp, together with insects, enabling the species to persist in otherwise harsh semi-arid environments.

The state has approximately 7,060 km² of suitable habitat, of which 1,743 km² has been identified as very highly suitable for sloth bears (Fig. 9). Parts of Ranthambhore tiger reserve have highly suitable habitat for sloth bear, while Mount Abu wildlife sanctuary have highly suitable habitat.

HABITAT SUITABLE FOR SLOTH BEARS (KM²)
7,067

Very Highly Suitable (km²)	Highly Suitable (km²)	Moderately Suitable (km²)	Low Suitable (km²)
1,743	1,779	1,811	1,734

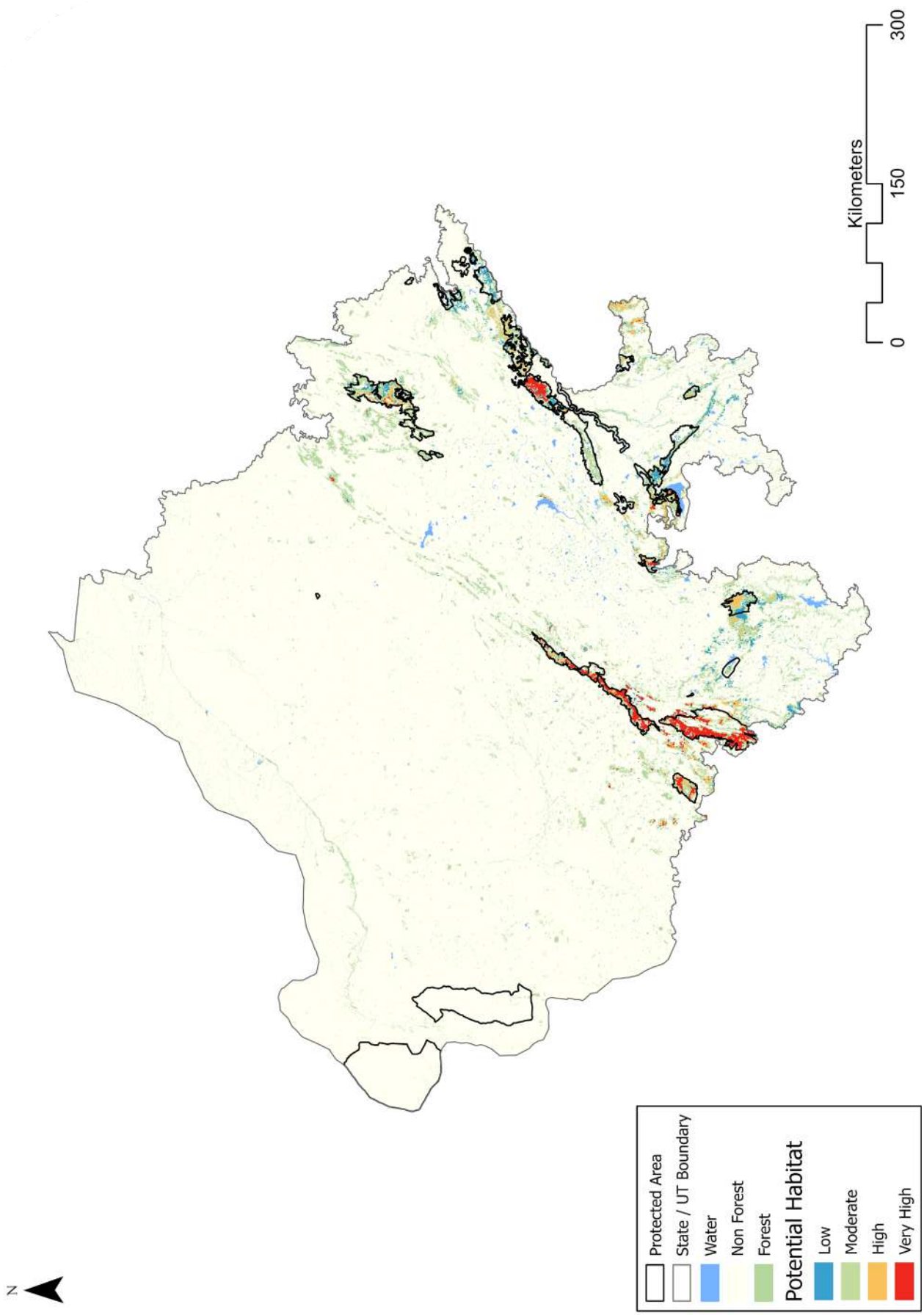

Figure 9: Modelled habitat suitability of Sloth Bears in Rajasthan, India derived from All India Tiger Estimation (2018 and 2022).

ANDHRA PRADESH

Andhra Pradesh contains extensive tropical dry deciduous forests, southern thorn scrub, and localized dry evergreen forests associated with the Nallamala and Seshachalam hill ranges. Nagarjunasagar Srisailam Tiger Reserve, the largest tiger reserve in India, protects a vast expanse of contiguous wilderness within the Eastern Ghats. Sloth bears occur at high densities across these rugged landscapes, benefiting from abundant rocky caves that provide secure denning sites, together with extensive termitaria and seasonally available fruits such as *Aegle marmelos* and *Ziziphus* spp. These habitat characteristics collectively make the Eastern Ghats one of the most suitable regions for sloth bear conservation in southern India.

Within the state, approximately 23,920 km² has been identified as suitable habitat for sloth bears, of which 2,982 km² constitutes very highly suitable habitat (Fig. 10). Highly suitable areas are largely confined to Nagarjunasagar Srisailam tiger reserve, Papikonda national park, Sri Penusila Narasimha, Sri Lankamalleswara and Sri Venkateswara Wildlife Sanctuaries, and adjacent forested patches.

HABITAT SUITABLE FOR SLOTH BEARS (KM²)
23,924

Very Highly Suitable (km²)	Highly Suitable (km²)	Moderately Suitable (km²)	Low Suitable (km²)
2,982	9,036	5,958	5,948

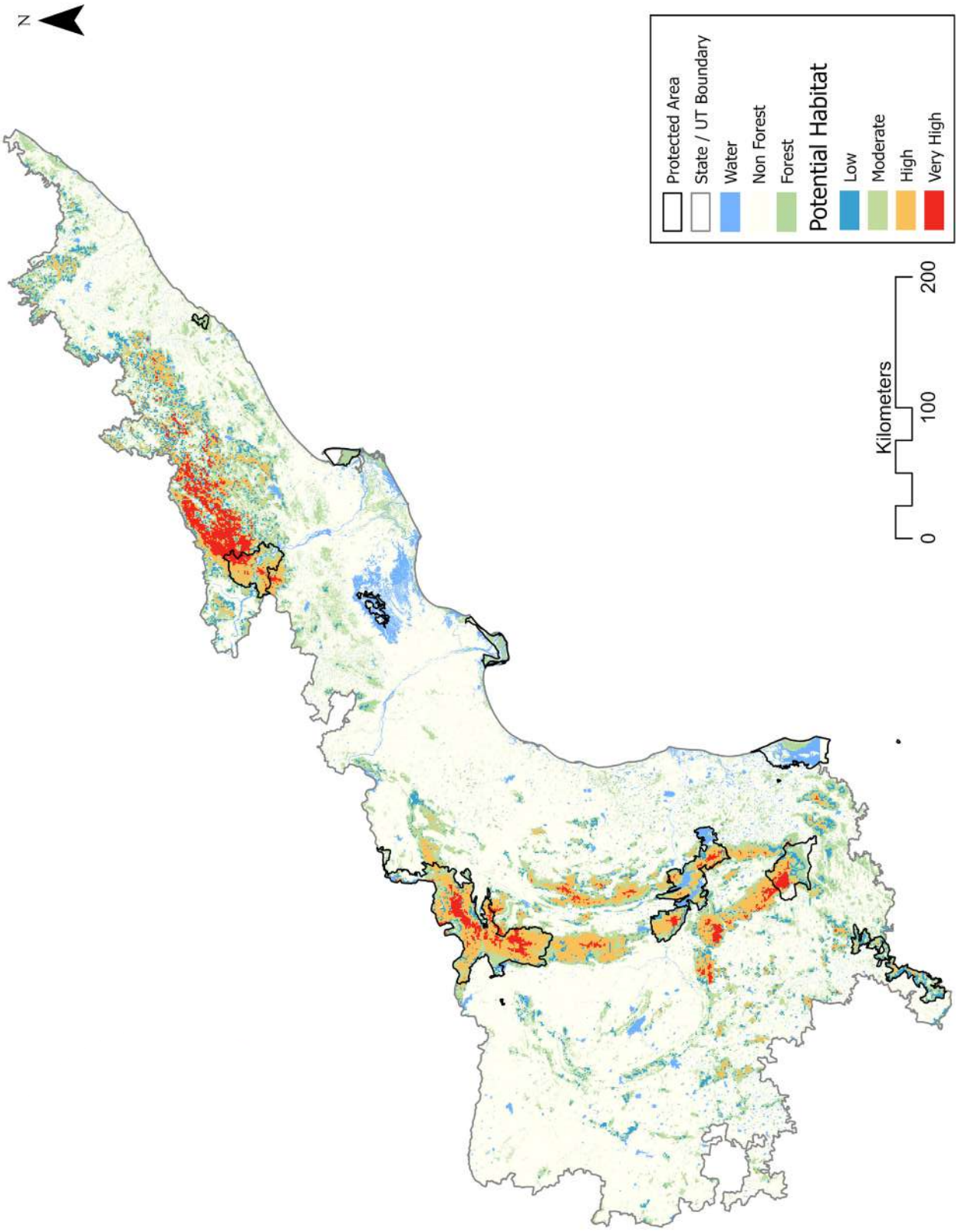

Figure 10: Modelled habitat suitability of Sloth Bears in Andhra Pradesh, India derived from All India Tiger Estimation (2018 and 2022).

TELANGANA

Telangana is dominated by southern tropical dry deciduous teak forests, scrublands, and riverine woodlands distributed across the Godavari and Krishna river basins. Amrabad and Kawal Tiger Reserves are important refugia of dry forest ecosystems and function as critical carnivore corridors across the Deccan Plateau. Sloth bears are widely distributed throughout these forests, where numerous rock outcrops provide essential denning habitat while seasonal forest fruits complement their predominantly insectivorous diet. The availability of extensive rocky terrain and dry deciduous vegetation continues to support viable populations across much of the state.

Model predictions suggest that the state contains approximately 9,825 km² of suitable sloth bear habitat, including 2,431 km² classified as very highly suitable (Fig. 11). Extensive patches of highly suitable habitat are distributed within Amrabad Tiger Reserve.

HABITAT SUITABLE FOR SLOTH BEARS (KM²)
9,825

Very Highly Suitable (km²)	Highly Suitable (km²)	Moderately Suitable (km²)	Low Suitable (km²)
2,431	2,510	2,470	2,414

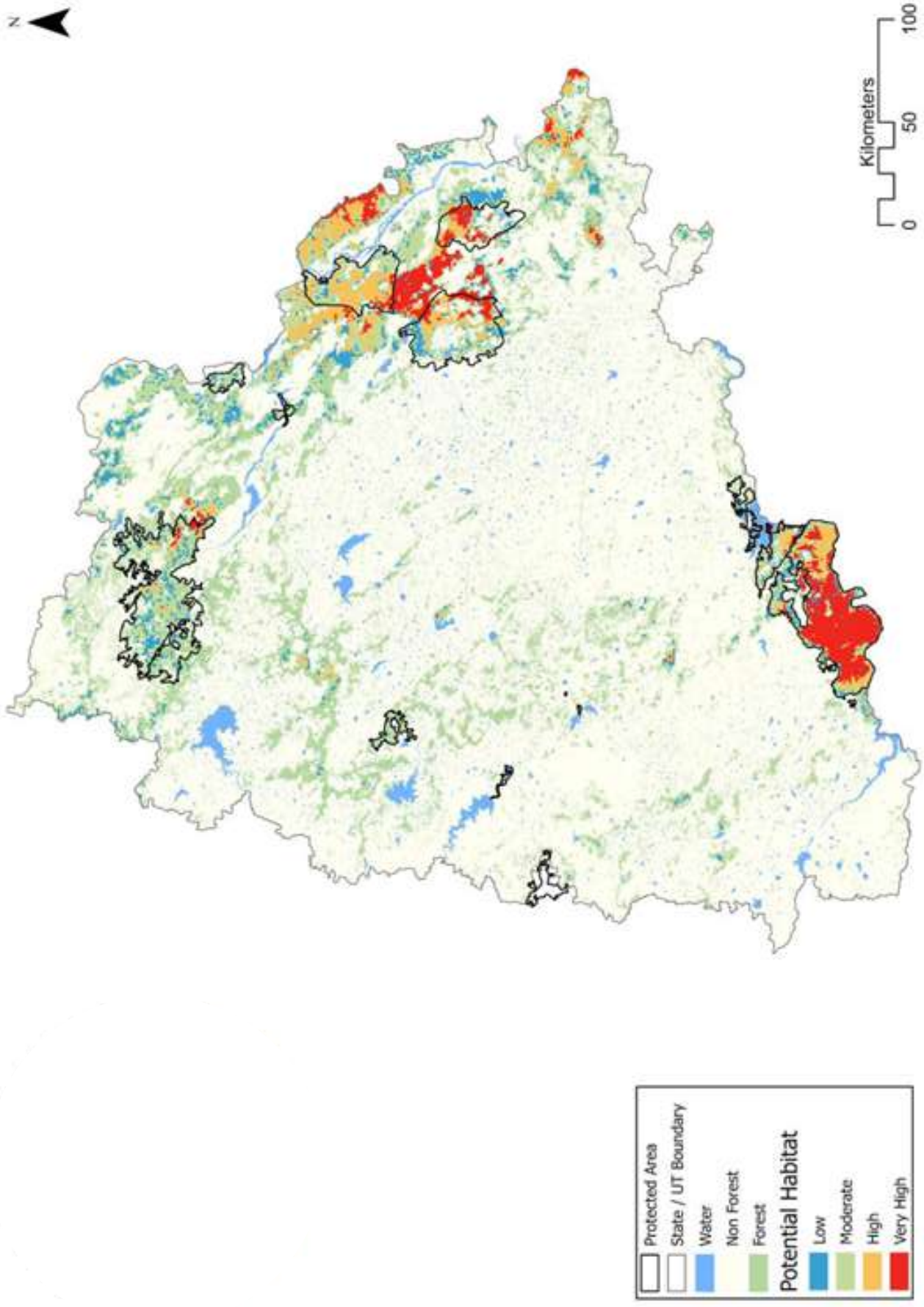

Figure 11: Modelled habitat suitability of Sloth Bears in Telangana, India derived from All India Tiger Estimation (2018 and 2022).

WESTERN GHATS

The Western Ghats Landscape is the second most important stronghold for the sloth bear in India after Central India. Although the species is widely distributed across much of the Western Ghats, its occurrence is patchier and heterogeneous than in Central India because of strong gradients in rainfall, elevation, forest type, and land use. Sloth bears in this landscape tend to concentrate in drier forests and rugged terrain, while human disturbance and higher precipitation generally reduce occupancy (Puri *et al.*, 2015).

The Western Ghats, one of the world's globally recognized biodiversity hotspots, encompass a remarkable diversity of vegetation types, including tropical wet evergreen forests, montane shola forests, grasslands, lateritic plateaus, moist and dry deciduous forests, dry thorn forests, and coastal scrub habitats. This exceptional habitat heterogeneity, combined with pronounced elevational and climatic gradients, supports extraordinary levels of biological diversity and endemism.

The region harbours approximately 5,800 species of flowering plants, of which a large proportion are endemic, representing nearly 27% of India's total flowering plant diversity (Gunawardene *et al.*, 2007, Nayar *et al.*, 2014). It also supports a rich assemblage of vertebrate and invertebrate fauna, including numerous endemic birds, mammals, reptiles, amphibians, freshwater fishes, and invertebrates. The Western Ghats provide critical habitat for several globally threatened species, including the tiger (*Panthera tigris*), Asian elephant (*Elephas maximus*), dhole (*Cuon alpinus*), lion-tailed macaque (*Macaca silenus*), Nilgiri tahr (*Nilgiritragus hylocrius*), Nilgiri langur (*Semnopithecus johnii*), and a remarkable diversity of endemic amphibians, including caecilians. Collectively, these attributes make the Western Ghats one of the most significant centres of biodiversity and conservation priority in the Indian subcontinent.

In the Western Ghats, sloth bear occupies a vast, contiguous range extending from Anshi-Dandeli of Northern Western Ghats to Tamil Nadu and Keralam, with its major stronghold anchored in the Southern Western Ghats–Nilgiri Landscape Complex (including Nagarhole, Bandipur, and Mudumalai) (Qureshi *et al.*, 2023; Puri *et al.*, 2015). Although primarily favouring tropical dry and moist deciduous forests along with eastern rain-shadow scrublands below 1,000 meters - where termitaria and rocky denning caves are abundant - the species demonstrates altitudinal flexibility up to 2,000 meters in upper montane forests. Evergreen patches serve mainly as thermal refuges and seasonal corridors. Local fruit trees like *Cordia dichotoma, Ficus benghalensis, Diospyros melanoxylon, Ziziphus* spp., and *Syzygium cumini* complement their insectivorous diet (Baskaran *et al.*, 2015). While core protected areas maintain dense populations, northern and fringe distributions face localized fragmentation, driving bears into human-dominated matrix habitats (Qureshi *et al.*, 2023).

The binary habitat suitability map, generated using the maximum training sensitivity-plus-specificity threshold, identified approximately 35,250 km² of suitable habitat in the Western Ghats landscape (Fig. 12), of which 41% occurred within the protected area network, while the remaining suitable habitat was distributed across reserved forests, territorial forests, and other forested landscapes outside formally protected areas. The distribution of suitable habitat within protected areas is summarized in Table 2.

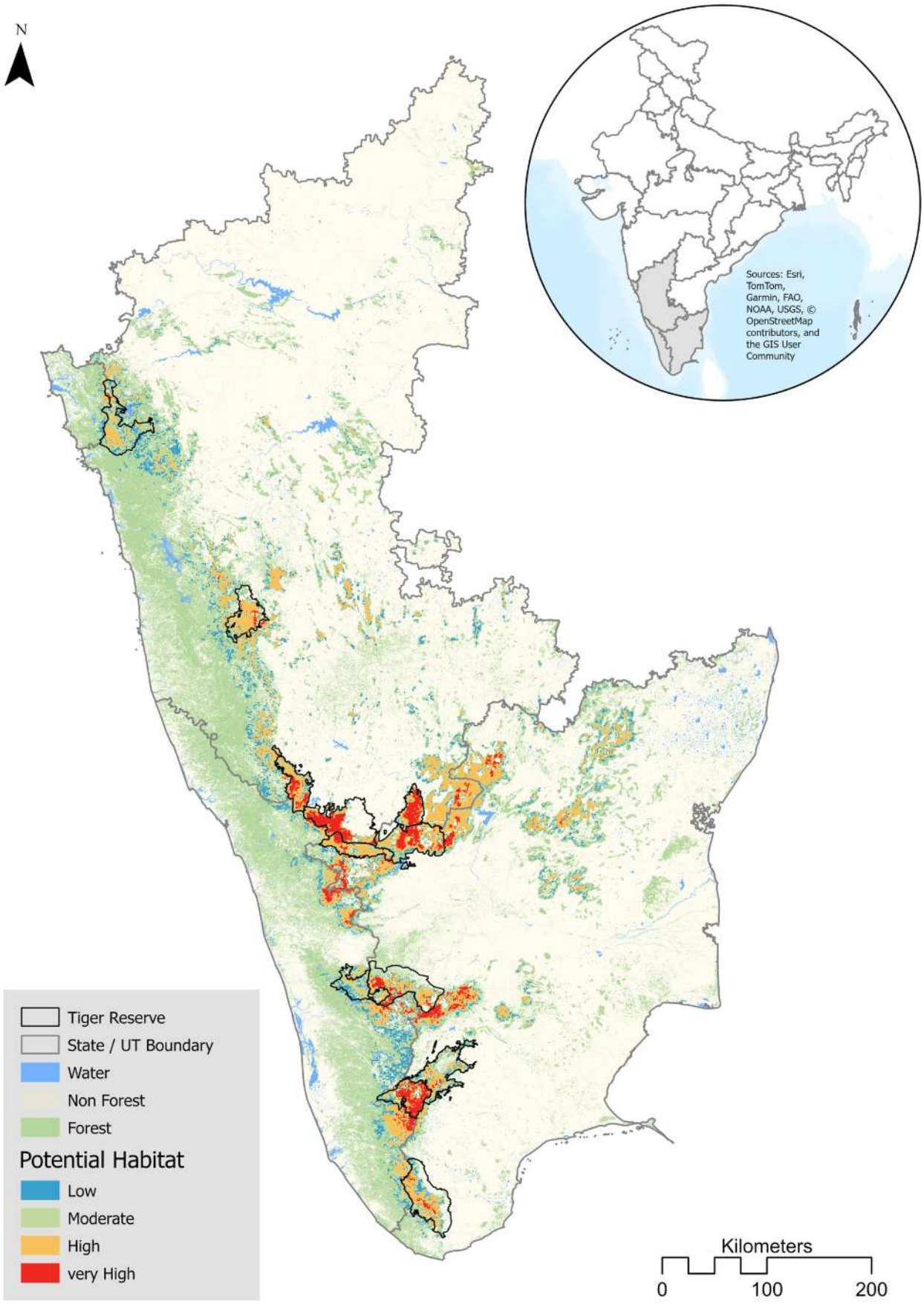

Figure 12: Modelled habitat suitability of Sloth Bears in Western Ghats Complex of India's tiger bearing Landscape derived from All India Tiger Estimation (2018 and 2022).

GOA

Although geographically small, Goa occupies a strategically important position within the Northern Western Ghats, supporting tropical semi-evergreen forests, moist deciduous forests, and riparian habitats along the Mandovi and Zuari river systems. Protected areas such as Mhadei and Bhagwan Mahaveer form a crucial ecological bottleneck that facilitates wildlife movement between Karnataka and Maharashtra. Sloth bears inhabit the dense moist deciduous forests of Mhadei and Mollem, where continuous forest cover and rugged terrain provide suitable habitat. Maintaining landscape connectivity across this region is essential for preventing genetic isolation of sloth bear populations while simultaneously supporting movement of other wide-ranging species, including tigers.

Suitable sloth bear habitat in the state encompasses approximately 350 km², of which 37 km² has been delineated as very highly suitable (Fig. 13). Very highly suitable habitats are located in and around Mollem national park, while Cotigao, Netravali and Mhadei wildlife sanctuaries have highly suitable habitat.

HABITAT SUITABLE FOR SLOTH BEARS (KM²)
357

Very Highly Suitable (km²)	Highly Suitable (km²)	Moderately Suitable (km²)	Low Suitable (km²)
37	149	28	143

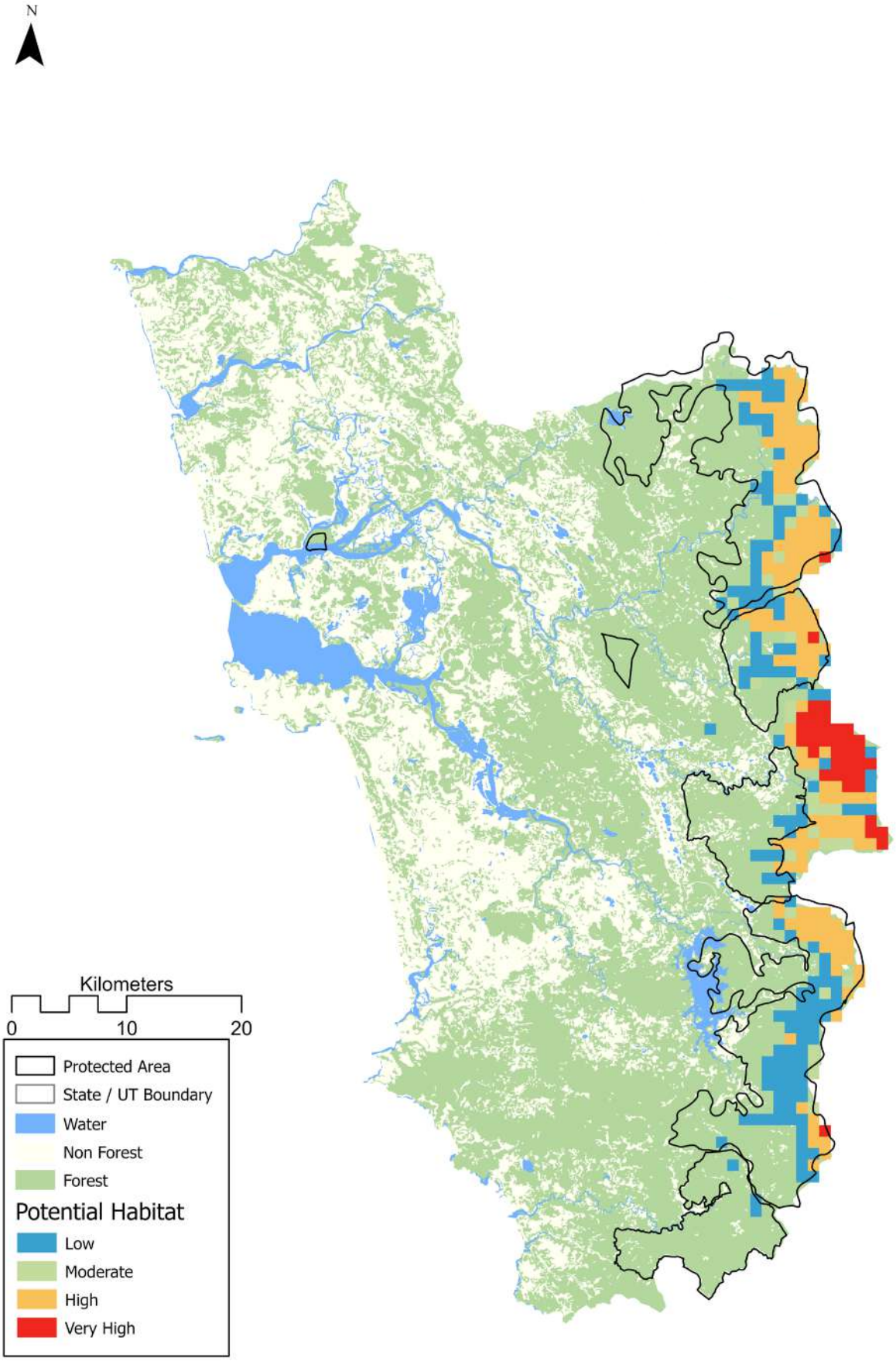

Figure 13: Modelled habitat suitability of Sloth Bears in Goa, India derived from All India Tiger Estimation (2018 and 2022).

KARNATAKA

Karnataka supports one of the most extensive ecological gradients in peninsular India, encompassing tropical evergreen and semi-evergreen forests along the west coast, moist and dry deciduous forests in tiger reserves such as Bandipur and Nagarhole, and thorn scrub habitats in eastern regions including Daroji sloth bear sanctuary and BRT tiger reserve. As part of the Nilgiri Biosphere Reserve, the state supports the world's largest contiguous tiger population and represents one of the country's most important biodiversity landscapes. Karnataka also sustains exceptionally high sloth bear populations, particularly within dry deciduous forests where rocky granite formations provide ideal denning habitat. Karnataka has three out of five designated sloth bear sanctuaries of India namely Daroji, Gudekote and Arasikere. These sanctuaries largely contain extensive granite boulder cave systems that offer thermal refuge, breeding sites, and secure daytime resting habitats.

The habitat suitability assessment identified approximately 14,770 km² of suitable habitat for sloth bears within the state, including 860 km² of very highly suitable habitat (Fig. 14). Areas of very high suitability occur within Nagarhole, Bandipur, Bhadra and BRT tiger reserves.

HABITAT SUITABLE FOR SLOTH BEARS (KM²)
14,770

Very Highly Suitable (km²)	Highly Suitable (km²)	Moderately Suitable (km²)	Low Suitable (km²)
860	6,507	3,799	3,604

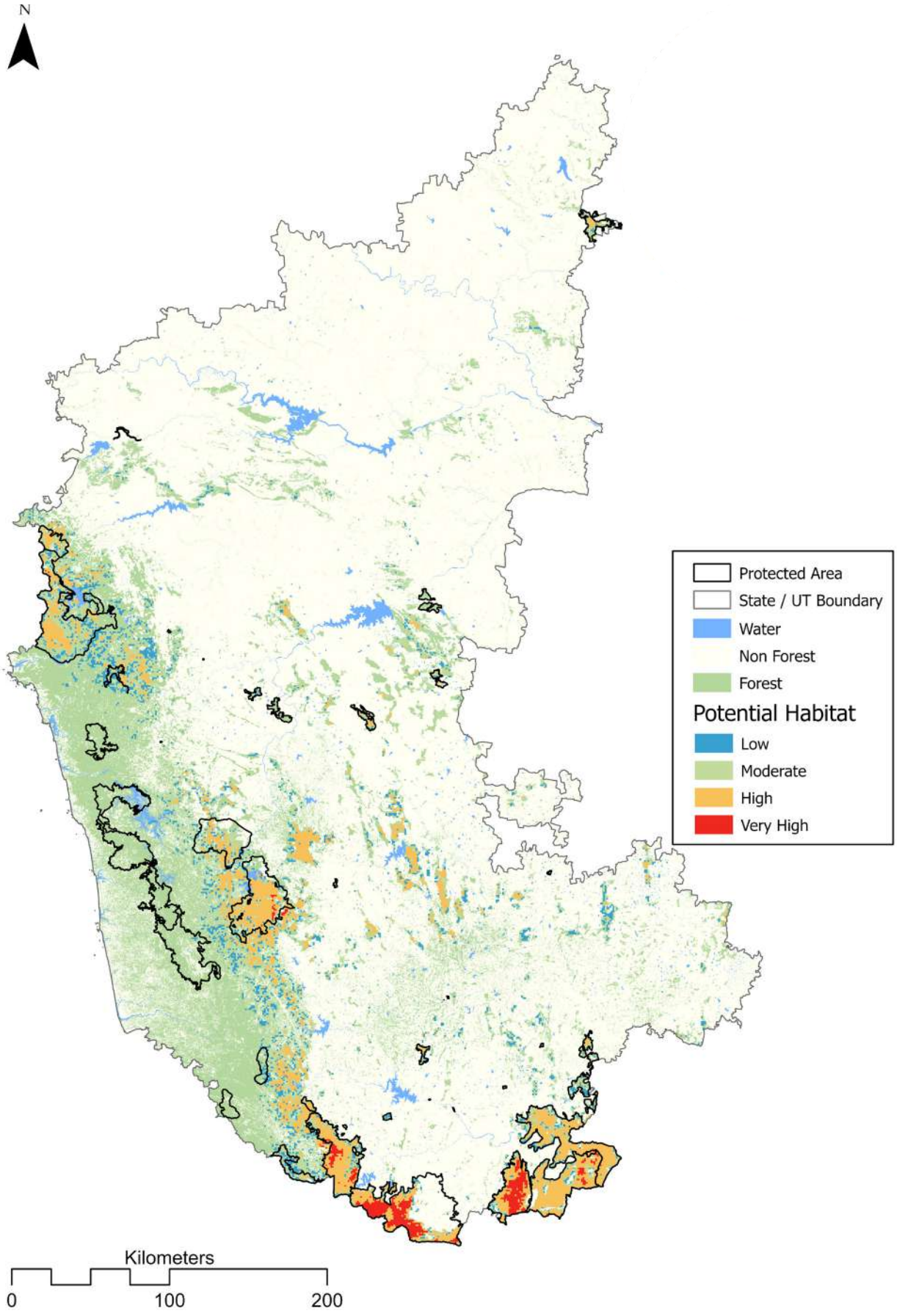

Figure 14: Modelled habitat suitability of Sloth Bears in Karnataka, India derived from All India Tiger Estimation (2018 and 2022).

KERALAM

Keralam is characterized by extensive tropical wet evergreen and semi-evergreen rainforests, moist deciduous forests, and high-elevation montane shola-grassland ecosystems that support exceptional levels of floral and faunal endemism. These forests also harbor important populations of tigers, Asian elephants, and Nilgiri tahr. Sloth bears are primarily confined to mid-elevation moist deciduous and semi-evergreen forests where suitable foraging and denning habitats occur. However, unlike the adjacent dry deciduous forests of Karnataka and Tamil Nadu, lower densities of subterranean termites in Keralam's moist forests naturally limit sloth bear abundance despite the availability of extensive forest cover.

Sloth bear habitat in the state encompasses approximately 6,860 km², of which 959 km² has been delineated as very highly suitable (Fig. 15). Highly suitable habitats are located in and around Periyar Tiger Reserve and Wayanad Wildlife Sanctuary.

HABITAT SUITABLE FOR SLOTH BEARS (KM²)
6,867

Very Highly Suitable (km²)	Highly Suitable (km²)	Moderately Suitable (km²)	Low Suitable (km²)
959	2,417	37	3,454

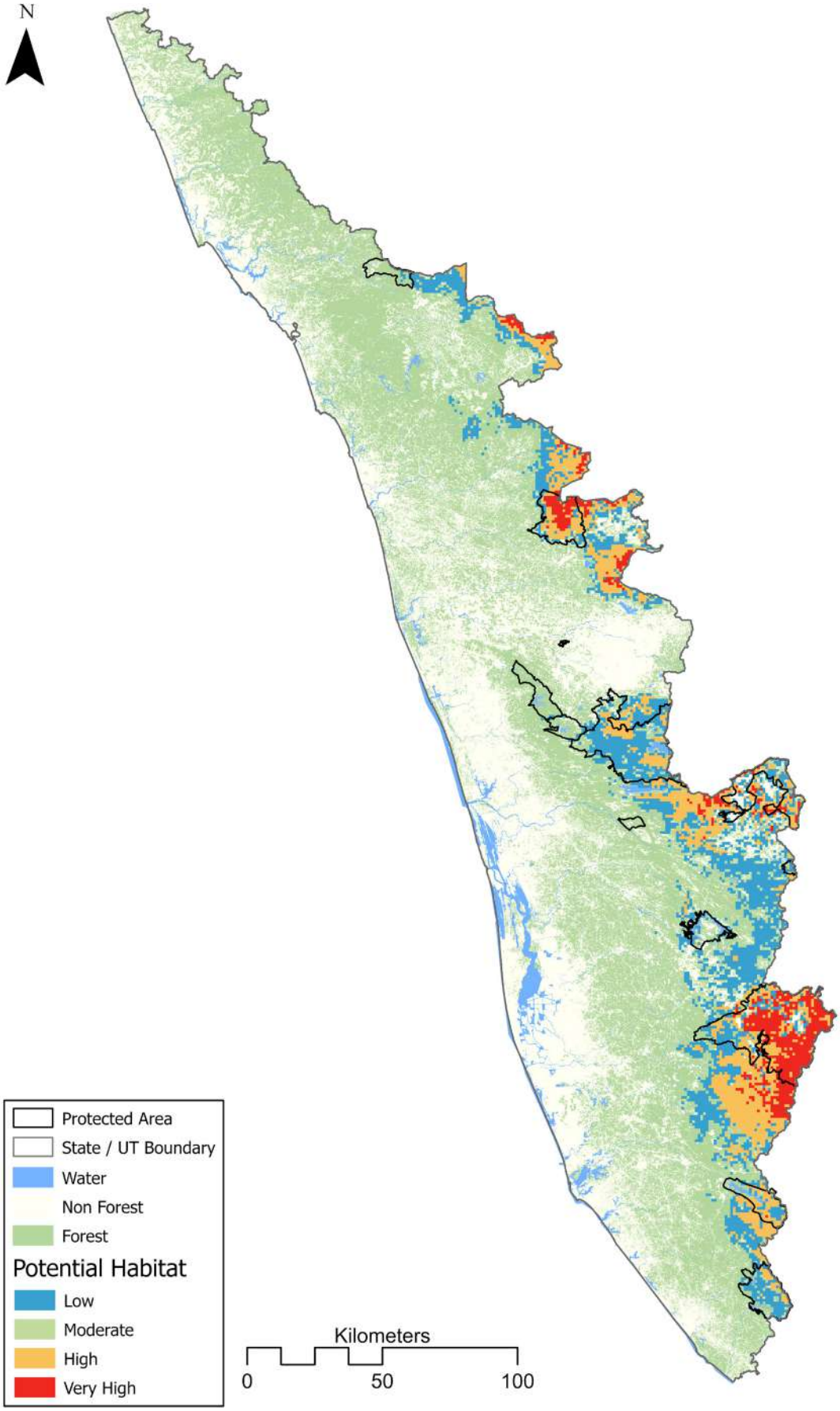

Figure 15: Modelled habitat suitability of Sloth Bears in Keralam, India derived from All India Tiger Estimation (2018 and 2022).

TAMIL NADU

Tamil Nadu contains a highly heterogeneous landscape where montane shola-grassland systems merge with tropical wet evergreen, moist deciduous, dry deciduous, and thorn scrub forests across the Eastern and Western Ghats interface. Tiger reserves such as Sathyamangalam and Mudumalai are particularly important for maintaining ecological connectivity for large carnivores across southern India. Sloth bears are primarily associated with dry deciduous forests and scrub habitats within these landscapes, where granite hills provide secure denning sites while deciduous vegetation supplies seasonal fruits and abundant insect prey. The combination of rocky terrain and productive dry forests supports stable bear populations across the state's major conservation landscapes.

The habitat suitability assessment identified approximately 13,250 km² of suitable habitat for sloth bears within the state, including 1,576 km² of very highly suitable habitat (Fig. 16). Areas of very high suitability occur within Sathyamangalam, Mudumalai, Anamalai and Kalakkad Mundanthurai tiger reserves.

HABITAT SUITABLE FOR SLOTH BEARS (KM²)
13,258

Very Highly Suitable (km²)	Highly Suitable (km²)	Moderately Suitable (km²)	Low Suitable (km²)
1,576	5,019	3,385	3,278

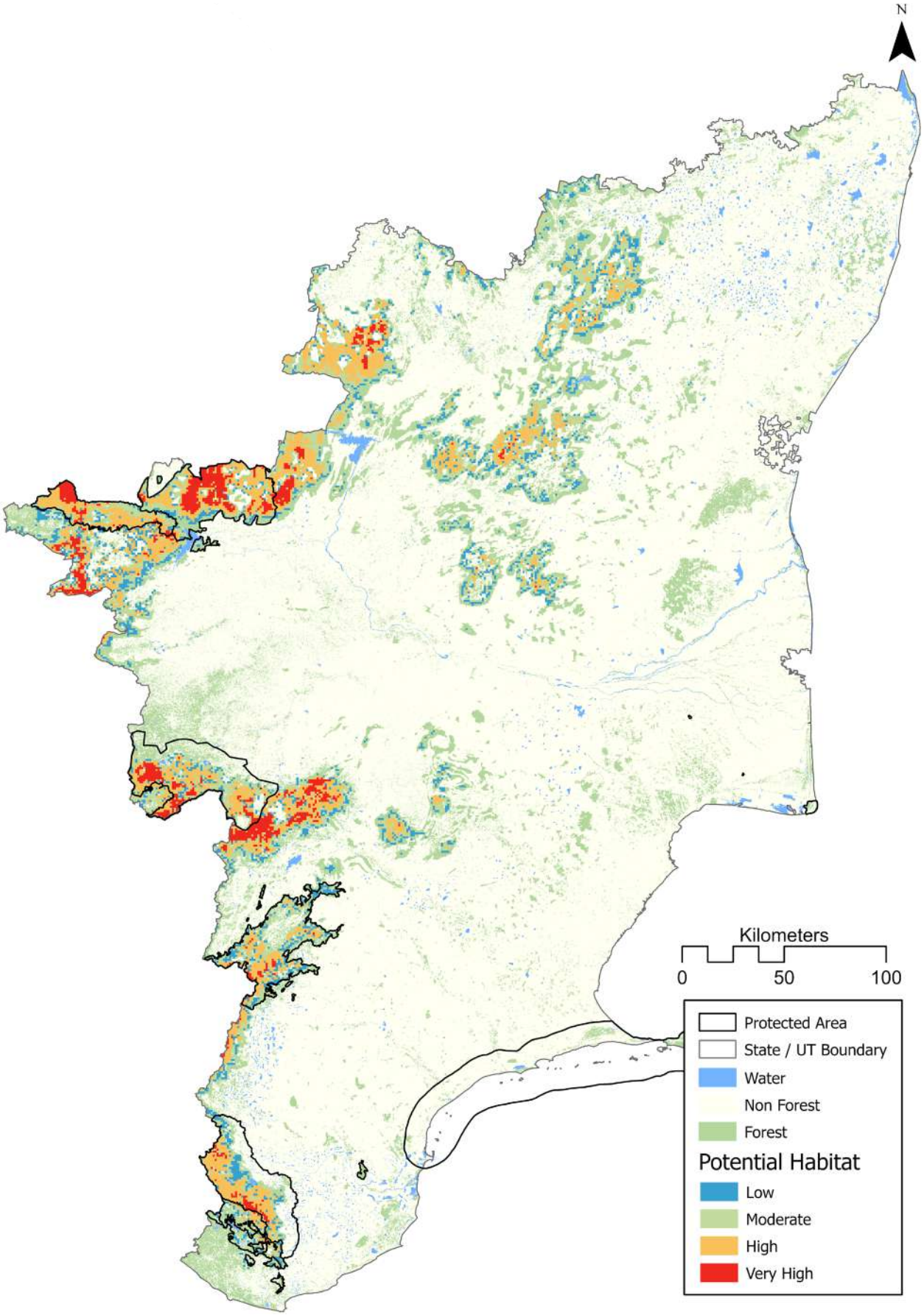

Figure 16: Modelled habitat suitability of Sloth Bears in Tamil Nadu, India derived from All India Tiger Estimation (2018 and 2022).

SHIVALIK HILLS & GANGETIC PLAINS

The Shivalik Hills and Gangetic Plains Landscape represents the northernmost extent of the sloth bear's distribution in India and forms an important transition zone between the Himalayan foothills and the alluvial plains of northern India. Compared with the Central India and Western Ghats Landscapes, sloth bear distribution in this region is relatively restricted, fragmented, and discontinuous. Suitable habitats are largely confined to the dry deciduous forests of the Shivalik foothills and selected parts of the Terai, where favourable topography, rocky denning sites, and adequate food resources occur. Extensive agricultural expansion, dense human settlements, linear infrastructure, and historical land-use change across the Gangetic Plains have substantially reduced habitat continuity, making this landscape one of the most challenging regions for long-term sloth bear conservation.

Within the tiger conservation framework, the landscape includes portions of Uttarakhand, Uttar Pradesh, and Bihar, encompassing several tiger reserves, wildlife sanctuaries, reserve forests, and territorial forest divisions (Qureshi *et al.*, 2023). Although internationally recognized for supporting globally significant populations of tigers, Asian elephants, and other large mammals, sloth bears occur only in localized habitat patches that meet their specific ecological requirements.

The species is primarily distributed across the Shivalik hill ranges of Uttarakhand and adjoining Uttar Pradesh, with smaller, isolated populations occurring in suitable forest patches farther east. It is generally absent from the intensively cultivated Gangetic Plains and the higher elevations of the Himalayas, where climatic conditions, vegetation structure, and terrain are unsuitable.

Sal-dominated forests provide dense canopy cover and support a variety of fruit-bearing tree species that contribute to seasonal food availability. Mixed deciduous forests interspersed with rocky hill slopes, ravines, and seasonal streams provide favourable conditions for foraging and denning, while the abundance of termite mounds, ant colonies, and perennial water sources further enhances habitat suitability.

The Terai forests, characterized by alluvial soils, dense vegetation, riverine forests, and tall grasslands, are generally less suitable for sloth bears than the adjoining Shivalik hills (Johnsingh *et al.*, 2004; Yoganand *et al.*, 2006). Although bears may use parts of the Terai seasonally for foraging, the limited availability of rocky outcrops and secure denning sites restricts long-term occupancy (Laurie & Seidensticker, 1977; Paudel *et al.*, 2022). Consequently, sloth bear populations are concentrated primarily within the heterogeneous foothill forests (Joshi *et al.*, 1995; Yoganand *et al.*, 2006).

Several protected areas support sloth bear populations within this landscape, although the species is generally less abundant than in central and peninsular India. Important tiger reserves include Rajaji, Corbett, Pilibhit, Dudhwa, Valmiki, and Ranipur, together with adjoining wildlife sanctuaries and reserve forests.

Rajaji Tiger Reserve represents one of the important habitats for sloth bears in the western part of the landscape (Jhala *et al.*, 2018). Its mosaic of dry deciduous forests, rocky hills, seasonal streams, and river valleys provides favourable habitat for the species. Corbett Tiger Reserve also supports resident populations, particularly within the drier foothill forests and rocky slopes surrounding its core valleys.

Farther east, Valmiki Tiger Reserve in Bihar forms an important component of the landscape and contributes to habitat connectivity with adjoining forests in Nepal. Although sloth bear densities are generally lower than those in Central India, these protected areas collectively support viable populations that define the northern limit of the species' distribution in India.

The binary habitat suitability map, generated using the maximum training sensitivity-plus-specificity threshold, identified approximately 7,930 km² of suitable habitat in Shivalik Hills and Gangetic Plains landscape (Fig. 17), of which 60% occurred within the protected area network, while the remaining 40% of suitable habitat was distributed across reserved forests, territorial forests, and other forested landscapes outside formally protected areas. The distribution of suitable habitat within and outside protected areas is summarized in Table 2.

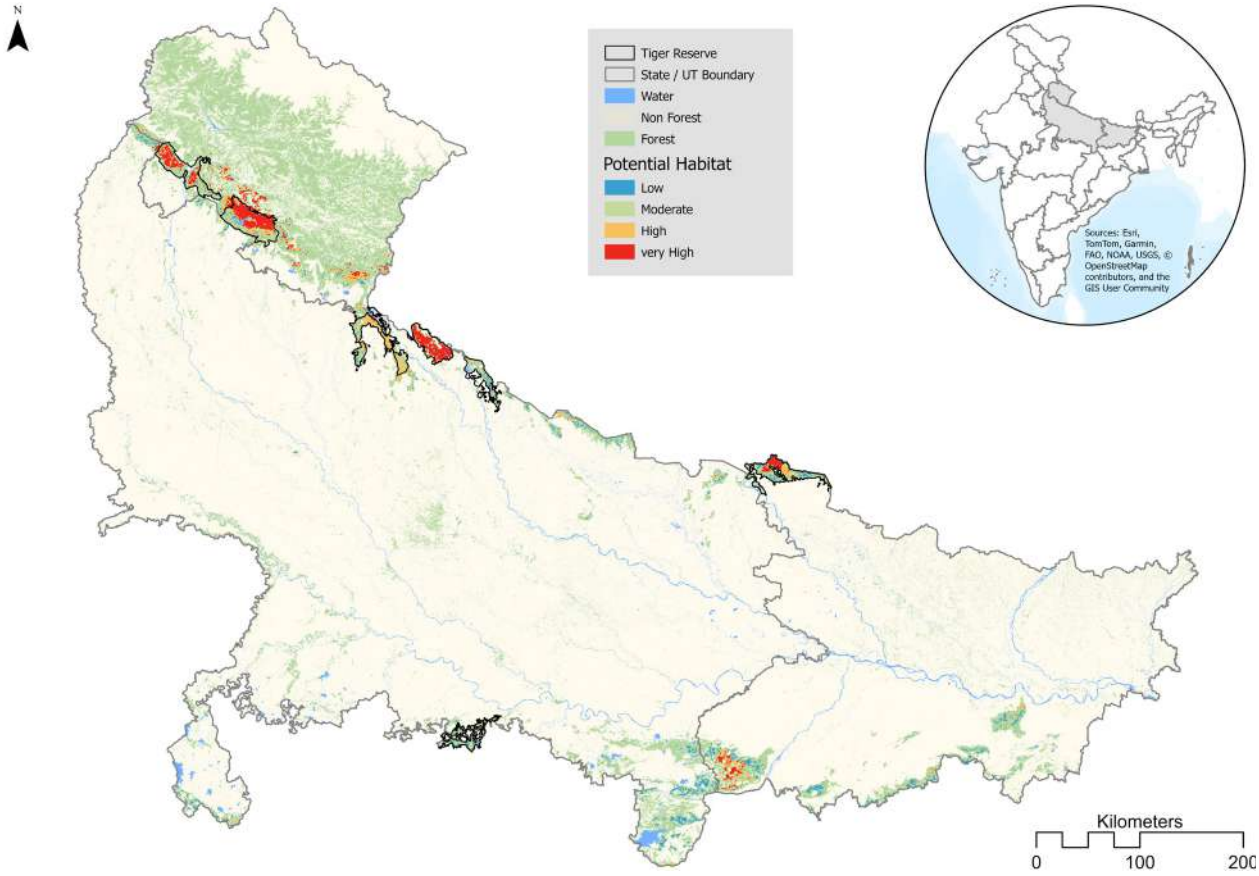

Figure 17: Modelled habitat suitability of Sloth Bears in Shivalik Hills and Gangetic Plains Complex of India's tiger bearing Landscape derived from All India Tiger Estimation (2018 and 2022).

UTTARAKHAND

Uttarakhand represents the northern limit of sloth bear distribution in South Asia and encompasses moist sal forests, sub-Himalayan mixed deciduous forests, Bhabar–Terai grasslands, and subtropical pine forests. The state supports globally significant tiger populations, with Corbett Tiger Reserve maintaining the highest tiger density in India. Sloth bears are primarily confined to the Shivalik foothills, particularly within Rajaji and Corbett landscapes, where they coexist with the Asiatic black bear. This overlap creates a unique ecological setting in which two bear species coexist within the same forest ecosystem while occupying partially differentiated habitats and resource niches.

The state has approximately 3,000 km² of suitable habitat, of which 283 km² has been identified as very highly suitable for sloth bears (Fig. 18). Areas of very high suitability occur within Corbett tiger reserve, while parts of Corbett and Rajaji tiger reserves have high suitable habitat.

HABITAT SUITABLE FOR SLOTH BEARS (KM²)
3,003

Very Highly Suitable (km²)	Highly Suitable (km²)	Moderately Suitable (km²)	Low Suitable (km²)
283	1,220	757	743

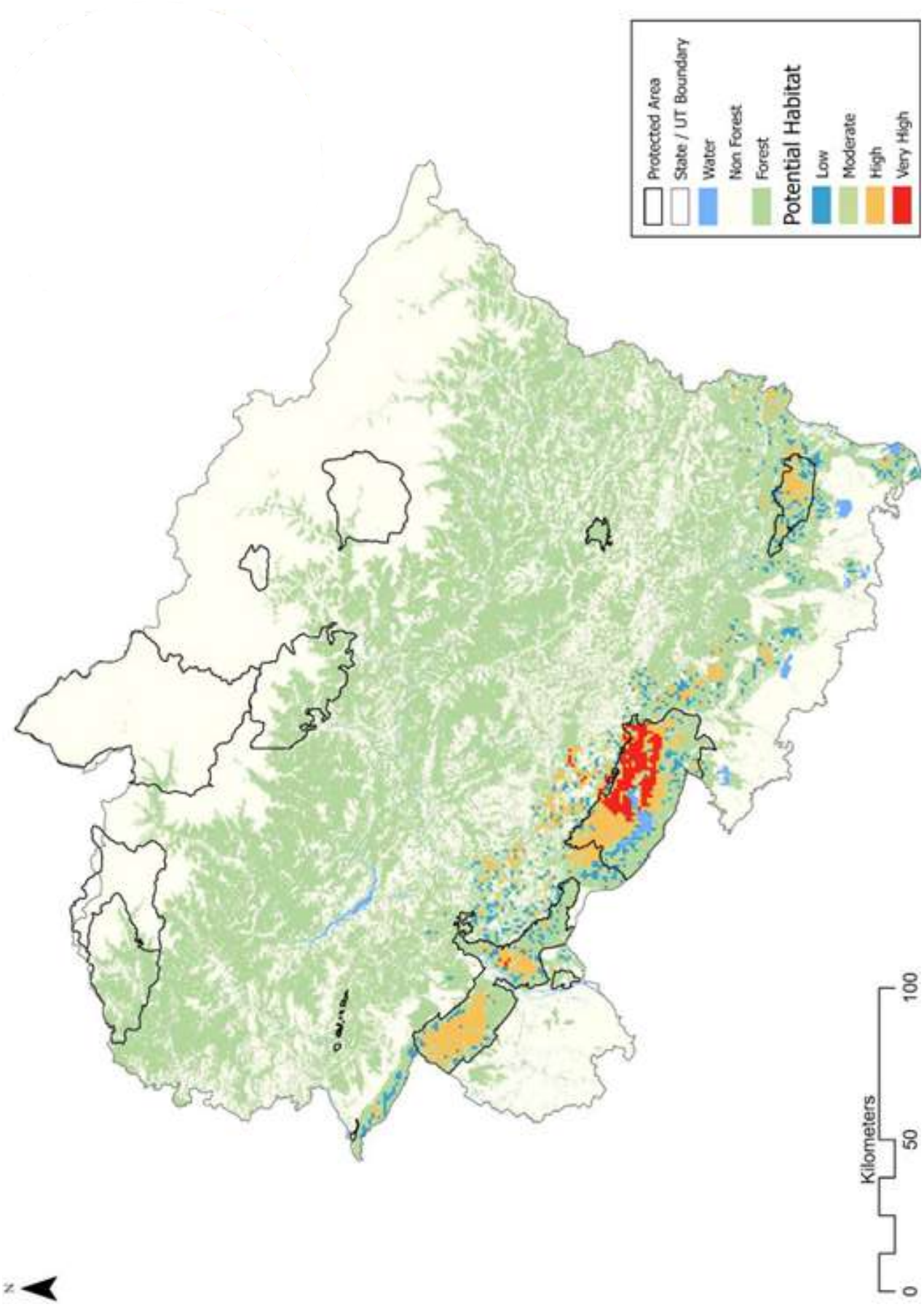

Figure 18: Modelled habitat suitability of Sloth Bears in Uttarakhand, India derived from All India Tiger Estimation (2018 and 2022).

UTTAR PRADESH

The Terai landscapes of Uttar Pradesh comprise alluvial savannas, tall grasslands, moist sal forests, and riverine swamp forests that support diverse assemblages of large mammals, including tigers, swamp deer, and greater one-horned rhinoceros within Dudhwa and Pilibhit. Sloth bears are distributed throughout suitable forest habitats of the Terai belt; however, conversion of native forest fringes into extensive sugarcane cultivation has created dense artificial cover adjacent to agricultural fields. Consequently, bears frequently move between forests and cultivated landscapes, substantially increasing the likelihood of encounters with agricultural workers and contributing to recurring human–bear conflict.

Model predictions suggest that the state contains approximately 2,940 km² of suitable sloth bear habitat, including 283 km² classified as very highly suitable (Fig. 19). Patches of very highly suitable habitat are distributed within Dudhwa Tiger Reserve, while Pilibhit Tiger Reserve has highly suitable habitat.

HABITAT SUITABLE FOR SLOTH BEARS (KM²)
2,943

Very Highly Suitable (km²)	Highly Suitable (km²)	Moderately Suitable (km²)	Low Suitable (km²)
728	737	744	734

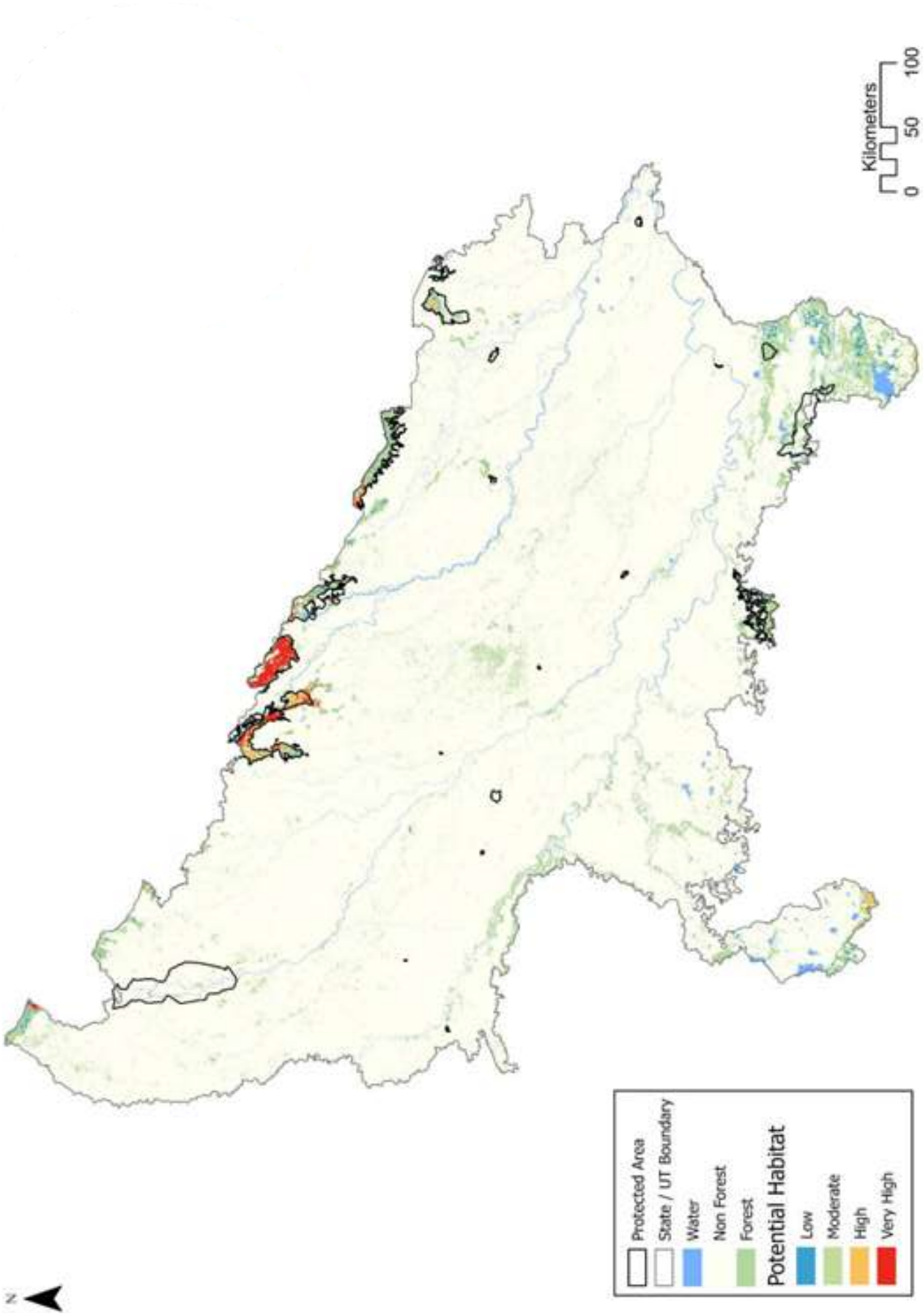

Figure 19: Modelled habitat suitability of Sloth Bears in Uttar Pradesh, India derived from All India Tiger Estimation (2018 and 2022).

BIHAR

Bihar supports sub-Himalayan moist deciduous sal forests, mixed deciduous forests, and riverine alluvial habitats, with Valmiki Tiger Reserve forming an important transboundary conservation landscape contiguous with Nepal's Chitwan National Park. Sloth bears utilize sal forests and boulder-strewn foothill riverbeds for foraging and shelter, while the international forest corridor facilitates seasonal movement between India and Nepal. Maintaining the integrity of these transboundary habitats is therefore important for ensuring long-term connectivity and persistence of sloth bear populations within the eastern Himalayan foothills.

Within the state, approximately 1,980 km² has been identified as suitable habitat for sloth bears, of which 480 km² constitutes very highly suitable habitat (Fig. 20). Very highly suitable areas are largely confined to Valmiki Tiger Reserve and forested patches of Kaimur wildlife sanctuary, while Bhimbandh Wildlife Sanctuary has highly suitable habitat.

HABITAT SUITABLE FOR SLOTH BEARS (KM²)
1,986

Very Highly Suitable (km²)	Highly Suitable (km²)	Moderately Suitable (km²)	Low Suitable (km²)
480	493	518	495

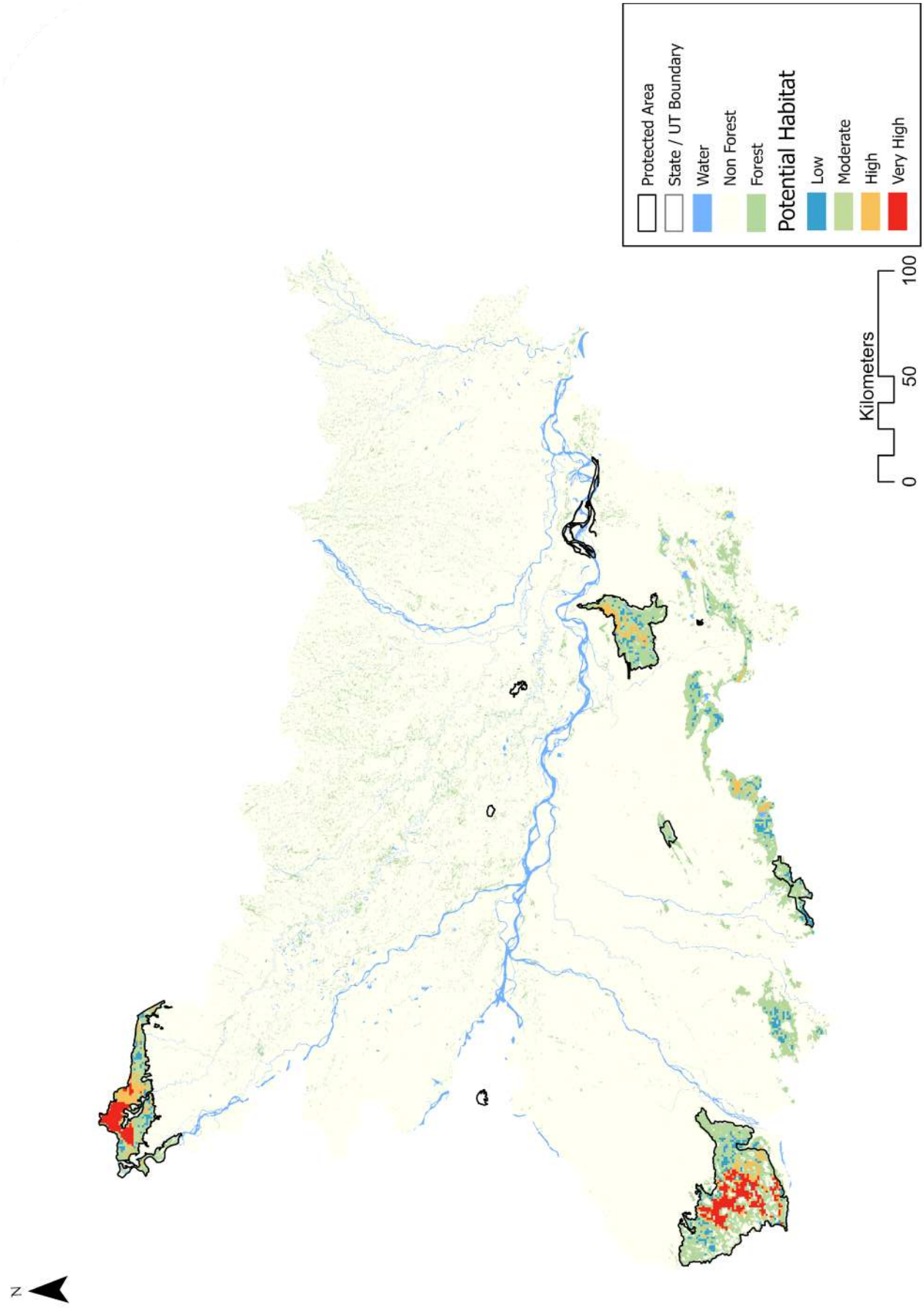

Figure 20: Modelled habitat suitability of Sloth Bears in Bihar, India derived from All India Tiger Estimation (2018 and 2022).

NORTH EAST HILLS & BRAHMAPUTRA FLOODPLAINS

The North East Landscape represents the easternmost extent of the global distribution of the sloth bear. It forms a unique biogeographic transition between the eastern Himalayan foothills, the alluvial floodplains of the Brahmaputra, Barak and Teesta river basins, and the Indo-Burma Biodiversity Hotspot. Compared with the Central India and Western Ghats Landscapes, sloth bear distribution in this region is highly restricted, fragmented, and naturally discontinuous (Chauhan, 2006; Bargali *et al.*, 2012). Suitable habitats are largely confined to lowland tropical moist deciduous forests, riverine forests, and open scrublands of the floodplains and lower foothills, where favourable topography, abundant termitaria, and adequate food resources occur (Choudhury, 2011; Dharaiya *et al.*, 2017). Extensive agricultural expansion, shifting cultivation (*jhum*), commercial tea plantations, dense human settlements, and linear infrastructure have substantially reduced habitat continuity, making this landscape one of the most challenging regions for long-term sloth bear conservation (Yoganand *et al.*, 2006; Bargali *et al.*, 2012).

This landscape is biogeographically unique because it is the only region in India- and globally- where three tropical Asian bear species occur sympatrically: the sloth bear, the Asiatic black bear, and the Malayan sun bear (Chauhan, 2006; Choudhury, 2011; Garshelis *et al.*, 2022b). Their coexistence is facilitated by pronounced altitudinal and habitat gradients that promote ecological niche partitioning. While the Asiatic black bear primarily occupies mid- to high-elevation temperate broadleaf and evergreen forests, the Malayan sun bear is associated with dense tropical evergreen and semi-evergreen forests. In contrast, the sloth bear is largely confined to low-elevation deciduous forests, riverine habitats, and scrublands.

Within the tiger conservation framework, the landscape encompasses states of Assam, Arunachal Pradesh, Mizoram and parts of northern West Bengal comprising nine tiger reserves, and several national parks, wildlife sanctuaries, and territorial forest divisions (Chauhan, 2006; Bargali *et al.*, 2012). Although internationally recognized for its exceptional biodiversity, sloth bears occur only in localized habitat patches that satisfy their specific ecological requirements and are naturally less abundant than the Asiatic black bear (Yoganand *et al.*, 2006). The species is primarily distributed across the lowland plains and foothill forests of Assam, particularly the Karbi Anglong Plateau and adjoining reserve forests, and parts of Meghalaya, including the Garo Hills landscape. Smaller, isolated populations occur in suitable forest patches farther east (Choudhury, 2011; Bargali *et al.*, 2012). The species is generally absent from the higher elevations of the Eastern Himalayas and dense montane forests, where climatic conditions, vegetation structure, and terrain are unsuitable.

Moist deciduous forests provide dense canopy cover and support a diversity of fruit-bearing tree species, including Ficus, Ziziphus, and Syzygium, which contribute substantially to seasonal food availability (Yoganand *et al.*, 2006). Deciduous forests interspersed with scrublands, rocky slopes, ravines, and seasonal streams provide favourable conditions for foraging and denning, while abundant termite mounds, ant colonies, and perennial water sources further enhance habitat suitability (Dharaiya *et al.*, 2017). Although sloth bears may seasonally utilize low-lying riverine floodplains and alluvial grasslands for foraging, the scarcity of rocky outcrops and secure denning sites limits long-term occupancy in these habitats (Laurie & Seidensticker, 1977; Paudel *et al.*, 2022). Consequently, populations are concentrated primarily within the heterogeneous foothill forests and elevated plateau systems (Yoganand *et al.*, 2006).

Several protected areas support sloth bear populations within this landscape, although the species is generally less abundant than in Central India or the Western Ghats (Yoganand *et al.*, 2006). Important protected areas include Kaziranga, Manas, Nameri, and Pakke tiger reserves, together with Balpakram National Park and the Garo Hills Conservation Area in Meghalaya (Chauhan, 2006; Choudhury, 2011; Garshelis *et al.*, 2022b). Balpakram National Park and the surrounding Garo Hills represent one of the most important zones where all three bear species have been documented sympatrically (Chauhan, 2006; Garshelis *et al.*, 2022b). Kaziranga National Park also represents an important stronghold for sloth bears in the Brahmaputra floodplains, where alluvial forests and adjacent grassland mosaics support abundant termite resources (Choudhury, 2011). Although sloth bear densities in northeastern India are naturally low, these protected areas collectively support populations that define the easternmost limit of the species' global distribution and contribute significantly to its long-term conservation.

The binary habitat suitability map (Fig. 21) was generated by applying the maximum training sensitivity-plus-specificity threshold to the continuous habitat suitability predictions. This classification identified approximately 7,610 km^2 of suitable habitat across the North East Hills and Brahmaputra Floodplains landscape. Of the total suitable habitat, only 4% was located within the protected area network, whereas the remaining 96% occurred outside protected areas, primarily within reserved forests, territorial forests, and other forested landscapes. A summary of the distribution of suitable habitat across protected areas is presented in Table 2.

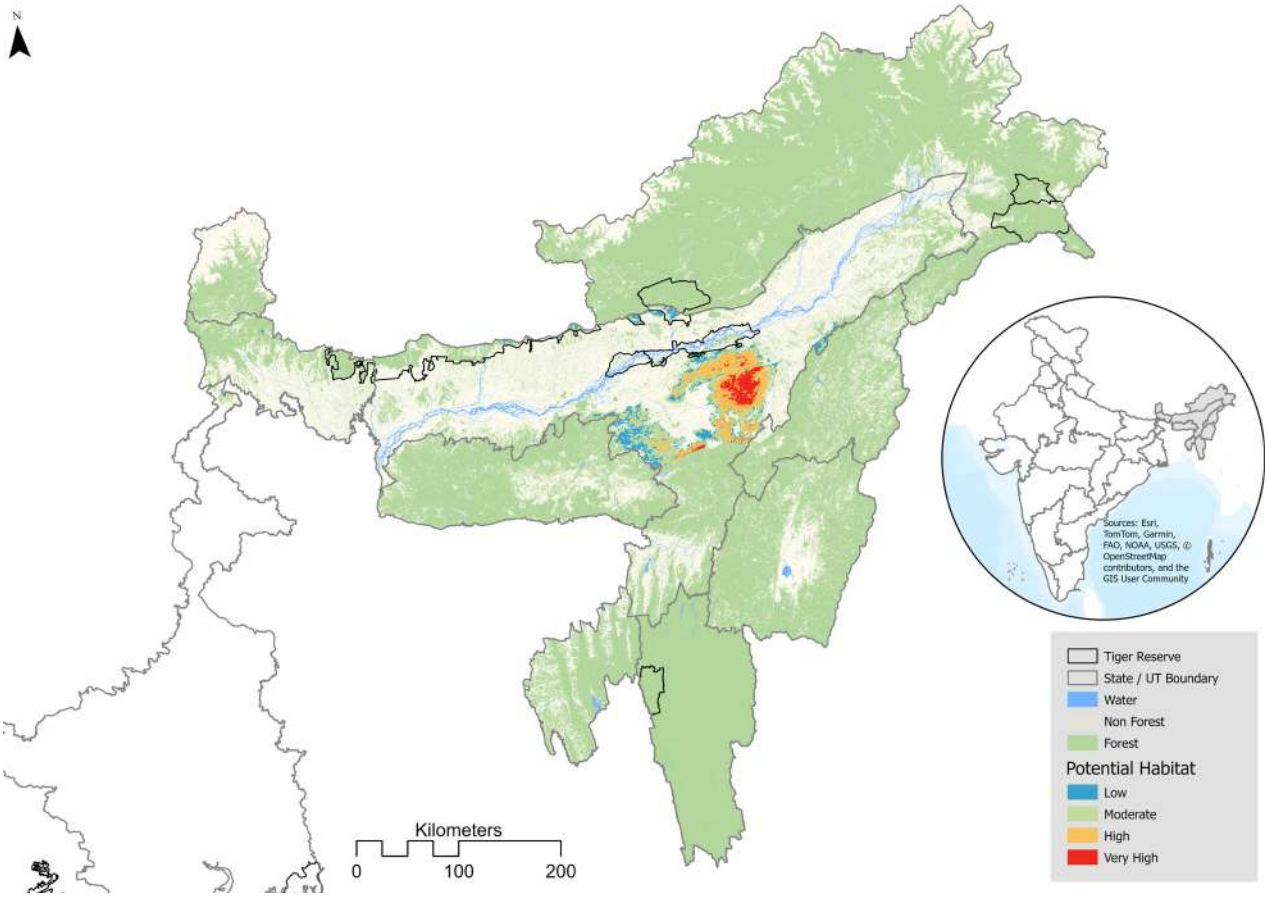

Figure 21: Modelled habitat suitability of Sloth Bears in North East Hills and Brahmaputra Floodplains Complex of India's tiger bearing Landscape derived from All India Tiger Estimation (2018 and 2022).

ASSAM

Assam's terrestrial ecosystem comprises a mosaic of tropical wet evergreen, semi-evergreen, and wet alluvial floodplain grasslands alongside riverine forest formations. These habitat matrices sustain globally significant, high-density populations of megaherbivores and apex carnivores, notably within protected strongholds such as Kaziranga and Manas tiger reserves. Critically, as a biogeographical transition zone where the easternmost limit of the sloth bear intersects with the westernmost extent of the sun bear and the broader distribution of the Asiatic black bear, Assam represents one of the rare global regions supporting the range overlap of three sympatric bear species. However, unlike regional distribution patterns across the broader subcontinent, the sloth bear exhibits low occupancy within Assam's seasonally inundated alluvial floodplains. Instead, its local distribution is ecologically constrained to the sub-Himalayan foothill semi-evergreen belt bordering Bhutan and the contiguous dry deciduous forests of the Karbi Anglong plateau. This spatial partitioning is driven by specific habitat selection parameters- namely a physiological and ecological preference for well-drained microclimates offering higher termitarium density, exposed rocky outcrops for shelter, and geomorphologically stable substrates suitable for denning.

Within the state, approximately 7,570 km² has been identified as suitable habitat for sloth bears, of which 823 km² constitutes very highly suitable habitat (Fig. 22). Very highly suitable areas are largely confined to the Karbi Anglong plateau, while parts of Kaziranga and Nameri tiger reserves have highly suitable habitat.

HABITAT SUITABLE FOR SLOTH BEARS (KM²)
7,572

Very Highly Suitable (km²) 823

Highly Suitable (km²) 2,942

Moderately Suitable (km²) 1,927

Low Suitable (km²) 1,880

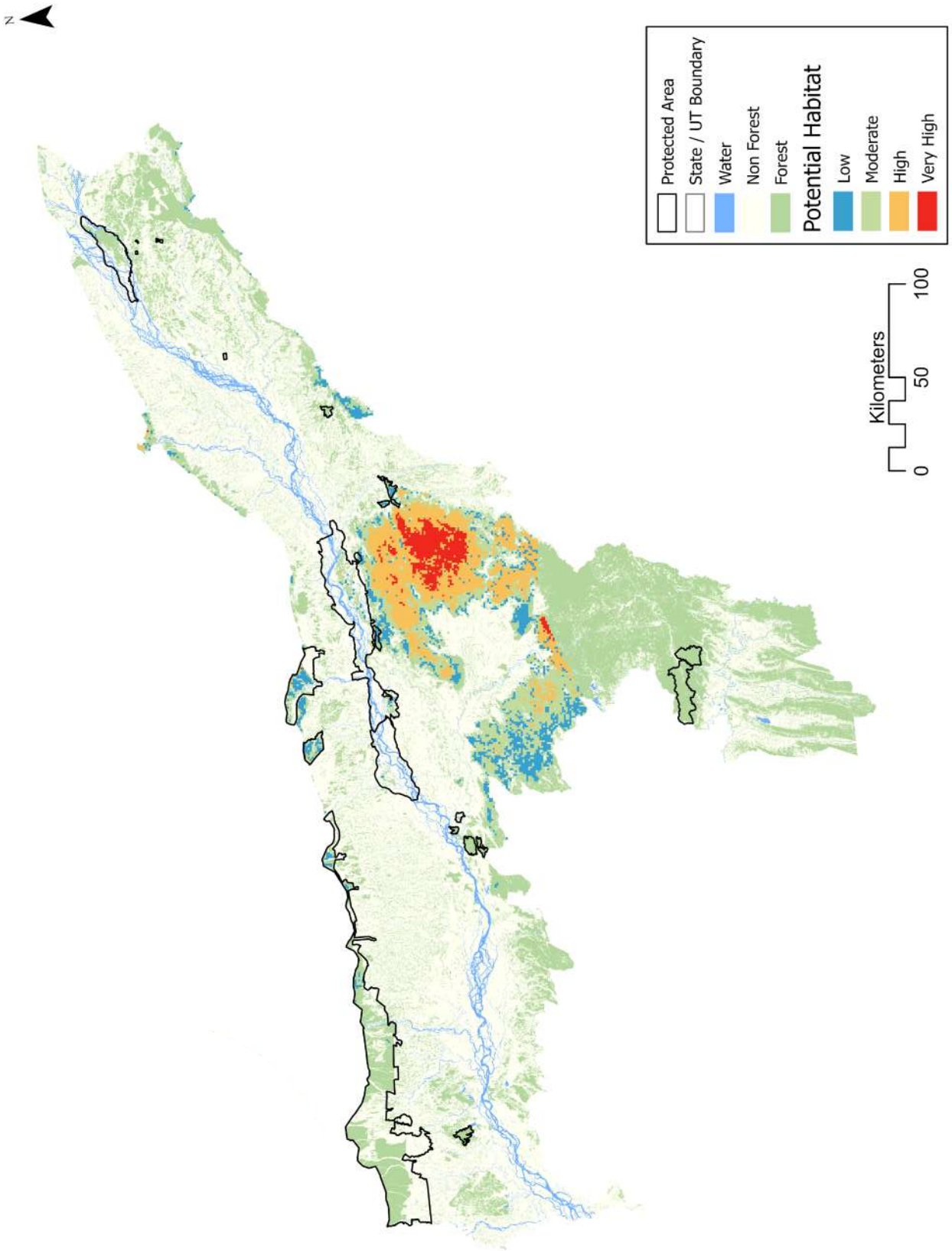

Figure 22: Modelled habitat suitability of Sloth Bears in Assam, India derived from All India Tiger Estimation (2018 and 2022).

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DISCUSSION

The four tiger landscapes evaluated in this report encompass the vast majority of the extant distribution of the sloth bear in India. Although the species exhibits high ecological plasticity, substantial variations exist across landscapes in habitat extent, forest composition, population continuity, structural connectivity, and anthropogenic pressures. These factors dictate distinct local occupancy and dispersal dynamics, highlighting the need for landscape-specific conservation strategies (Table 4).

Representing the global cornerstone for sloth bear conservation, Central India and Eastern Ghats landscape supports the largest continuous populations, highest habitat diversity, and most extensive ecological connectivity. It features contiguous tracts of tropical dry and moist deciduous forests, extensive rocky hill systems for denning, and a dense network of Protected Areas (PAs). Functioning as the principal source region for regional population persistence, it allows natural dispersal into neighbouring areas.

As the second largest conservation stronghold, the Western Ghats form an essential complement to Central India. Supporting high population densities across a complex rainfall gradient - from eastern dry deciduous forests to western evergreen forests - the landscape retains high ecological integrity and a robust PA network. However, expanding plantations, mining, and linear infrastructure increasingly fragment these habitats.

Forming the northern biogeographic limit of sloth bear distribution, Shivalik Hills and Gangetic Plains Landscape region supports smaller, more fragmented populations confined largely to the Shivalik foothills. Widespread agricultural expansion across the Gangetic Plains has severely degraded habitat continuity, isolating forest patches and elevating human–bear interactions. Nevertheless, maintaining these peripheral populations is vital for preserving the species' overall geographic breadth and genetic diversity.

Marking the eastern limit of the sloth bear's global range, North East Hills and Brahmaputra landscape differ markedly in its ecological setup. Populations are naturally localized, restricted to deciduous foothill remnants within a dominant matrix of humid evergreen forests. Distribution is ecologically constrained by forest composition, climatic factors, and a scarcity of rocky denning sites. Historical research gaps mean significant uncertainties remain regarding population occupancy and connectivity.

Across all four landscapes, habitat suitability is governed by forest cover, terrain ruggedness, availability of termite and ant colonies, seasonal fruit resources, denning sites, water availability, and human disturbance.

Human-induced landscape modification remains the most pervasive threat nationwide. Agriculture, mining, urban expansion, and forest degradation reduce habitat quality while intensifying human–bear conflict. Because sloth bear ranging behaviour routinely extends beyond administrative borders, long-term survival hinges on maintaining functional ecological connectivity across multiple-use matrix lands.

Strategic Framework for Landscape-Level Planning

Although tiger reserves function as effective umbrella habitats by safeguarding extensive forest tracts, high densities of apex predators can displace sympatric sloth bears toward peripheral, human-dominated landscapes, thereby increasing interspecific competition and the potential for human–bear conflict (Kumar *et al.*, 2019; Puri *et al.*, 2023). Addressing these socio-ecological challenges requires a multi-faceted conservation approach that integrates government-led mitigation programmes with the active participation of local communities, particularly within shared-use landscapes and ecological corridors outside protected areas.

Effective landscape-scale conservation also requires an integrated monitoring and decision-support framework. The combined application of species distribution modelling, occupancy surveys, landscape connectivity analyses, camera-trapping, and environmental DNA (eDNA) can provide the scientific basis for adaptive management across administrative boundaries. Collectively, these approaches will enable managers to:

- ***Secure critical habitat and corridors while anticipating distributional shifts under future climate scenarios.***
- ***Prioritise habitat restoration and implement targeted conflict mitigation in areas of greatest conservation risk.***
- ***Maintain long-term genetic connectivity, demographic resilience, and functional landscape connectivity across India's tiger landscapes.***

Table 4: Comparative characteristics of the four tiger landscapes with respect to sloth bear habitat suitability in India.

Attribute	Central India & Eastern Ghats	Western Ghats	Shivalik Hills & Gangetic Plains	North East Hills & Brahmaputra Floodplains
Geographic extent	Largest and most extensive landscape, spanning central peninsular India	Continuous mountain chain along western India	Northern distributional limit along Himalayan foothills	Easternmost distributional limit with localized occurrence
States covered	Madhya Pradesh, Maharashtra, Chhattisgarh, Jharkhand, Odisha, Rajasthan, Telangana, Andhra Pradesh	Goa, Karnataka, Kerala, Tamil Nadu	Uttarakhand, Uttar Pradesh, Bihar	Assam
Dominant forest types	Sal forests, Dry deciduous, moist deciduous, mixed deciduous forests	Moist deciduous, dry deciduous, semi-evergreen, evergreen forests	Sal forests, dry deciduous forests, riverine forests, Terai forests	Moist deciduous, semi-evergreen, evergreen forests
Habitat suitability	Very high	High to very high in deciduous forests; moderate in evergreen forests	Moderate and fragmented	Moderate and localized

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Member Secretary
National Tiger Conservation Authority
B-1 Wing, 7th Floor, Pt. Deendayal
Antyodaya Bhawan, CGO Complex
New Delhi, 110003
ms-ntca@nic.in

Nodal Officer,
NTCA-WII Tiger Cell
Wildlife Institute of India, Chandrabani
Dehradun, Uttarakhand 248001
bh@wii.gov.in