NAT. CROAT. | VOL. 32 | No 1 | 1-15 | ZAGREB | June 30, 2023

original scientific paper / izvorni znanstveni rad
DOI 10.20302/NC.2023.32.1

IDENTIFYING SUITABLE HABITATS FOR SLOTH BEAR CONSERVATION IN EASTERN INDIA

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Mardaraj, P.C., Panda, A., Pirie, T.J., Sethy, J. & Fellowes, M.D.E.: Identifying suitable habitats for sloth bear conservation in Eastern India. Nat. Croat., Vol. 32., No. 1, 1-15, 2023, Zagreb.

Today, the most significant threats to mammal predators are habitat losses and anthropogenic pressure. Although sloth bears are widely distributed in India, there is still a risk of populations becoming fragmented and isolated. As a result of continuous habitat loss and degradation over the past century, sloth bear populations have steadily declined. They now exist only in isolated or fragmented habitats across the entire range. Therefore, it is necessary to conduct a habitat suitability analysis to determine these areas. The modeling was carried out using the maximum entropy method (Maxent version 3.4.3, November 2020) with presence data collected from 230 sample areas in the Nilgiri wildlife range of Balasore, eastern India.

The average training AUC for the replicate runs is 0.984. The model is also evaluated according to the receiver operating characteristic value and jackknife test. Environmental variables contributing to the model were BIO-12 (annual precipitation), BIO-11 (annual mean temperature), DEM (digital elevation model), although the contribution level of terrain ruggedness index (TRI), forest cover (FC), human impact index (HII) and LULC are also there in the model. We also establish that the environmental variable Bio 12 (66%) significantly affects the distribution pattern of sloth bears. In contrast, the forest cover (0.4%) has a more negligible effect on the distribution pattern. A habitat suitability map of the sloth bear was created following the modeling process, and the usability of the model and the map was evaluated for sloth bear management plans. The sloth bear is intensively distributed in the western part of the study area. To conclude, the sloth bear is a notable mammal species whose habitat must be preserved.

Keywords: *Melursus ursinus*, sloth bears, India, Maxent modeling, habitat

Mardaraj, P.C., Panda, A., Pirie, T.J., Sethy, J. & Fellowes, M.D.E.: Identifikacija prikladnih staništa za zaštitu usnatih medvjeda u istočnoj Indiji. Nat. Croat., Vol. 32., No. 1, 1-15, 2023, Zagreb.

Danas su najznačajnije prijetnje sisavcima predatorima gubitak staništa i antropogeni pritisak. Iako su usnati medvjedi široko rasprostranjeni u Indiji, još uvijek postoji rizik da populacije postanu fragmentirane i izolirane. Kao rezultat kontinuiranog gubitka i degradacije staništa tijekom prošlog stoljeća, populacije usnatih medvjeda se stalno smanjuju. Sada u cijelom području svog areala žive samo u izoliranim i fragmentiranim staništima. Stoga je za utvrđivanje ovih područja potrebno provesti analizu prikladnosti staništa. Modeliranje je provedeno korištenjem metode maksimalne entropije (Maxent verzija 3.4.3, studeni 2020.) s podacima o prisutnosti životinja prikupljenim iz 230 uzorkovanih područja u rezervatu Nilgiri u Balasoreu, istočna Indija.

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Prosječna AUC krivulja za ponavljanja je 0,984. Model se također procjenjuje prema ROC vrijednosti i metodi ponovnog uzorkovanja. Okolišne varijable koje su pridonijele modelu bile su BIO-12 (godišnja količina padalina), BIO-11 (srednja godišnja temperatura), DEM (digitalni model nadmorske visine), a u modelu su doprinosom prisutni i indeks razvedenosti terena (TRI), šumskog pokrova (FC), indeks antropogenog utjecaja (HII) i LULC također su prisutni u modelu. Također smo utvrdili da okolišna varijabla BIO-12 (66%) značajno utječe na obrazac rasprostranjenosti usnatog medvjeda. Suprotno tome, šumovitost (0,4%) ima zanemariviji učinak na taj obrazac. Nakon procesa modeliranja izrađena je karta prikladnosti staništa za usnate medvjede te je procijenjena upotrebljivost modela i karte za planove upravljanja usnatim medvjedom. Usnati medvjed je intenzivno rasprostranjen u zapadnom dijelu istraživanog područja. Zaključujemo da je usnati medvjed značajna vrsta sisavca čije se stanište mora očuvati.

Ključne riječi: *Melursus ursinus*, usnati medvjed, Indija, Maxent modeliranje, stanište

INTRODUCTION

Bears (Family Ursidae) are widely distributed on all continents apart from Africa, Australia, and Antarctica (Nowak & Paradiso, 1983). While some species are widespread and have stable populations, many are considered under threat because of hunting, over-exploitation, habitat loss, and conflict with humans. The sloth bear is one of the four bear species found in India (Prater, 1980; Laurie & Seidensticker, 1977) and is endemic to the subcontinent (Garshelis *et al.,* 1999). The sloth bear is distributed in lowland areas from Sri Lanka to Nepal through India (Garshelis *et al.,* 1999b); about 90% of their current range occurs in India (Dharaiya *et al.,* 2016). Sloth bears in India are found from the southern tip of the Western Ghats mountains to the Himalayan foothills (Yoganand *et al.,* 2006) and in five biogeographic regions: northern, north-eastern, central, south-eastern, and south-western. (Garshelis *et al.,* 1999a; Johnsingh, 2003; Dharaiya *et al.,* 2016; Yoganand *et al.,* 2006; Sathyakumar *et al.,* 2012). On the Indian mainland, sloth bears can be found in diverse ecosystems, including wet and dry tropical forests, savannahs, scrublands, and grasslands (Akhtar *et al.,* 2004; Joshi *et al.,* 1995; Ramesh *et al.,* 2012; Sreekumar & Balakrishnan, 2002; Yoganand *et al.,* 2006; Seidensticker *et al.,* 2011). However, they are predominantly a lowland species with a patchy range spanning 20 Indian states, and this can lead to conflict with expanding human populations.

Where human population size grows, habitat degradation typically follows (Cowan, 1972; Schoen, 1990). There is a clear trend of habitat deterioration throughout much of sloth bears' range, which is associated with sloth bear population decline (Naim & Chauhan, 2008). In particular, demands for natural resources from the region's ever-increasing human and livestock populations are putting severe and escalating pressure on bear habitats outside of protected areas (Akhtar, 2006a), which in turn is anticipated to have significant direct and indirect effects on sloth bear populations (Dharaiya *et al.,* 2016). The sloth bear is listed in Appendix I of the CITES Convention on International Trade in Endangered Species and has been assessed as "Vulnerable A3c" by the IUCN Red List (amended Ver. assessment, 2016), and it is also listed under Schedule I of India's Wildlife Protection Act 1972 (amended, 2002).

Determining distributions is critical for this species' long-term survival in the face of growing anthropogenic disturbance (Ebrahimi *et al.,* 2017). Long-term data on habitat use and abundance are essential, but traditional techniques such as transect surveys, camera traps, and non-invasive genetic analysis are costly, time-consuming, and labour-intensive (McCarthy *et al.,* 2005; Jackson *et al.,* 2006; Janečka *et al.,* 2011; Zeller *et al.*, 2011; Sharma *et al.*, 2014). Consequently, conservation biologists are increasingly relying on predictive models to estimate patterns of species distribution and thereby defining conservation strategies (Peterson & Robins, 2003; Araújo *et al.*, 2004). Since the 1980s, Habitat Suitability Index (HSI) models have emerged and have proven to be very effective for identifying and protecting critical habitats for threatened species (Lauria *et al.*, 2015), assessing ecological impacts on wildlife populations, and facilitating management plans (Brooks & Temple, 1990; Kaminski *et al.*, 2013). Furthermore, such HSI models have been utilised to detect and assess sloth bear habitat feasibility (e.g., Kaminski *et al.*, 2013; Nawaz *et al.*, 2014).

The prediction of habitat suitability for species depends on adequate knowledge of their ecological requirements and behavioural characteristics (Bargali *et al.*, 2012; Porwal *et al.*, 1996). Food availability has been found to be a significant element in the dispersal of the bear population. (e.g., Akhtar *et al.*, 2004; Clevenger *et al.*, 2002; Joshi *et al.*, 1995; Clevenger *et al.*, 2006; Mitchell *et al.*, 2002; Smith, 1985). Across much of the sloth bear's range, fine-scale habitat selection studies have shown that the presence of moist and dry deciduous forest, degree of human impact, the temporal distribution of food resources, and presence of termites were significant elements in determining sloth bear habitat relationships (e.g. Joshi *et al.*, 1995; Akhtar *et al.*, 2004; Yoganand *et al.*, 2006; Ratnayeke *et al.*, 2007; Ramesh *et al.*, 2012).

MAXENT (Phillips *et al.*, 2006) is widely regarded as one of the most effective tools for studying wildlife habitat modelling, consistently generating good species distribution predictions (Elith *et al.*, 2006; Tsoar *et al.*, 2007). This method works well with presence data and produces accurate findings even when only few data are available. Modeling of correlations with environmental factors in areas where the species exists is used (Elith *et al.*, 2006; Hernandez *et al.*, 2006; Phillips *et al.*, 2006).

Given the challenges faced by sloth bear populations in India, understanding what limits the distribution of sloth bears is of considerable interest to ecologists and conservation biologists. Sloth bears have been observed in twelve of Odisha's 30 districts (Sathyakumar *et al.*, 2012), with a significant population in the NWLR, an area of considerable biodiversity value. The aim of this work is to utilize suitability modelling and mapping to determine the distribution of sloth bears in the NWLR so that we can quantify habitat suitability and demarcate sloth bear habitats, with the aim of improving sloth bear conservation and reducing bear-human conflict.

STUDY AREA

The research was undertaken in the Nilgiri wildlife range (NWLR), which is part of the Balasore Wildlife Division in Odisha, India (Fig. 1). It lies between 21° 25' and 21° 40' North latitude and 86° 35' and 86° 55' East longitude. The total Range area is 444.5 km^2. The Nilgiri sub-division encompasses the majority of the NWLR. The human population of Nilgiri block and NAC according to the 2011 census data, is 1,46,624 (Census of India, 2011). Swarnachuda, Mitrapur, Ajodhya, Tinkosia, and Arabandh are the five reserve forests that make up the forest cover of NWLR. Among these, Swarnachuda and Mitrapur reserve forests have the highest sloth bear populations, and the people who live near these reserve forests confront major challenges in the form of human-sloth bear conflict (Mardaraj & Dutta, 2011). The area is biogeographically part of the Chotanagpur plateau. These regions consist of mixed deciduous

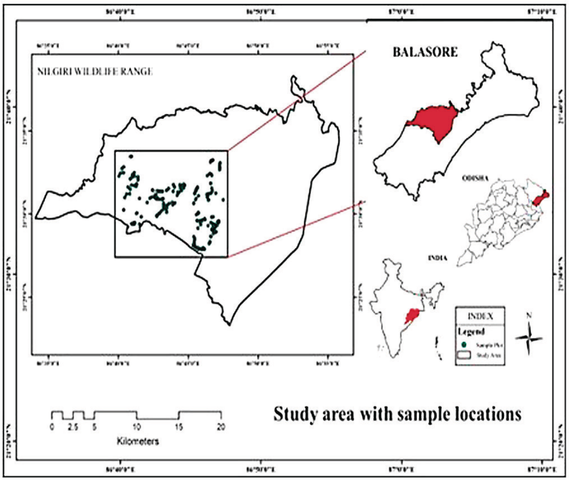

Fig. 1. Location of the study area with the sample point

forests, which provide an excellent habitat for sloth bears. Farming and labouring are the primary occupations of the local people. The Budhabalanga River flows with its tributary the Sono in the west-northwest section of the range. The elevation varies between 40 and 504 metres above sea level (MSL).

METHODS

Species occurrence data

We collected sloth bear occurrence data in NWLR by surveying 2km x 2km grids in different habitats, walking the trails within forests, streams, ridgelines, human habitations in different landscapes. In our opinion, important habitats of sloth bear were indicated by scats and digging, so we surveyed the broad habitat which minimised the omission bias in our results. The geocoordinates of direct sightings or presence signs were recorded using a hand-held global positioning system (Garmin Etrex 10 GPS). Direct sightings and presence evidence (scat and digging) of the sloth bear were assembled between January 2019 and January 2021. In all, 540 points were collected, spread over all significant habitats in the entire study area. For maximum entropy species distribution modelling, we consider 230 points for the input. Direct sightings (n= 26) and indirect evidence (n =204). This species generally does not defecate in particular areas, except for concentrations at bed sites like brown bears (Menges, 2011). But to identify repeated and aggregated occurrence information, we have used spatial filtering with the export to circuitscape (v 1.0.87) in ArcGIS (10.5).

Predictor variables

To predict sloth bear habitat suitability, habitat preferences, and potential distribution across NWLR, a set of environmental and climatological variables were used (Tab. 1). We included 19 climatic variables, topographical data (elevation, slope and aspect), land-cover, and vegetation indices [normalized difference vegetation index (NDVI)

Tab. 1. Environmental variables for the Modelling process

Variables	Details
BIO-1	Annual mean temperature
BIO-2	Mean diurnal temperature range [mean of Monthly (MAX TEMP–MIN TEMP)]
BIO-3	Isothermality (P_2/P_7) (×100)
BIO-4	Temperature seasonality (STANDARD DEVIATION×100)
BIO-5	Max temperature of warmest month
BIO-6	Min temperature of coldest month
BIO-7	Temperature annual range (P_5–P_6)
BIO-8	Mean temperature of wettest quarter
BIO-9	Mean temperature of driest quarter
BIO-10	Mean temperature of warmest quarter
BIO-11	Mean temperature of coldest quarter
BIO-12	Annual precipitation
BIO-13	Precipitation of wettest month
BIO-14	Precipitation of driest month
BIO-15	Precipitation seasonality (COEFFICIENT OF VARIATION)
BIO-16	Precipitation of wettest quarter
BIO-17	Precipitation of driest quarter
BIO-18	Precipitation of warmest quarter
BIO-19	Precipitation of coldest quarter

and enhanced vegetation index (EVI)]. Climatic metrics, including 19 bioclimatic data layers (11 temperature and 8 precipitation variables), were obtained from the WORLDCLIM database (www.worldclim.org) representing annual trends, seasonality and extreme or limiting environmental factors were used for the modelling study, which is presumed to be maximally relevant to animal existence (Pearson & Dawson, 2003; Pearson, 2007). In order to obtain more biologically meaningful variables, bioclimatic variables were constructed using monthly temperature and rainfall information. Yearly trends (e.g., mean annual temperature, annual precipitation), seasonality (e.g., annual range in temperature and precipitation, and extreme or limiting environmental elements are all represented by bioclimatic variables (e.g., temperature of the coldest and warmest month, and precipitation of the wet and dry quarters). A quarter is a three-month period (1/4 of a year). Bioclimatic data included 19 bioclimatic variables derived from monthly temperature and precipitation values. We checked correlations among the variables using R (RStudio version 1.4.1106) and we have excluded variables which showed high corelation (above 0.8) among the bioclimatic variables; the threshold for the correlation coefficient was 0.8 based on the best model choice (Capainolo *et al.*, 2020; Escobar *et al.*, 2014). Thirteen bioclimatic data sets based on different correlation coefficients among bioclimatic variables were used to run MAXENT. All analyses were conducted at the 30 m spatial resolution of the environmental data sets. All environmental data layers were finally cropped for the study area to perform the modelling experiment.

The shuttle radar topography mission (SRTM) elevation model (http://srtm.csi.cgiar.org) was used as digital elevation model (DEM), and slope (in degrees) and aspect (Northness and Eastness) were calculated from the DEM using ArcGIS software (ESRI, 2010). The land cover and land use maps were developed using the data from the

Bhuvan Indian Geo-Platform of ISRO (https://bhuvan.nrsc.gov.in/). As a human disturbance factor, human impact index (HII) of the study area was obtained from SEDAC, the Socioeconomic Data and Applications Center, (https://sedac.ciesin.columbia.edu/). All datasets were converted to GRID (raster) format and resampled to 30-meter resolution using the raster calculator tool in the ArcGIS spatial analyst extension.

Modelling and mapping processes

MaxEnt (maximum entropy modeling) version 3.4.1 is used to generate the potential distribution maps for sloth bears in the NWLR. Maxent applies some features including linear, quadratic, product, threshold and hinge to predict the geographic distribution of species. The environmental layers, along with the occurrence layer, were loaded into MaxEnt as the model inputs (Fig. 2). Two sets of presence data were generated, 90% of the sloth bear presence data was allocated as training value and 10% as test value and modelled with environmental variables. This method creates a suitability model to evaluate the data collected in the study area where the species exist and areas with similar features (Baldwin, 2009). The model was run in thirty replications using the

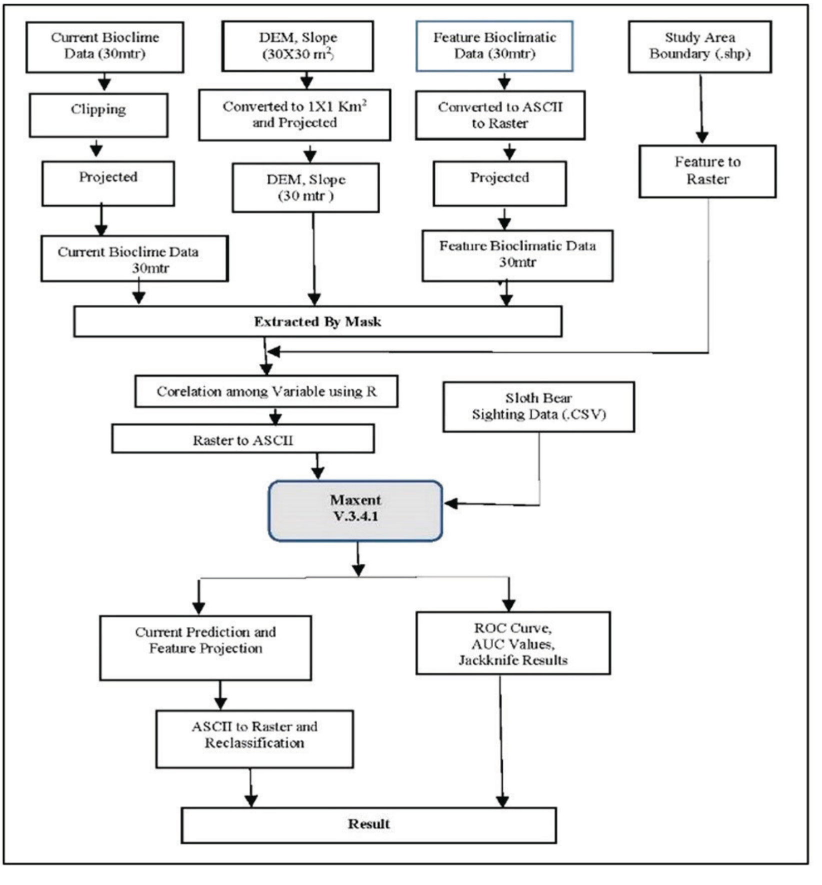

Fig. 2. Flow chart for Maxent modeling.

sub-sampling method with 5000 iterations, and the percent contribution of each environmental variable was estimated for each iteration in the MaxEnt algorithm (Kichloo & Sharma, 2021). After this process, the potential habitat suitability modeling process was completed using MAXENT.

Prediction accuracy of maximum entropy model outputs was measured through receiver operating characteristics (ROC) analysis because of its wider application in the modelling studies despite some recent arguments (Boubli & de Lima, 2009; Lobo *et al.*, 2008; Van Der Wal *et al.*, 2009; Yates *et al.*, 2010). The MAXENT model calculates using ROC (receiver operating characteristic) curves; AUC values of training-test data and their contribution to model levels are assessed with jackknife graphs (Deleo, 1993; Fielding & Bell, 1997; Phillips *et al.*, 2006; Baldwin, 2009; Monterroso *et al.*, 2009). Potential distribution map ranging between 0 and 1 was illustrated in ArcMap 10.5 software (Özkan *et al.*, 2015). The results were obtained from the average about thirty times running the model for the species. AUC (the area under the curve) summarizes the overall location of the entire ROC curve. This measure was used to evaluate the model performance that varies between 0 and 1. For example, the accuracy of 0.5 in AUC is low and does not perform better than random, whereas a value of 1 demonstrates excellent model predicting ability.

RESULTS

A successful and valid model with the AUC value obtained for 30 bootstraps with 30 replicate runs was 0.983 with a standard deviation of 0.001 as reflected in the Receiver Operating Characteristic (ROC) curve (Fig. 3). The higher AUC values substantiate the high accuracy of the model generated for predicting the distribution of sloth bears in the NWLR. The training AUC value of the data is 0.9829 (Tab. 2), whereas AUC value of training data is higher than the test data, yet the discrepancy is not high. However, the area under the ROC curve is higher than the area under the random prediction line (Fig. 4). These results suggest that the model can be utilized because it provides realistic outcomes.

The omission rate and anticipated area are both a function of the cumulative threshold, according to this graph (Fig. 3). The omission value is set using both the training and (if test data are included) the test presence records. This graph shows the emissi-

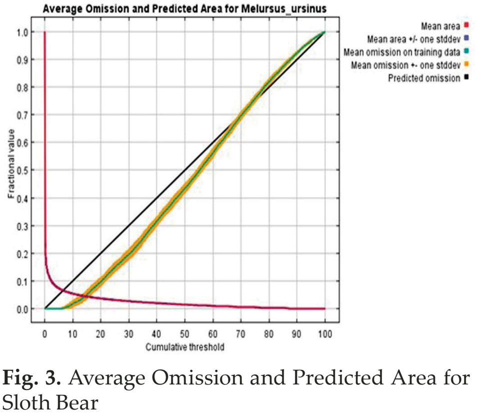

Fig. 3. Average Omission and Predicted Area for Sloth Bear

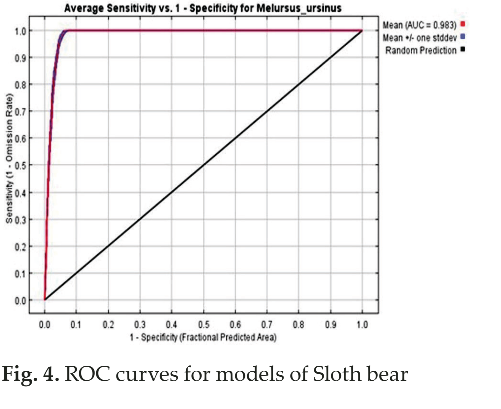

Fig. 4. ROC curves for models of Sloth bear

Tab. 2. Model validation values

Model validation	Values
Regularized training gain	2.7616
Training AUC	0.9829
Unregularized training gain	3.0077
Standard deviation	0.001

on rate is closer to the predicted omission, which implies that the maximum output value of AUC is less than 1. The average training AUC for the replicate runs is 0.983, and the standard deviation is 0.001. The omission rate is closer to the expected omission rate.

Analysis of variable contributions

While comparing the estimates of relative contributions of all the 19 environmental variables to the Maxent model, we found that the maximum contribution was from BIO_12 (annual precipitation; 40.2%) and DEM (elevation; 32.2%). For the final test result the environmental variables are annual precipitation (BIO-12), digital elevation model (DEM), mean temperature of coldest quarter (BIO_11), precipitation of driest month (BIO_14), mean diurnal temperature range (BIO_2), terrain ruggedness index (TRI), forest cover (FC, and human impact index (HII). The variable Bio_12 that contributes most to the model, 40.2%, emerged as a significant factor influencing the spatial distribution of sloth bears in the NWLR. It was followed by DEM (18.5%), Bio_11 (16.7%), while others Terrain, Forest, Land use & landcover (LULC) and Human impact HII carried tiny weightage (Fig. 5).

When the results of jackknife statistics are examined, the contribution of the 18 environmental parameters in the distribution of species of interest in the study area can be discerned. It can be seen that Bio_12 makes the biggest contribution to the model, followed by DEM. When Bio 12 was tested in isolation, it yielded the largest gain, implying that it contains the most useful information on its own. Other significant variables in terms of model gain are BIO_11 and BIO_13. They also play a role in the model's success. Although the contribution levels of Terrain, Forest, LULC and Human Impact are also there, excluding **them**? would not cause a great loss in the model, in which case it can be said that terrain and forest are more descriptive than

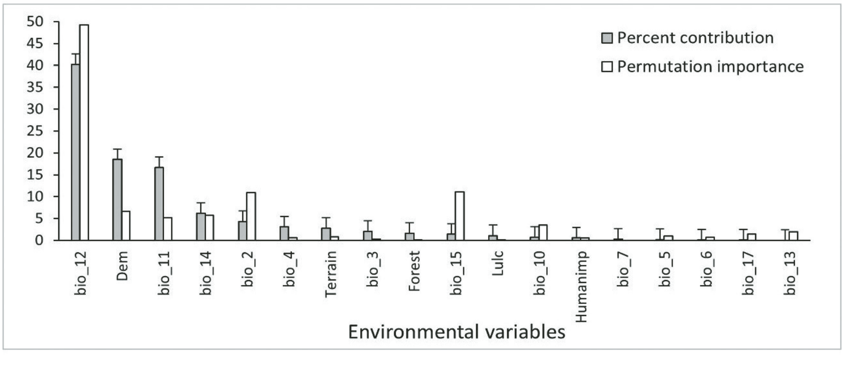

Fig. 5. Contribution of environmental variables in the model building

LULC. HII has the lowest contribution both alone and in terms of total model gain (Fig. 6). Here, the human impact index and forest type do not affect the distribution pattern because the sloth bear prefers open forest habitat close to villages with good termite and ant availability. And they are habituated and adapted to this urban landscape.

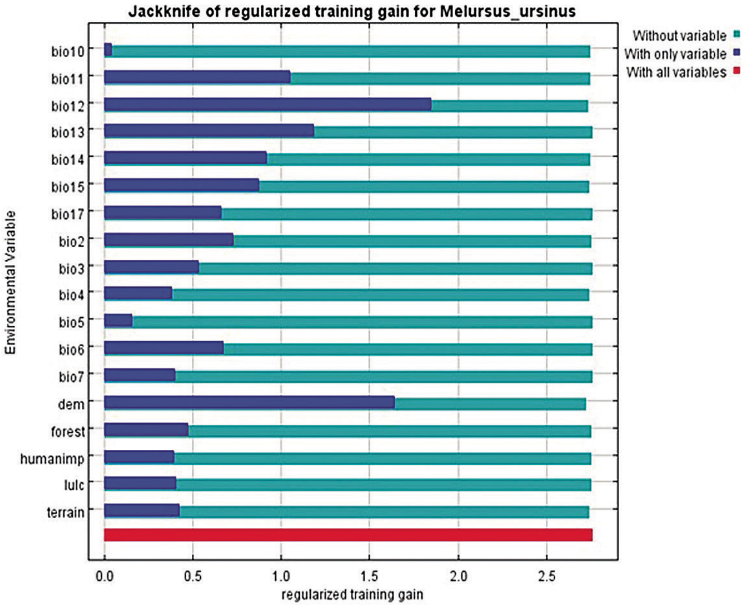

Fig. 6. Jackknife test of variable importance for sloth bear in Nilgiri Wildlife Range

These graphs show the impact of each environmental variable on the Maxent projection. The graphs depict how the anticipated probability of presence changes as each environmental variable changes, while all other environmental variables remain constant (Fig. 7). The curves show the marginal effect of changing precisely one variable, whereas the model may take advantage of sets of variables changing together. The curves depict the average response of the 30 Maxent duplicate runs (red) and the mean +/- one standard deviation (blue, two shades for categorical variables).

Habitat suitability

The probability distribution map was generated using MaxEnt. The warmer colors (P = 1) in the continuous colored distribution map generated for the species indicate areas with a high probability of species occurrence, while blue (P = 0) suggested the least likelihood (Fig. 8). The generated probability distribution map was imported into Arc Gis and re-classified based on the 10-percentile logistic threshold to a three-category low, moderate, and high suitable habitat map for sloth bears in NWLR (Fig. 9). About 13.2% of the area is ideal for the sloth bear habitat from the whole Balasore wildlife division. It has been found that the sloth bear is very intensively distributed in the western part of the study area, which has all of the reserve forests of NWLR

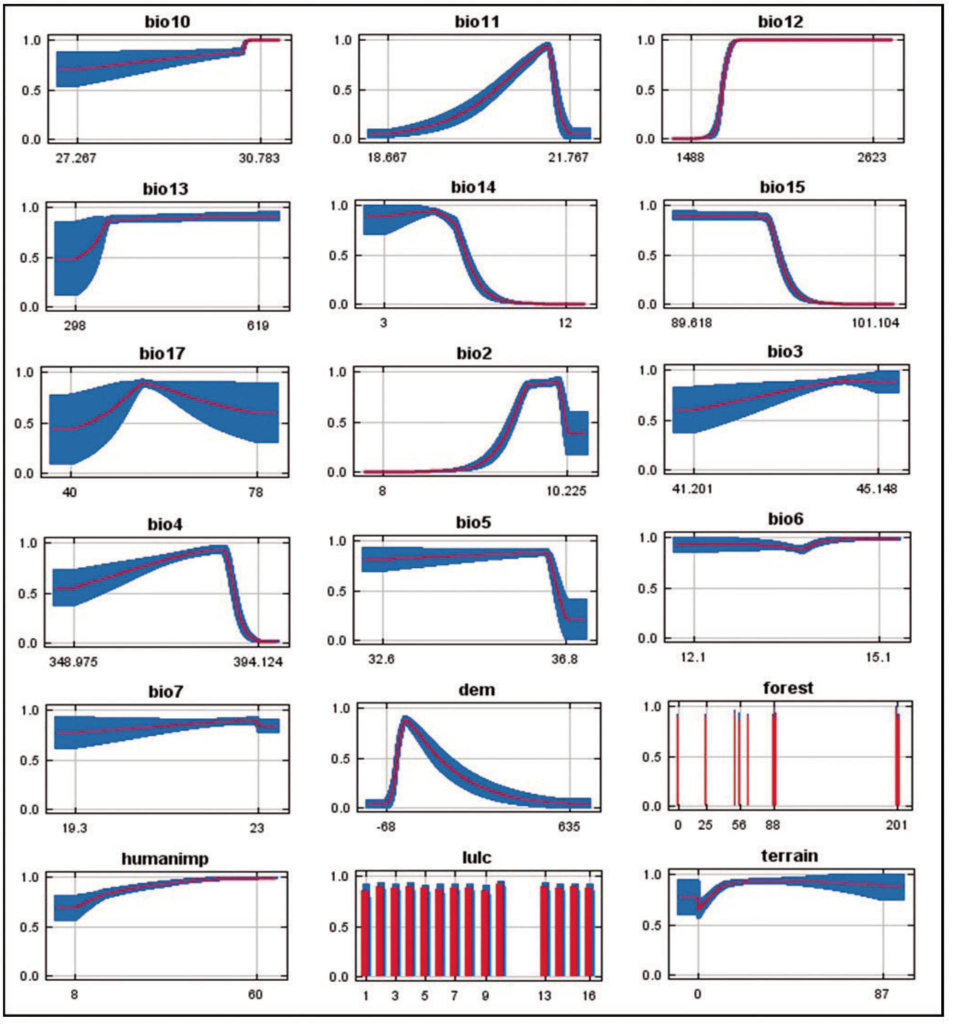

Fig. 7. Important factor response curve (left to right): Mean temperature of warmest quarter (BIO-10), Mean temperature of coldest quarter (BIO-11), Annual precipitation (BIO-12), Precipitation of wettest month (BIO-13), Precipitation of driest month (BIO-14), Precipitation seasonality (BIO-15), Precipitation of driest quarter (BIO-17), Mean diurnal temperature range (BIO-2), Isothermality (BIO-3), Temperature seasonality (BIO-4), Max temp of the warmest month(BIO-5), Min temperature of coldest month (BIO-6), Temperature annual range (BIO-7), Digital elevation model (DEM), Forest cover (fc), Human impact index (hii). Land use land cover (LULC), Terrain ruggedness index (tri).

with potential sloth bear habitats with better food and shelter availability. The Maxent habitat maps show that the suitable category included areas with environmental conditions conducive for the species to survive and vice versa. The habitat suitability map can serve as a valuable component for setting up sloth bear conservation and management practices.

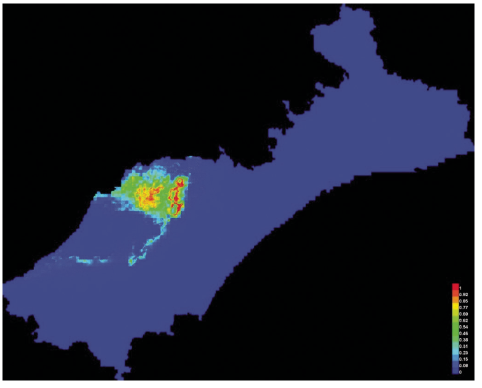

Fig. 8. Species distribution map of Sloth bear

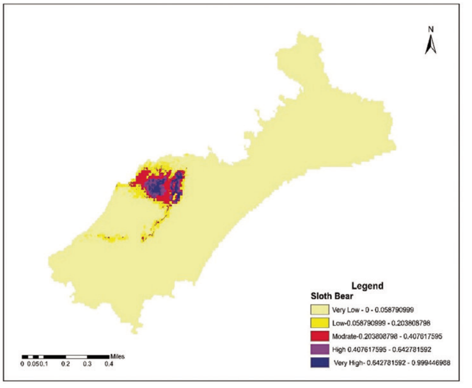

Fig. 9. Habitat suitability map for Sloth bear of the study area.

DISCUSSION

This was the first research of its sort in the state of Odisha, where data on mammals in general, and sloth bears in particular, are limited. While data are limited to a small area, the MAXENT approach yielded successful results. The model was verified via ROC graph, and jackknife tests (Phillips *et al.*, 2006; Wisz *et al.*, 2008; Baldwin 2009; Elith *et al.*, 2010; Tekin *et al.*, 2018).

Our study demonstrated that many factors such as settlements in urban and rural areas and human population density do not have any negative effect on bear habitat suitability. In the other words, this species tends to stay around the central region which provides some suitable habitat for bears with mosaic forests and human habituation. In contrast, the forest is degraded and bears depend on human settlements for food sources (Mardaraj *et al.*, 2008; Prajapati *et al.*, 2021). About 13.2% of the area is suitable sloth bear habitat in the study area and quite widely dispersed in the western section, which means that the above conditions provide shelter and enhance the prospects for foraging. The north, south-eastern and eastern parts are non-habitable for the sloth bear, as no forest patches are available.

Various environmental variables may be contributing to this spatial distribution of sloth bears. Elevation of the study area (DEM) and the forest type, human impact index and land use land cover (LULC) do not affect sloth bear habitat preference. In a previous study, the mean diurnal temperature range is an important environmental factor that affects the habitat preferences of sloth bears in the Similipal Biosphere Reserve (Jena & Nandi, 2017). In our study we found sloth bears are adapting to the human dominated habitat simultaneously, however, in largely disturbed regions, forest habitats represent only a small portion of the total area, thus making the species-habitat relationships complicated to predict (Akhtar *et al.*, 2004; Rather *et al.*, 2021). Therefore, our results are site-specific and make more sense when applied to the disturbed regions. Puri *et al.*, (2015) also point out that sloth bears are not limited to protected areas and occur widely in unprotected, human-use habitats. Last but not least, our study makes makes no conclusion about expanding human habitation in order to protect sloth bears in damaged habitats.

Our work suggests that instigation of habitat restoration is needed. This work leads to the prediction that the small populations of sloth bear are expected to show more tolerance towards humans and signs of a rise in interaction in the near future. The sloth bear, largely ignored as a species of interest despite being a keystone species to the landscape, is certainly worth further study as well as more widespread and ecological research.

MANAGEMENT IMPLICATIONS

In conclusion, habitat suitability modelling and mapping study was carried out successfully in the NWLR of the Balasore region and supported with the literature. The actual status and potential distribution areas of the species under the effect of essential environmental variables that affect the habitats of sloth bears were revealed. The results indicate that the main distribution of sloth bears is in the western part of the NWLR. The western part comprises forest patches, agricultural fields and villages and it is observed from the physical evidence that the movement of sloth bears between fprest reserves was through the agricultural fields and villages. Positive sloth bear associations with agricultural areas and degraded habitats adjacent to villages may not be regarded a general rule of sloth bear ecology (Rather *et al.*, 2021) but they have adapted the human dominated landscape for their usage. Previous studies on sloth bears have shown that they occur in and use disturbed habitats across many areas of their range in India (Akhtar *et al.*, 2004).

Due to severe anthropogenic pressure, sloth bears are at risk of extinction in the area; nevertheless, because they exist in tiny populations and are scattered, they are also in the globally threatened group. This study determined habitat factors and potential areas for sloth bears, which is important for action plans to be prepared. The outputs produced by MaxEnt generally reflected established understanding of bear ecology and biology associated with habitat suitability (Kichloo & Sharma, 2021). Species distribution models that relate species occurrence data to environmental variables are now essential tools in distributional and spatial ecology (Guisan & Zimmermann, 2000; Elith *et al.*, 2006; Drew *et al.*, 2011). As an outcome, this paper gives a detailed account of sloth bear habitat connections in an anthropogenic landscape, helping to guide the creation of action plan for this species. Management should identify and protect suitable habitats in disturbed regions and integrate the human-modified landscapes with the existing conservation landscape network by restoration of corridors between the forest reserves. Awareness and education programs on conservation of wildlife for the villagers close to the bear habitats are strongly recommended.

ACKNOWLEDGMENTS

The authors would like to thank the Balasore Wildlife Division for providing secondary data that enabled the successful completion of this study. We want to extend our gratitude to the Principal Chief Conservator of Forest (Wildlife), Forest & Environment department, Government of Odisha, for their constant cooperation. We would also like to extend our special thanks to Dr Utku Perktas (Hacettepe University, Turkey) for providing invaluable comments on the analyses. Finally, our acknowledgments are with the local people for their support and suggestions during the fieldwork.

Received August 21, 2022

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