



Original Research Paper

Comparative Study of Nocturnal and Diurnal Activity Patterns in Mammals Inhabiting Fragmented Forests and Human Dominated Landscapes

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Key Words	Abstract
Habitat Fragmentation, Mammalian Activity Patterns, Nocturnal Behaviour, Diurnal Behaviour, Human- Dominated Landscapes, Camera Trapping, Wildlife Conservation	Ecological adaptations and health of the ecosystems are very heavily dependent on the structure of the habitat, the availability of resources and the anthropogenic disturbance in the environment are considered to be important clues to the activity pattern of mammals. The purpose behind using this research was to comparatively assess the nocturnal and diurnal activity of the mammals living in the fragmented forests and human dominated landscape with consideration of the behavioural adaptation to the fragmentation and human pressure on the habitat. The information was gathered as integrated ecological methods, such as motion- triggered camera traps, on-the-field observations, as well as GPS tracking on various study sites which represent fragmented forest areas, and surrounding anthropogenic environments. The records of the activities were divided into nocturnal, diurnal, and crepuscular periods and statistical analyses were conducted with the help of R and Python packages such as ANOVA, the Wilcoxon rank-sum test, and the Pearson correlation analysis. Eighteen mammal species had been noted and fragmented forests provided greater species richness (15 species) than human dominated landscapes (12 species). The behavioural patterns of fragmented forests were rather diurnal (65%), and the activity of mammals in the human-controlled landscape was more nocturnal (55%), reflecting behavioural patterns that help to avoid anthropogenic perturbation. Forest fragments had a higher frequency of activity (3.2 ± 0.6 detections/day) compared to disturbed habitats (2.1 ± 0.5 detections /day). The result of the statistical test was significant differences in the activity patterns among the habitats ($F = 8.62$, $p < 0.01$). There were positive associations between night activity and the distance to roads and settlements ($r = 0.590.61$, $p < 0.05$). Comprehensively, the research paper presents the ecological significance of habitat interconnectedness, canopy, and less human disruption to preserve natural mammalian behavioural pattern and stable long-term biodiversity.

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Introduction

Mammals exhibit different activity patterns that are typically either diurnal, i.e. active in the daytime, or nocturnal, i.e. active at night. Some of the factors that define these temporal behaviours include food availability, predator avoidance, social interactions and thermoregulation. The patterns of activities affect ecological roles such as foraging efficiency, predator-prey interactions, and habitat use. The benefits of studying such patterns include understanding how species behave, thus how to develop a healthy ecosystem and also what effects on the environment might affect wildlife.

Increasingly, the natural rhythms of activity are disrupted on a landscape of habitat fragmentation and anthropogenic domination. Fragmented forests facilitate less movement, decreasing connectivity, and may leave wildlife more to predation and human disturbances (Reddy & Qureshi, 2024; Patil, 2018). Equally, the effects of urban and agricultural environments are artificial and may pressure the mammals to change their temporal behaviors, especially due to the presence of noise, light pollution, and human activity (Ramya & Geetha, 2025). Changes in activity such as higher levels of nocturnality can indicate how people can adapt to reduce risk without limiting access to resources, however, it may have ecological effects, including changes to predator-prey relationships and reduced reproductive success.

Although there is a lot of literature on habitat fragmentation and mammalian ecology, a limited number of research works have resulted in a direct comparison of night and day activity

patterns in the two opposing landscapes (Chandravanshi & Neetish, 2023). The current study examines the patterns of mammal activity in fragmented patches of forests and the areas inhabited by people and attempts to measure temporal activity changes, the ability to find species-specific reactions, and the effects of anthropogenic stress. The hypothesized problem is that the nocturnal activity of the mammals in human altered and highly broken habitats is higher than that of the mammals in the intact forests with more normal diurnal activity. It is hoped that the results guide conservation plans and landscape management to promote wildlife survival in evolving landscapes.

1. The study offers a comparative analysis of the nocturnal and daytime activity of mammals in fragmented forests and in human-dominated landscapes and emphasizes species-specific behavioral modifications.
2. Measures the impact of habitat fragmentation and human pressures in temporal activity transitions and provides empirical support that nocturnal adaptations are adaptive in disrupted habitats.
3. Provides practical guidance on wildlife conservation and landscape management that direct the design of corridors, habitat restoration and human-wildlife co-existence plans.

The paper is organized into seven sections. Section I presents a research background, objectives and importance. In Section II, past research on habitat fragmentation and the

patterns of mammal activity is conducted. The methodology is described in section III, such as study area, sampling, data collection and statistical analysis. Section IV is the course give the results and statistical findings. The ecological interpretation of the results is discussed in Section V. Section VI covers the management and conservation implications and section VII summarizes the study by giving its main findings, limitations and future research directions.

Literature Review

Habitat fragmentation and anthropogenic disturbance can have severe impacts on the mammalian biodiversity, movement and seasonal patterns of activity. Discontinuous habitats decrease connectivity of habitats, change resource dynamics and influence species persistence, which translate into behavioral changes in wildlife species (Norris et al., 2010; Kupfer & Franklin, 2009). Research on tropical landscape has demonstrated that fragmentation and deforestation alter ecological succession and downgrade habitat quality, thereby influencing both long-term ecosystem stability and conservation of biodiversity (Santo-Silva et al., 2016; Arroyo-Rodríguez et al., 2017). Artificialized spaces also place additional ecological pressures on the living organisms causing mammals to change their activity patterns and movement choices to evade conflicts.

Past studies have shown that disturbed mammal species tend to evolve towards nocturnal activities as an evolutionary change to human presence and construction of infrastructures (Moreira-Arce et al., 2015; Chen

et al., 2023). Such phenomena as behavioral plasticity in circadian activity regimes has already been noted in mesocarnivores, facilitating co-existence and survival under diverse environmental stresses (Monterroso et al., 2014). The development of monitoring technologies such as telemetry systems, deep learning algorithms, and automated sensing methods have enhanced the analysis of the movement and habitat use of wildlife (Yashaswini et al., 2025; Fenton et al., 2021). Nonetheless, minimal research has directly juxtaposed nocturnal and diurnal patterns of activity in fragmented forests with adjacent human-influenced habitats through integration of ecological monitoring techniques, and this is the basis of the current research.

The literature review demonstrates that habitat fragmentation and anthropogenic disturbance has a great effect on biodiversity and activity patterns in mammals, frequently leading to changes towards nocturnal behaviour. It also points to the significance of habitat connectivity and ecological monitoring, and indicates that there is a paucity of comparative studies of fragmented forests and human-dominated landscapes.

Methodology

Study Area

The experiment involved sampling of a series of discontinuous forest areas and the surrounding man-made environment in the study area. Fragments of the forest ranged between 2 and 50 hectares in size and were different with respect to canopy cover, vegetation density, connectivity

and offered a gradient of habitat quality. Other human-altered ecosystems were agricultural lands, peri-urban communities, and secondary scrublands near forest patches. Once in every site, the canopy height, the structure of the vegetation, water sources, nearness to roads or settlements among other environmental possibilities were documented. It was observed that GPS coordinates accurately mapped the location of study sites and provided a way to analyze the patterns of species activity in different habitat types.

Sample and Strategy of Species Selection.

The ecological relevance, detectability, and occurrence historically in the region of study were used to select the species with a representative sample of nocturnal and diurnal behaviours (with medium and large-sized mammals). The sampling design was a stratified one that guaranteed balance in the amount of effort put on the forest segments and the areas taken over by humans. The sampling was done across a series of weeks to consider activities changes over time and seasonal effects on activities. This strategy enabled solid comparison of species, habitat types, and activity patterns of various times.

Data Collection Methods

Camera Traps

Camera traps were set up on well-established waterholes and feeding points of animals moving along familiar routes. The cameras were mounted at a height of 30-50 cm and programmed to enable them work continuously 24 hours with

time-stamped images taken to be analyzed at a later date.

Direct Observation

Visual survey was done in the morning (05:30-18:30) and evening (16:30-19:30) to record peak day and crepuscular activity. Those who watched trailed pre-defined trans utilizing a pair of field glasses and noted sightings, behaviours and times spent in activities.

GPS Tracking

GPS collars were placed on select mammals (median and large-sized) to track patterns of movement. Location fixes were taken at 30-minute intervals. The camera trap and observational data were corroborated by the GPS data which gave continuous time and location data on the activities of the different organisms.

Temporal Data Recording

Activity data were categorised into diurnal (06:00–18:00), nocturnal (18:00–06:00), and crepuscular periods (05:30–07:00, 17:30–19:00). The active hours of each species, the number of times each species was detected and the length of the activity bouts was recorded. Camera trap, direct observation, and GPS collar data were all synchronised by time point to keep them consistent with each other.

Temporal Data Recording

All activity data were categorised into diurnal (06:00–18:00), nocturnal (18:00–06:00), and crepuscular periods (05:30–07:00 and 17:30–19:00). The active hours, frequency of observation, and the duration of activity bouts, in accordance with each species, were removed out

of the camera trap images, firsthand observations, and GPS tracking information records. All the data sources were time-stamped to create consistency and accuracy in identifying patterns of activities.

Data Analysis

R (v4.3) and Python (v3.10) were used to analyze the data. Each species and habitat type was determined to have its activity indexes in terms of proportion of active hours and frequency

of detection. ANOVA and Wilcoxon tests were applied to compare forest fragment with human-dominated landscapes through differences in analysis. Pearson correlation coefficients evaluated relationships between patterns of activities and the environmental factors like canopy cover, the habitat size and proximity to the human settlements. Specifically, the curves of temporal activity and the heatmap were created to visualise species-specific changes in activity in each habitat.

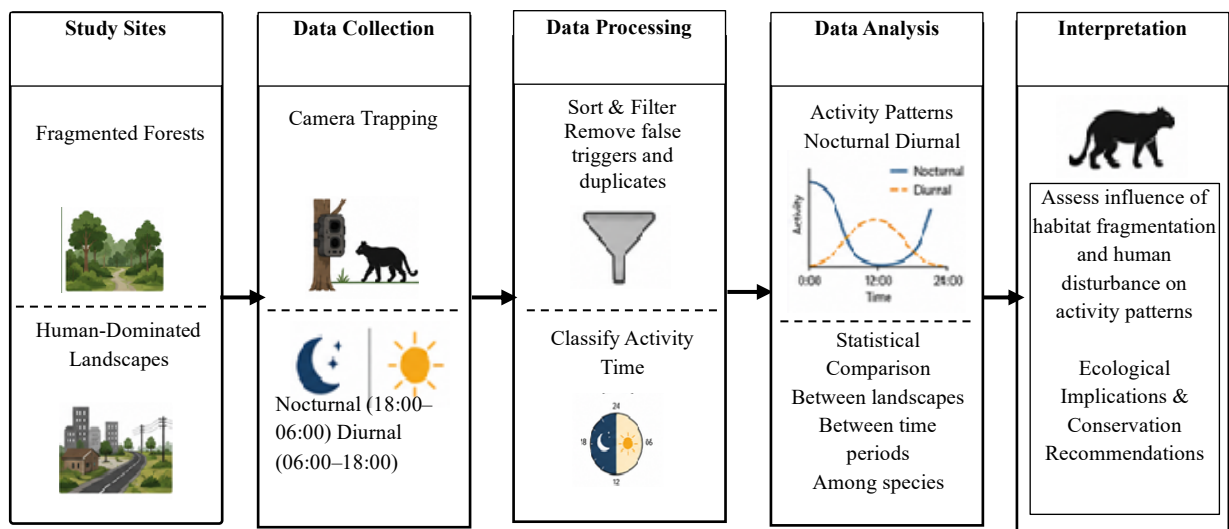


Figure 1. Conceptual Framework for Comparative Analysis of Nocturnal and Diurnal Mammalian Activity Patterns

Figure 1 represents the methodology employed in comparing the behavior of mammals with respect to nighttime and daytime activities in fragmented forests and human dominated landscapes. This process consists of selecting the study sites, recording observations through camera traps, categorizing the behavioral times of the observed activities, data processing and analysis.

Results

Species Detection and Distribution

In summary, a total of 18 mammalian species have been recorded in all the sites studied through the use of camera traps, direct sightings, and GPS tracking techniques. The fragmented forests had 15 species recorded, while the human-influenced areas had 12 species recorded; nine species being shared between the two habitats. Large contiguous fragments had high levels of species diversity and equal sex-age

ratios compared to small fragments and human-influenced areas.

Table 1: Species Richness and Distribution Across Habitats

Habitat Type	Total Species Detected	Common Species	Unique Species	Notes
Fragmented Forests	15	9	6	Higher richness; more diurnal species
Human-Dominated Landscapes	12	9	3	Shift towards nocturnal activity

The summary of species diversity and their distribution in fragmented forests and human dominated landscapes is given in Table 1. Fragmented forests had a larger species composition (15 species), with six species unique to fragmented forests with diurnal activities being more common. Human dominated landscapes had fewer species (12 species) with three unique to these landscapes, with nocturnal activities dominating.

4.2 Temporal Activity Patterns

The analysis of detections with timestamp showed significant differences between night-

time and day-time activities depending on the habitat type. Detections within the forest fragments showed 65% detection during day time, 30% during the night time, and 5% crepuscular detection. In the anthropogenic modified landscape, there was a shift to nighttime activities with 55% detection during night time, 35% during day time, and 10% crepuscular detection. Animals like Indian Palm Civet (*Paradoxurus hermaphroditus*) and Small Indian Mongoose (*Herpestes auropunctatus*) displayed increased nocturnality in the anthropogenic habitat.

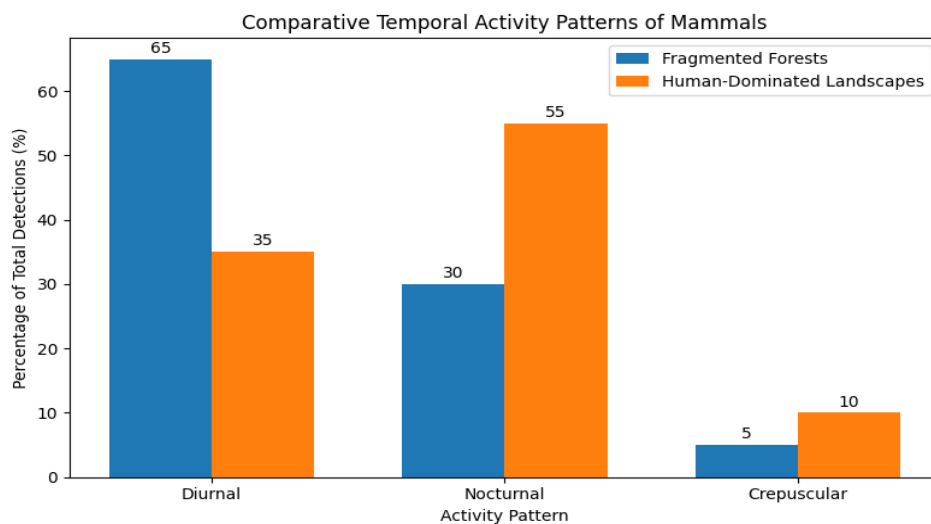


Figure 2. Comparative Temporal Activity Patterns of Mammals in Fragmented Forests and Human-Dominated Landscapes

Figure 2 shows the proportion of diurnal, nocturnal, and crepuscular mammals observed in fragmented forests and human-modified lands. Mammals in fragmented forests are mainly active during the day (65%), while those in human-modified lands are mostly active at night (55%). The study findings suggest that there is a change in behaviour from diurnality to nocturnality due to disturbances by humans.

4.3 Activity Frequency and Duration

The average frequency of activities expressed as the number of activities per species per day

Table 2: Activity Frequency and Duration per Habitat

Habitat Type	Average Detections per Species per Day	Mean Diurnal Bout Duration (hrs)	Mean Nocturnal Bout Duration (hrs)
Fragmented Forests	3.2 ± 0.6	3.1 ± 0.7	2.8 ± 0.7
Human-Dominated Landscapes	2.1 ± 0.5	2.2 ± 0.6	4.5 ± 0.8

Summary of the activity frequency and durations of mammals in different habitats is provided in Table 2. The mammals in the fragmented forests showed greater activity frequency, recording an average of 3.2 ± 0.6 sightings per species per day, with increased diurnal activity periods of 3.1 ± 0.7 hours and reduced nocturnal activity periods of 2.8 ± 0.7 hours. For mammals in human-modified landscapes, their activity frequency was reduced to 2.1 ± 0.5 sightings per day, and their diurnal activity was reduced to 2.2 ± 0.6 hours while nocturnal activity was prolonged to 4.5 ± 0.8 hours.

4.4 Statistical Analysis

The comparisons of habitats through ANOVA and Wilcoxon rank sum test demonstrated

was significantly greater in the forest fragments (3.2 ± 0.6) compared to the human-altered landscapes (2.1 ± 0.5). Nighttime activity period in human-altered landscapes was much more prolonged (4.5 ± 0.8 hours) than in forest fragments (2.8 ± 0.7 hours), indicating increased nocturnal activities resulting from human pressure. Daytime activity period became shorter in human-altered landscapes and particularly in case of medium and larger mammals like leopard cats (*Prionailurus bengalensis*) and Indian porcupines (*Hystrix indica*).

significant differences in the activity pattern between the fragmented forest and the human dominated habitat ($F = 8.62$, $p < 0.01$; $W = 72.5$, $p < 0.05$). The correlation test for the relationship between nocturnal activity and distance to human settlements and roads revealed that the relationship was significantly positive ($r = 0.61$, $p < 0.05$). On the other hand, the relationship between diurnal activity and canopy cover as well as fragment size was found to be significantly positive ($r = 0.58$ and $r = 0.52$ respectively, $p < 0.05$).

Table 3: Correlation Between Activity Patterns and Environmental Variables

Variable	Diurnal Activity (r)	Nocturnal Activity (r)	p-value
Canopy Cover	0.58	-0.41	<0.05
Habitat Fragment Size	0.52	-0.38	<0.05
Distance to Human Settlements	-0.45	0.61	<0.05
Distance to Roads	-0.42	0.59	<0.05

Table 3 indicates the relationships between the activity patterns of the mammals and the critical environmental variables. Canopy cover ($r = 0.58$) and habitat fragment size ($r = 0.52$) were all positively correlated with diurnal activity suggesting that larger and well-vegetated fragments could sustain more activity during the day. Conversely, nocturnal activity positively correlated with human settlements ($r = 0.61$) and with roads ($r = 0.59$), and negatively with canopy cover and fragment size implying that the mammals have adapted their action in order to avoid being disturbed by humans. All of the correlations were statistically significant ($p < 0.05$) and the significance implements the impact of both the anthropogenic and habitat structure on the temporal behaviour.

Discussion

The current research revealed that activity patterns of mammals varied greatly in fragmented forests compared to the human-dominated landscapes, which showed the importance of habitat fragmentation and anthropogenic disturbance in shaping behaviour in wildlife. Fragments forests allowed the occurrence of increased species richness and mainly diurnal richness, which contained evidence that larger and well-developed habitat availed favourable ecological conditions with

minimal interference of human impact. Conversely, mammals in anthropogenic scenery were a bit more active at night and crepuscular hours, which is likely an adaptive behavioural response to escape the presence of humans, roads, and other human traits. Plasticity in behaviour with environmental stress led species like the Indian palm civet and small Indian mongoose to display greater nocturnal behaviour in disturbed habitats. The lower frequency of activity and shorter diurnal activity bouts in altered landscapes are also signs that mammalian communities in the ecology were under ecological stress. Statistical tests supported a significant difference in activity among the habitats and positive relationships between nocturnal activity and close to settlements and roads illustrated the importance of anthropogenic pressure in influencing temporal behaviour. On the other hand, canopy cover, and greater habitat fragments positively affected diurnal activity, indicating the significance of habitat quality and connectivity. Generally, the results indicate that behavioural adaptation to disturbed environment may be evident among some mammals but the ongoing habitat degradation can impact negatively on biodiversity, ecological interactions as well as the stability of populations over a long period.

Implications to Management and Conservation

The results of this research show that conservation measures to enhance habitat connectivity and mitigate anthropogenic disturbance in fragmented landscapes are much needed. Creating ecological pathways among remote units of forests will improve the movement of species, genetic exchange, and establishment of stable populations of mammals. This should be accompanied by restoration of damaged habitats by reforestation, sustainability of canopy cover which allows the conservation of diurnal species and minimizes stress on behaviour due to habitat disintegration. The heightened nighttime behavior in human-dominated landscapes further underscores the need to encourage the co-existence of humans and wildlife via regulated land-use, minimizing of night disruption, provision and support of wildlife-friendly landscape structures and local awareness campaigns. Strategies, including reducing the road widening in the area of essential habitat and installing wildlife upon passage are further attempts to reduce the human-wildlife conflict and disruption. The use of camera traps, GPS tracking and long-term ecological survey as a continuous monitoring is suggested to determine a change in behaviour and population over time. Further studies are advised to examine seasonal effects, effects species-specific, and the ecological impacts of changed activity patterns over time to enable the most effective policies on wildlife conservation and landscape management.

Conclusion

This paper comparatively examined the nocturnal and diurnal activity patterns of mammals living in fragmented forests and human dominated horizons and showed that anthropogenic perturbation markedly changes the temporal behaviour of mammals. Eighteen mammal species were observed in all sites under study where fragmented forests had the highest species richness (15 species) compared to human dominated landscapes (12 species). Results showed that 65 percent of detections in fragmented forests were at daytime with 55 percent of mammals in human dominated landscapes exhibiting nocturnal behaviour. There were obvious changes in some species like the Indian palm civet and the small Indian mongoose to nocturnal patterns in disturbed habitats, which suggested changes in behaviour to avoid human interference and environmental pressures. Fragmented forests (3.2 ± 0.6 detections per species per day) and human dominated landscapes (2.1 ± 0.5) were found to have higher activity frequency, with longer activity bouts at night in disturbed landscapes (4.5 ± 0.8 hours). The statistical results proved that the patterns of activities differed significantly in habitats (ANOVA: $F = 8.62$, $p < 0.01$; Wilcoxon test: $W = 72.5$, $p < 0.05$). Further Pearson correlation analysis revealed that nocturnal activity was positively correlated to the closeness to roads and settlements ($r = 0.59$ to 0.61 , $p < 0.05$) and diurnal activity correlated to canopy cover and size of the habitat fragment ($r = 0.52$ to 0.58 , $p < 0.05$). On the whole, the research indicates the ecological value of habitat connectivity and

minimization of human disturbance in preservation of the natural patterns of mammal active behavior and long-term biodiversity evenness.

Ethical Considerations

Fieldwork was structured to ensure that as little disturbance as possible was given to the wildlife and non-invasive techniques such as camera traps and observation surveys were put to the fore. GPS collars were installed in accordance with the accepted animal welfare guidelines to be safe and comfortable. Relevant authorities provided all the necessary research permits that included handling and tracking of animals as well as carrying out studies in safeguarded areas and data collection was conducted in line with the ethical considerations on wild animal research.

Author Contributions

Funding: No funding was received for this research.

Conflict of Interest: The authors declare that there are no conflicts of interest associated with this research. All analyses and interpretations were conducted objectively without any financial or personal influences affecting the outcomes.

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