DIURNAL ACTIVITY PATTERNS AND FEEDING BEHAVIOR OF SLOTH BEAR (*MELURSUS URSINUS*) DURING WET AND DRY SEASONS IN WILPATTU NATIONAL PARK, SRI LANKA

Pola Aktiviti Siang dan Tingkah Laku Pemakanan Beruang Sloth (Melursus ursinus) Semasa Musim Basah dan Kering di Taman Negara Wilpattu, Sri Lanka

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ABSTRACT *This study examines the seasonal behavioral patterns of sloth bears (Melursus ursinus) in Wilpattu National Park, Sri Lanka, focusing on their activities and feeding behaviors during the dry and wet seasons. Systematic field observations were conducted to record the frequency of six key behaviors: Walking, Bedding down, Self-grooming, Fighting or Chasing, Defecation and Urination, and Hydration. Chi-squared tests were used to assess seasonal differences, revealing significant variations in Walking ($\chi^2 = 32.895$, $p < 0.001$), Bedding down ($\chi^2 = 4.5$, $p = 0.034$), and Fighting or Chasing ($\chi^2 = 5.444$, $p = 0.020$). These behaviors were influenced by seasonal factors such as food and water availability, temperature, and shelter conditions. In contrast, Self-grooming, Defecation and Urination, and Hydration showed no significant seasonal differences ($p > 0.05$). Activity patterns indicated increased activity in the morning and afternoon, with reduced activity in the evening. Feeding duration did not differ significantly between seasons ($W = 81$, $p = 0.535$), though the distribution of feed types varied, with ants and termites being more prevalent in the wet season and berries in the dry season. These findings suggest that sloth bears adjust their behavior and feeding strategies to seasonal changes in resource availability. Understanding these patterns is essential for effective conservation and management of sloth bear populations.*

Keywords: *Sloth bear, Wilpattu, Behavioral Activity, Feeding*

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1. Introduction

Sloth bears (*Melursus ursinus*) are a key species in the ecosystems of South Asia (Ratnayeke, Van Manen, Pieris, & Pragash, 2014), notably within Wilpattu National Park (WNP) in Sri Lanka (Ratnayeke, 2021). As omnivorous mammals with diverse dietary habits and behavioral patterns, sloth bears provide important ecological functions, including seed dispersal and habitat modification (Ratnayeke, Manen, Pieris, & Pragash, 2015). The conservation status of the Sri Lankan Sloth Bear is Vulnerable (VU) on the IUCN Red List, and it is also considered vulnerable within Sri Lanka (MOE, 2012). This sub-species faces threats including habitat loss, human-wildlife conflict, and poaching (Kittle, Watson, & Fernando, 2017). Understanding their behavior concerning seasonal variations is crucial for developing effective conservation and management strategies to mitigate these threats and ensure their long-term survival (Hartmann, Davila-Ross, Wong, Call, & Scheumann, 2017).

2. Literature Review

Seasonal changes significantly affect wildlife behavior, primarily through variations in food and water availability (Ratnayeke & Manen, 2020). In tropical environments like Wilpattu National Park, the transition between the dry and wet seasons introduces distinct environmental shifts that can influence animal activity and behavior (Ratnayeke et al., 2015). Sri Lanka has a tropical climate, characterized by warm temperatures and high humidity throughout the year. Being an island near the equator, it experiences relatively consistent temperatures, typically ranging between 26°C and 32°C in the lowlands, while the central highlands are cooler. Sri Lanka's climate is heavily influenced by two major monsoon seasons, resulting in distinct wet and dry periods across different regions (Rahubaddhe & Kadupitiya, 2020). For sloth bears, these seasonal variations may impact their movement patterns, resting habits, social interactions, and feeding behaviors (Hartmann et al., 2017). During the dry season, reduced water availability and lower food resources may drive sloth bears to modify their activity levels and behavioral strategies (Eisenburg & Lockhart, 1972; Sandamali & Welikanna, 2018). Conversely, the wet season, with increased vegetation and resource availability, could lead to different behavioral adaptations (Prakash, Perera, Newsome, Kusuminda, & Walker, 2018). This study aims to investigate the behavioral patterns of sloth bears in Wilpattu National Park (give geo-coordinates) across these two distinct seasons. The behaviors examined include Walking, Bedding down, Self-grooming, Fighting or Chasing, Defecation and Urination, and Hydration. By systematically observing these behaviors, we can assess how sloth bears adapt their behavioral patterns and interactions in response to seasonal changes. In addition to general behavioral patterns, this study evaluates the duration and distribution of feeding behaviors. Sloth bears consume a variety of food sources, including ants, termites, and berries. Seasonal shifts in the availability of these food sources could

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influence feeding patterns and duration. By analyzing the frequency and duration of feeding on different food types, we aim to identify any significant seasonal variations in food preferences and foraging strategies. The findings of this study will provide valuable insights into the ecological adaptability of sloth bears, highlighting how seasonal variations affect their behavior and feeding strategies. This information is vital for developing targeted conservation measures and managing the habitat of sloth bears to ensure their continued survival and ecological role within Wilpattu National Park (Prakash et al., 2018; Ratnayeke et al., 2015). Understanding these seasonal dynamics will contribute to more informed and effective conservation practices, ultimately benefiting both the sloth bear population and the broader ecosystem.

3. Materials and Methods

3.1 Study Area

This study was carried out in a section of Wilpattu National Park (WNP) in Sri Lanka (Figure 1), with a primary focus on investigating the behavioral patterns of sloth bears (*Melursus ursinus*) across two distinct climatic seasons: the dry season and the wet season. Wilpattu National Park, covering an area of approximately 1,317 km², is situated in the northwestern region of the island and extends across the North-Central and Western provinces (Gabadage et al., 2015; Kottawa-Arachchi & Gamage, 2015). The park is bounded by the Indian Ocean to the west, Moderagam Aru to the north, and Kala Oya to the south (Eisenburg & Lockhart, 1972; Reuter, Harzhauser, & Piller, 2020). The average annual rainfall is estimated to be around 1,000 mm, reflecting the park's dry zone climatic conditions (Eisenburg & Lockhart, 1972). Ecologically, Wilpattu is characterized by a heterogeneous landscape comprising dry monsoon forests, open scrublands, and seasonal wetlands. The dominant vegetation includes semi-evergreen tree species interspersed with grasslands and thorny shrub layers, indicative of the seasonal monsoonal influences that shape the region's ecological dynamics (Eisenburg & Lockhart, 1972).

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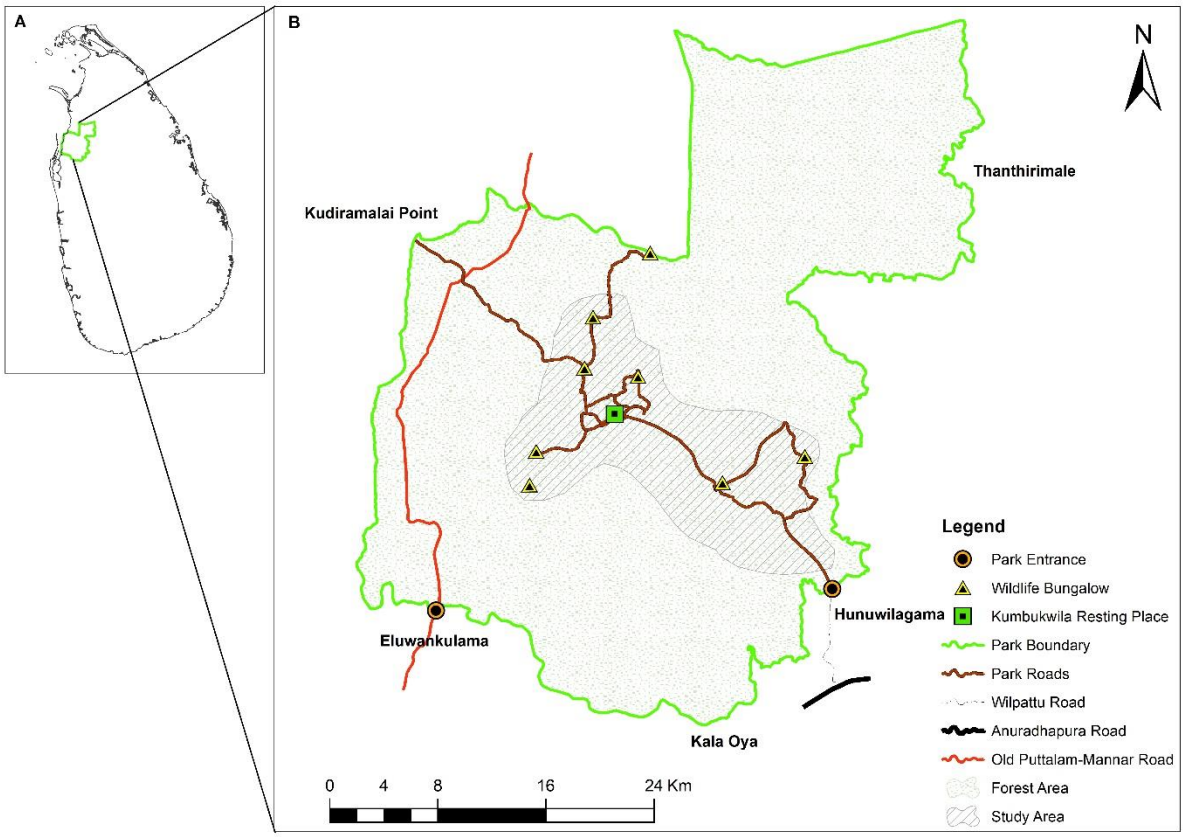

Figure 1. *Geographical representation of the study area within Wilpattu National Park, Sri Lanka. (A) Map showing the location of Wilpattu National Park within the national context of Sri Lanka. (B) Enlarged view highlighting the specific study site located within the boundaries of the park.*

3.2 Behavioral Observation

Behavioral observations were performed during both the dry and wet seasons to capture a comprehensive range of sloth bear activities. Observations were conducted systematically, with behaviors recorded through direct field monitoring. Data was recorded from 2018 to 2024 for four year period excluding 2021 and 2022. A four-wheel vehicle was used for the field surveys and field surveys were conducted between 0600 hours to 1800 hours. Bears were recorded opportunistically and all individual bears were followed for a few minutes in the field and short video clips were taken using Nikon camera (Nikon P900) for later observation. The frequency of each behavior was noted to assess seasonal variations (Hartmann et al., 2017). The behaviors examined included Foraging, Walking, Bedding down, Self-grooming, Fighting or Chasing, Defecation and Urination, Mating, and Hydration (Table 01).

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Table 1.
Ethogram of sloth bear behavior

Behavior Name	Description
Foraging	Searching, digging, sniffing, picking berries, and consuming food
Walking	Walking continuously
Hydration	Drinking water from villus, artificial waterholes, and puddles
Self-grooming	Self-grooming including scratching, biting, and rubbing on objects
Bedding down	Sleeping under the vegetation, on the road
Defecation & Urination	Defecation & Urination on the road, close to the road, and in the forest
Fighting or chasing	Male bear fighting or chasing another bear and or a leopard

3.3 Statistical Analysis

All statistical analyses and graphical visualizations were performed using RStudio ver 4.4.1. The primary objective was to evaluate the behavioral activity patterns of sloth bears across different seasons and times of the day.

To examine seasonal variations, a chi-squared test was conducted to compare the frequency of each behavior such as Walking, Bedding down, Fighting or Chasing, Self-grooming, Defecation and Urination, and Hydration between the dry and wet seasons. This approach enabled the identification of statistically significant differences in behavior patterns attributable to seasonal changes. The significance level was set at $p < 0.05$ (Rannestad *et al.*, 2006; Dittus, 2014; Hartmann *et al.*, 2017).

3.4 Feeding Duration Analysis

The duration of feeding behavior was assessed using the Shapiro-Wilk test to evaluate normality across seasons (Kittle et al., 2017). Visual inspection via histograms and Q-Q plots, along with the Shapiro-Wilk test results, indicated a right-skewed and non-normal distribution of feeding durations in the dry season, with several high-duration outliers ($W = 0.871$, $p = 0.021$). Therefore, a non-parametric Mann-Whitney U test was applied to compare feeding durations between the wet and dry seasons (Winker, 1993).

3.5 Feed Type Distribution

The distribution of feed types, including ants, termites, and berries, was analyzed to determine seasonal patterns in availability or consumption. Observed frequencies of these feed types were compared between seasons to assess any significant changes in feed preferences.

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3.6 Data Visualization

Figures were generated to visualize the findings. A stacked area plot was used to illustrate the proportion of time spent feeding on different food sources across seasons. This plot highlighted seasonal variations in feed type distribution and feeding behavior patterns.

4. Results

A total of 60 individual sloth bear sightings were recorded during the study period. The results revealed significant seasonal variations in several behaviors. Walking behavior showed a marked difference between the seasons ($\chi^2 = 32.895$, df = 1, $p < 0.001$),. Bedding down also varied significantly between seasons ($\chi^2 = 4.5$, df = 1, $p = 0.034$), Similarly, Fighting or Chasing behavior was significantly more frequent in the dry season ($\chi^2 = 5.444$, df = 1, $p = 0.020$), (Figure 2 and Figure 3).

In contrast, no significant seasonal differences were found for Self-grooming ($\chi^2 = 1$, df = 1, $p = 0.317$), Defecation and Urination ($\chi^2 = 0.333$, df = 1, $p = 0.564$), or Hydration ($\chi^2 = 2$, df = 1, $p = 0.157$) (Figure 3).

The analysis of sloth bear activity across different day parts revealed a distinct pattern. Activity levels were higher in the morning and afternoon periods, with 48 occurrences each, while activity during the evening was notably lower, with only 16 occurrences. Shapiro-Wilk test was used to assess the normality of feeding durations across seasons. The results showed that feeding duration during the wet season was marginally normally distributed ($W = 0.807$, $p = 0.068$), whereas the dry season data significantly deviated from normality ($W = 0.841$, $p = 0.0019$). A non-parametric Mann-Whitney U test revealed no significant difference in feeding durations between the wet and dry seasons ($W = 81$, $p = 0.535$), suggesting that sloth bears maintain consistent feeding patterns throughout both seasons. Additionally, the seasonal distribution of feed types, including ants, termites, and berries, was analyzed to observe patterns in availability or consumption. Ants were found in both seasons, with a higher frequency in the wet season (2 occurrences) compared to the dry season (1 occurrence). Termites were exclusively observed in the wet season (2 occurrences), suggesting their availability might be linked to wetter conditions. Berries were entirely restricted to the dry season, with three occurrences, highlighting a shift in available food resources during that period (Figure 03).

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Figure 2. *Different Behavior types showed by the sloth bear in Wilpattu National Park (A: Hydration, B: Feeding on berries, C: Foraging on termites, D: Foraging on ants, E and F: Bedding down, G: Self-grooming, H: Walking).*

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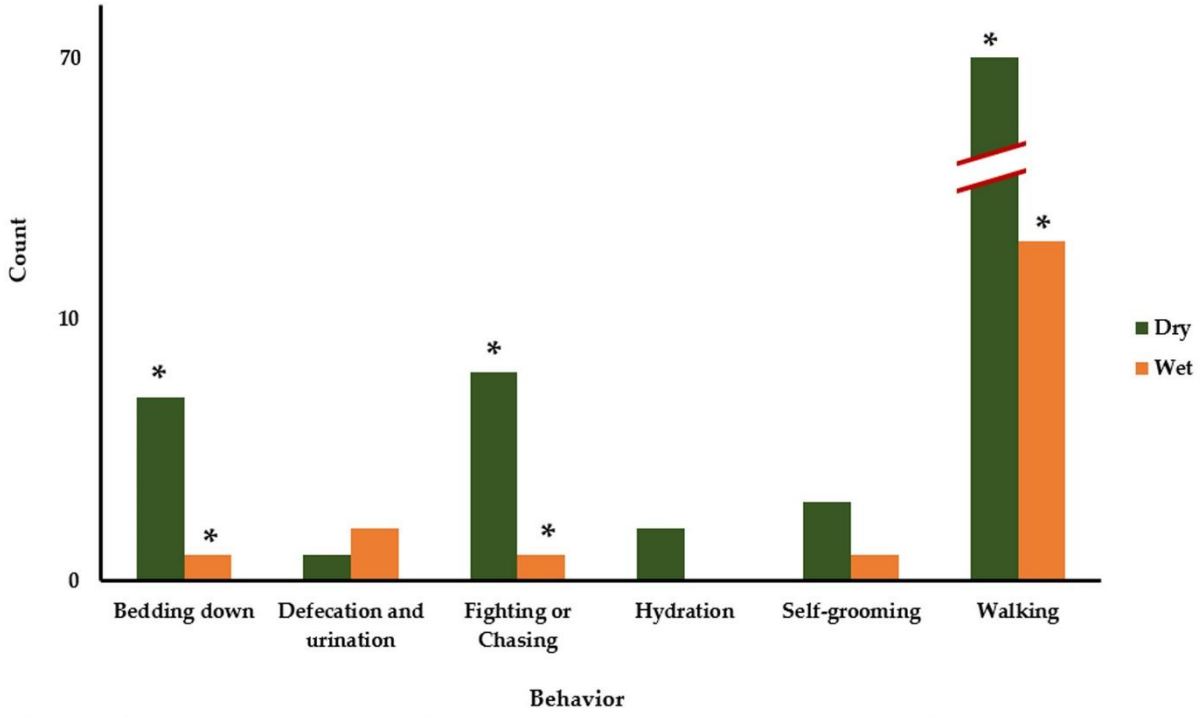

Figure 3. *Sloth Bear Behavior in Dry and Wet Seasons at Wilpattu National Park. The figure presents the frequency of key behaviors observed in sloth bears across dry and wet seasons. Count refers to the number of occurrences recorded for each behavior. Significant seasonal differences were noted in Walking, Bedding down, and Fighting or Chasing (*), while Self-grooming, Defecation and Urination, and Hydration showed no significant variation.*

To visualize these trends, the Stacked Area Plot depicted the proportion of feed types in the wet and dry seasons, showing the dominance of termites and ants in the wet season, and berries in the dry season. A stacked area plot further illustrated the distribution, with a clear separation between termites and berries as season-specific feed types, while ants were present in both seasons (Figure 4). These findings suggest distinct seasonal feeding patterns, likely reflecting ecological responses to the availability of specific food types. The dominance of berries in the dry season and termites in the wet season could be linked to seasonal shifts in food availability, influencing sloth bears' foraging behaviors and adaptation to changing environmental conditions. Understanding these patterns is vital for the conservation and management of species dependent on these seasonal resources.

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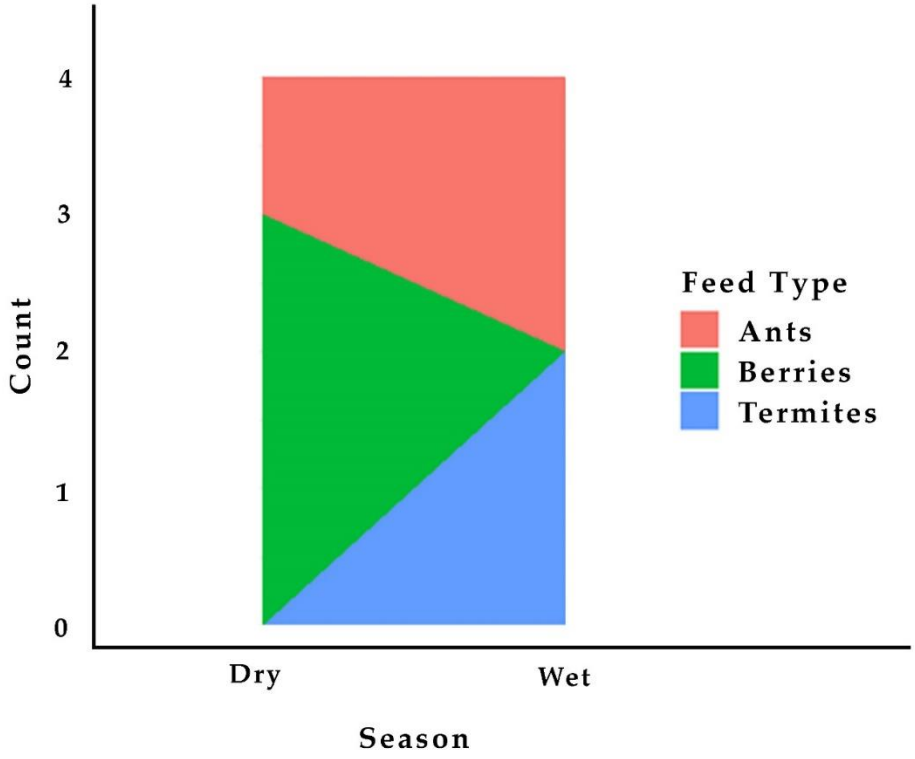

Figure 4. *Stacked area plot illustrating the feeding duration by food source across seasons. The figure presents the distribution of time spent feeding on different food sources such as ants, termites, and berries, during the dry and wet seasons. Seasonal variations in the proportion of feeding time allocated to each feed type are visually emphasized.*

5. Discussion

This study examines the seasonal behavioral patterns of sloth bears in Wilpattu National Park, Sri Lanka, with a particular focus on their activity and feeding behaviors across the dry and wet seasons. Our results indicate that sloth bear movement patterns are strongly influenced by seasonal factors, likely linked to variations in food and water availability. Additionally, the bears appear to adjust their resting habits in response to fluctuations in temperature and the accessibility of suitable shelter. Observed changes in aggressive behaviors may reflect heightened competition during specific seasonal conditions. In contrast, certain behaviors remain relatively stable throughout the year, suggesting a limited seasonal influence on those aspects of sloth bear ecology. Overall, these findings underscore significant seasonal variations in key behaviors, emphasizing the critical role of environmental factors in shaping the ecology and adaptive strategies of sloth bears.

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5.1 Seasonal Variations in Behavior

Our analysis indicates a significant difference in walking behavior between the dry and wet seasons ($\chi^2 = 32.895$, $p < 0.001$). This result aligns with previous studies that show how seasonal changes impact animal movement patterns. For instance, sloth bears are known to adjust their movement in response to resource availability, travelling greater distances during periods of resource scarcity (Garshelis, 2022). The marked increase in walking during the dry season likely reflects the bears' need to search for food and water as resources become less accessible.

Similarly, the significant variation in bedding down behavior ($\chi^2 = 4.5$, $p = 0.034$) suggests that sloth bears modify their resting habits according to seasonal conditions. During the dry season, higher temperatures and reduced shelter availability may force sloth bears to alter their resting sites or times, whereas the wetter season provides more favourable conditions for resting (Baskaran, Venkatesh, Srivasthava, & Desai, 2015). These findings are consistent with observations of other bear species, where bedding behavior is closely linked to environmental conditions (Laurie & Seidensticker, 1977).The increased frequency of fighting or chasing behavior in the dry season ($\chi^2 = 5.444$, $p = 0.020$) may reflect intensified competition or aggression under certain seasonal conditions. Such behavior is often associated with competition for limited resources or mates, which can be more pronounced during specific times of the year (Laurie & Seidensticker, 1977). This observation is consistent with reports of heightened aggression in wildlife during periods of resource scarcity or mating seasons (Baskaran et al., 2015; Laurie & Seidensticker, 1977).

5.2 Stable Behaviors

In contrast, self-grooming, defecation and urination, and hydration behaviors did not show significant seasonal variations (Self-grooming: $\chi^2 = 1$, $p = 0.317$; Defecation and Urination: $\chi^2 = 0.333$, $p = 0.564$; Hydration: $\chi^2 = 2$, $p = 0.157$). These stable behaviors suggest that they are less influenced by seasonal changes compared to other activities. The stability in self-grooming and physiological processes may be due to their fundamental role in maintaining health and hygiene, which remains constant despite environmental fluctuations (Urbani & Bosque, 2007).

5.3 Activity Patterns

Our analysis of activity patterns across different day parts shows increased activity during the morning and afternoon, with reduced activity in the evening. This diurnal pattern is consistent with other studies indicating that many wildlife species adjust their activity levels based on temperature and predation risks (Sharp, Smith, Swaminathan, & Arun, 2022).

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The low evening activity of sloth bears may be a strategy to avoid heat stress and minimize exposure to predators, reflecting similar patterns observed in other large mammals (Prajapati & Koli, 2020).

5.4 Feeding Behavior

The analysis of feeding behavior reveals that sloth bears exhibit consistent feeding durations across seasons, as indicated by the Mann-Whitney U test ($W = 81$, $p = 0.535$). This finding suggests that feeding durations are maintained despite seasonal changes in resource availability. However, the distribution of feed types varies significantly between seasons. Ants and termites were more prevalent in the wet season, while berries were exclusively observed in the dry season. This seasonal variation in feed types reflects shifts in resource availability, with termites and ants being more accessible during the wet season due to increased moisture (Laurie & Seidensticker, 1977; Urbani & Bosque, 2007). The preference for berries in the dry season aligns with their seasonal abundance, illustrating how sloth bears adapt their foraging strategies to changes in food availability (Sharp et al., 2022).

5.5 Conservation Implications

Understanding the seasonal behavioral and feeding patterns of sloth bears is crucial for their conservation. Our findings highlight the need to consider seasonal changes in resource availability when developing management strategies. Effective conservation efforts should focus on preserving critical habitats and ensuring the availability of essential resources throughout the year to support sloth bear populations (Ratnayeke, 2021). Continued monitoring and research are necessary to adapt conservation strategies to the dynamic environmental conditions affecting sloth bears.

In conclusion, this study provides valuable insights into the adaptive behaviors of sloth bears in response to seasonal changes. These findings contribute to a deeper understanding of sloth bear ecology and inform conservation practices aimed at preserving this species in a changing environment.

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Author contribution:
Shashi Madhushanka: Data curation, Formal analysis, Investigation, Visualization. Danushka S. Weerasekara**:** Conceptualization, Methodology, Writing – original draft, Project administration, Supervision**.** Malmi Jayaweera: Resources, Validation, Writing – review & editing. Kithsiri B. Ranawana**:** Supervision, Writing – review & editing.

Conflicts of Interest: The authors declare no conflict of interest.

Data Availability Statement: The authors confirm that the data supporting the findings of this study are available from the corresponding author upon reasonable request.

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