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HABITAT PREFERENCE OF THE SRI LANKAN SLOTH BEAR (*Melursus ursinus inornatus*) IN RAINY SEASON USING OCCUPANCY MODELING IN WILPATTU NATIONAL PARK, SRI LANKA

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The study focused on the endangered Sri Lankan sloth bear (*Melursus ursinus inornatus*), assessing its habitat preferences through occupancy modeling to improve target conservation efforts in protected areas. The study was conducted in Wilpattu National Park from September 2024 to April 2025 during the wet season. Twelve passive infrared camera traps were installed using a systematic-random sampling method and relocated every 1.5 months. Data on sloth bear presence/absence and habitat variables, including vegetation, physical, and food abundance covariates, were collected. Occupancy was analyzed using a likelihood-based method, with detection histories recorded as binary values ('1' for presence, '0' for absence), assuming camera trap station independence and no animal movement between stations. Logistic regression identified significant covariates, and highly collinear ones (r > 2) were excluded to avoid overfitting. Data analysis was performed using the PRESENCE software, where detection histories were combined into single-species models. Multiple models incorporating various covariates were developed to assess their impact on occupancy. Model selection was based on delta AIC (dAIC), with model-averaged parameters used to estimate occupancy and detection probabilities. Occupancy probabilities for different habitat types were calculated and visualized using R Studio 4.5.0. The occupancy probability of sloth bears was highest in dry mixed evergreen forests (0.93) and tropical thorn forests (0.68), with grasslands showing the lowest probability (0.30). The best-fitting model for occupancy had an AIC weight of 0.11, with a model-averaged occupancy probability of 0.79, compared to a naïve estimate of 0.49. Main factors influencing sloth bear occupancy include stem density>10cm, litter depth, termite mound density, and fruiting tree density, all of which positively impact occupancy. The negative impact of distance to water bodies highlights the importance of key habitat features for conservation. Focusing on areas with essential resources, such as water and food, can improve habitat management and ensure the long-term survival of sloth bears.

Keywords: camera trapping, occupancy modeling, habitat preference, large carnivore, Wilpattu National Park

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INTRODUCTION

The Sri Lankan sloth bear (*Melursus ursinus inornatus*), an endemic and endangered subspecies (IUCN 2012) of the Indian sloth bear, is primarily confined to the island's dry zone forests. As an important omnivorous mammal in Sri Lanka's ecosystem (Ratnayeke and van Manen 2012), it plays an important role in seed dispersal and maintaining ecological balance. On the other hand, habitat fragmentation and increasing anthropogenic pressures have significantly threatened its survival, leading to a sharp decline in population across its range.

Wilpattu National Park, one of the largest and oldest protected areas in Sri Lanka, serves as one of the primary habitats for the Sri Lankan sloth bear. Although it is important, detailed information on the species' habitat usage within the park remains limited. Understanding habitat preferences is essential for identifying critical areas for target conservation and minimizing human activity on these habitats.

This study aims to assess the habitat occupancy of the Sri Lankan sloth bear within the Wilpattu National Park using occupancy modeling technique. By analyzing presence-absence data collected through camera traps and linking bear detections to habitat covariates, this research seeks to determine how environmental and anthropogenic factors influence the likelihood of sloth bear presence across different habitat types. The outcomes are expected to inform evidence-based conservation planning, support park management in prioritizing high-use areas, and contribute to the long-term protection of this rare and ecologically significant species.

METHODOLOGY

This study was carried out in Wilpattu National Park, Sri Lanka, from September 2024 to April 2025, during the wet season that does not coincide with the peak fruiting season which is consumed by sloth bears, with the aim of assessing habitat occupancy of the Sri Lankan sloth bear. Twelve passive infrared Browning camera traps were deployed using a systematic-random sampling design (Jayasekara *et al.* 2022). The study area was divided into 3×3 km² plots, with one camera trap installed per plot and relocated every 1.5 months, covering a total of 45 locations. Cameras were positioned 35cm above ground and operated continuously, capturing presence-absence data of sloth bears. Detection histories were recorded as binary values ('1' for detection and '0' for non-detection) across repeated survey occasions, assuming independence among camera stations and minimal animal movement between them. Alongside camera trap data, a comprehensive set of twelve habitat covariates were collected and categorized into vegetative, physical, and food-related parameters. Vegetative variables included Stem Density 1 (SD1) and Stem Density 2 (SD2), calculated using the Modified Point-Centered Quarter (PCQ) method for plants with DBH <10 cm and >10 cm, respectively. Canopy Cover (CC%) was measured through photo point analysis using the TinEye Online Colour Extractor. Litter Cover (LC%) and Litter Depth (LD) were recorded in 1×1 m^2 quadrats, while Ground Vegetation (GV%) was estimated within 10×10 m^2 plots. Canopy Height (CH) was measured using a rangefinder and ranked based on predefined height categories. Physical parameters included Elevation (Elev), measured using a Kestrel 4000 weather meter; Euclidean Distance to Water (EDW) and Euclidean Distance to Roads (EDR), both derived using the Zonal Statistics tool in ArcGIS 10.8; and Euclidean Distance to Seasonal Water (EDSW), measured with a Bushnell rangefinder. Food availability was assessed using termite mound (TM) abundance, fruit tree availability (FT), and beehive availability (BH), each quantified and ranked within 30×30 m^2 quadrats. Occupancy modeling was conducted using PRESENCE software (version 12.23), applying a likelihood-based approach to single-season, single-species models. Logistic regression was used to identify influential habitat variables, while highly collinear covariates ($r > 2$) were excluded to prevent overfitting. Multiple candidate models incorporating different combinations of covariates were developed, and model selection was based on delta Akaike Information Criterion (ΔAIC). Model-averaged estimates were used to calculate site occupancy (ψ) and detection probabilities (p). All graphical representations and visualizations were generated using RStudio version 4.5.0 (Rodrigo *et al*. 2025).

RESULTS AND DISCUSSION

A total of 38 models were tested during the analysis. Among these, the models Ψ(SD2+edw). p(.), Ψ(SD2). p(LD), Ψ(SD2). p(.), Ψ(SD2+Term). p(LD), Ψ(SD2+Fruit). p(.), and Ψ (). p(.) had ΔAIC values lower than 2. Of these, Ψ(SD2+edw). p(.) was the highest-ranked model.

The model-averaged occupancy probability for sloth bears was 0.79, with a naïve occupancy estimate of 0.49. The top-ranked model, Ψ(SD2+edw). p(.), had an AIC weight of 0.11, indicating a 11% probability of being the best-fitting model for sloth bear occupancy among all the tested models. These models suggest that SD2, LD, EDW, termite mounds, and fruiting trees have a significant influence on sloth bear occupancy in WNP. All these covariates, except for EDW, had a positive impact on occupancy. The beta coefficient for SD2 in the highest-ranked model was 0.27, while the coefficients for LD, termite mounds, and fruiting trees were 0.17, 0.21, and 0.12, respectively.

Table 1.1: Impact of habitat variables

Model	Parameter	Beta coefficient	Impact
psi (SD2+edw). p ()	SD2	0.272	Positive
	Edw	0.146	Negative
psi (SD2). p(LD)	SD2	0.026	Positive
	LD	0.178	Positive
psi (SD2). p ()	SD2	0.147	Positive
psi (SD2+term). p ()	SD2	0.062	Positive
	Termite mounds	0.205	Positive
psi (SD2+fruit). p ()	SD2	0.186	Positive
	Fruiting trees	0.124	Positive

The occupancy probability for sloth bear was highest in DMEG and then TTF with average occupancy value of 0.93 and 0.68 respectively. Lowest occupancy probability was recorded for GL at 0.30 shows the average occupancy probabilities for sloth bear in each habitat type.

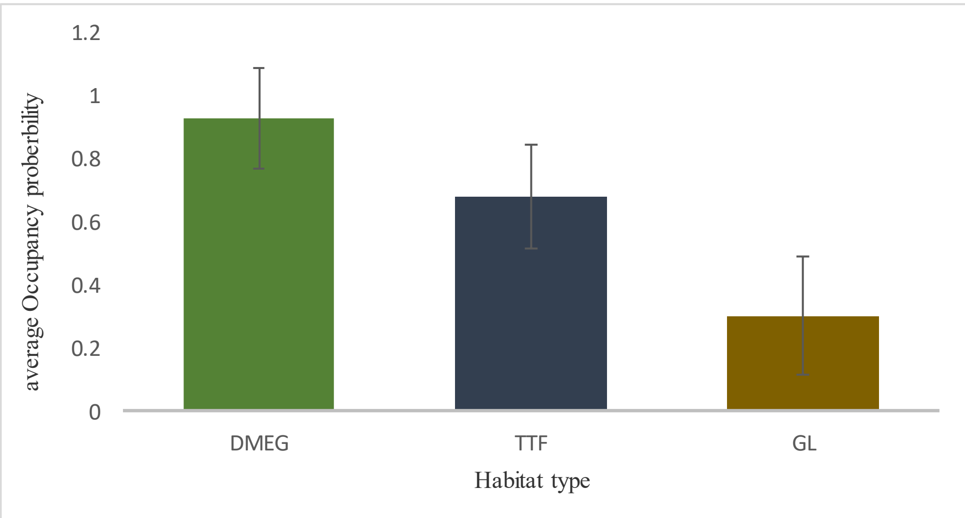

Figure 1.1: Average occupancy probability of sloth bear in main habitat types

CONCLUSIONS AND RECOMMENDATIONS

The Sri Lankan sloth bear exhibits distinct habitat preferences influenced by several key environmental factors. In this study, $3\times3km^2$ plots were used for systematic sampling because these dimensions align closely with the average daily home range of the species approximately 3.4km for males and 2.2km for females. This spatial scale effectively captures the bears' movement patterns and habitat use within their natural territory moderate density of mature trees provides critical canopy cover that offers stable territories for the bears. These areas also tend to support higher prey densities, particularly termites, which are a vital component of the sloth bear diet. However, forests with excessively high tree density can limit the growth of understory vegetation, reducing the availability of important food resources such as fruiting trees and termite mounds. Therefore, an optimal balance of mature tree density is essential to maintain suitable habitat conditions.

Proximity to water bodies was found to be an important factor influencing sloth bear occupancy. Bears are more frequently found closer to water sources, likely because such areas provide not only hydration but also higher availability of seasonal food resources. This pattern highlights the role of water availability in habitat selection in dry zone forests. Termite mounds are a critical resource, as termites form a major and consistent part of the sloth bear diet throughout the year. Consequently, areas with a high density of termite mounds are highly preferred for foraging. Similarly, the abundance of fruiting trees strongly affects habitat use, particularly during the fruiting season when bears rely more heavily on seasonal fruits. This seasonal dietary shift reduces the need for extensive foraging across larger areas.

Litter depth also influences habitat suitability. Moderate litter depth enhances insect populations by retaining soil moisture, increasing prey availability. However, very deep litter may impede bear movement, making navigation of the forest floor more challenging. Thus, a moderate amount of leaf litter appears to provide the best balance between food availability and ease of movement.

In summary, these environmental variables interact complexly to influence sloth bear habitat occupancy. Conservation strategies should prioritize maintaining forest structures that provide an optimal balance of mature tree density, adequate water sources, abundant termite mounds, fruiting trees, and appropriate leaf litter depth. This will ensure the availability of both shelter and food resources necessary for sustaining viable sloth bear populations. The findings are intended to guide informed target conservation efforts, help park authorities focus on critical habitats, and aid in ensuring the sustained protection of this rare and ecologically valuable sloth bear species.

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