



# DISTRIBUTION AND HABITAT PREFERENCES OF SPOTTED DEER (*Axis axis*) IN KUVEMPU UNIVERSITY CAMPUS, SHANKARAGHATTA, SHIVAMOGGA, KARNATAKA

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## Abstract

The study was carried out to understand the distribution patterns and habitat preferences of Spotted Deer (*Axis axis*) within the Kuvempu University campus, situated in the Bhadra Tiger reserve, Shivamogga District, Karnataka, India. Employing a multi-method approach, field surveys were conducted for a span of 6 months from January 2025 to June 2025, with methodologies like, line transect sampling, camera trap deployment, and indirect sign identification, across diverse habitat types. Out of 1247 total photographic captures from the camera trap dominated ones were the spotted deer with 26%. The density was high along the semi disturbed habitat with 14.15 compared to forest and the disturbed habitat. Group size varied from 1 to 22 individuals. Camera trap analysis documented peak activity periods during early morning from 05:00-08:00 hours and late afternoon from 04:00-06:00 hours, consistent with crepuscular behaviour patterns. Threat assessment revealed the presence of potential predators like tiger, leopard, dholes and the major effect was observed from the stray dogs. The findings reveal a pronounced association between habitat heterogeneity and Spotted Deer presence and abundance. As the spotted deer has the high ecological significance as a keystone herbivore species and primary prey base, conservation of healthy Spotted Deer populations contributes substantially to broader landscape-scale ecosystem integrity. These results underscore the critical importance of maintaining structurally complex, heterogeneous habitats and minimising disturbances for the effective conservation and management of this keystone ungulate species in shared landscapes.

**Keywords:** *Axis axis*, chital, camera trapping, line transect, habitat preference.

## 1. Introduction

Spotted Deer is one of the most recognizable and common ungulate species in the Indian subcontinent, often referred to as chital or axis, belongs to the family Cervidae and order Artiodactyla (Baruzzi and Krofel, 2017; Naik et al. 1964). India supports high ungulate diversity due to varied habitats ranging from grasslands and deserts to tropical forests and alpine ecosystems (Schaller, 1967). Ungulates form a major component of terrestrial ecosystems, acting as primary herbivores and key prey species for large carnivores (Prater, 1971; Menon, 2014). *Axis axis* is one of the most common and widely distributed cervids in the Indian subcontinent, this species is easily recognized by its reddish-brown coat marked with distinctive white spots (Schaller, 1967). Within India, they are among the most abundant large herbivores and play a crucial ecological role in forest ecosystems as primary grazers and prey species for large carnivores, thereby occupying a critical position within terrestrial food webs (Johnsingh, 1983, Bagchi et al. 2003; Majumder et al. 2013). The species typically inhabits tropical dry deciduous forests, moist deciduous forests, and grasslands, often preferring areas close to water sources (Schaller, 1967), native to countries such as India, Nepal, Sri Lanka, and Bhutan and conservation status currently listed as Least Concern (IUCN, 2025). The state of Karnataka, part of the Western Ghats and Deccan Plateau, supports diverse ungulate fauna due to its mosaic of forests and grasslands (Karanth et al., 2004). Spotted deer are highly social animals, usually forming herds that may range from a few individuals to over a hundred, depending on habitat conditions and predation pressure (Raman, 1997). The spotted deer, is primarily a grazing herbivore with a flexible feeding strategy that includes both grazing and browsing. Its diet composition varies seasonally depending on food availability, habitat type, and climatic conditions (Schaller, 1967). During dry seasons, when grasses are scarce, they shift toward browse species, fallen fruits, and tree foliage to meet nutritional requirements (Prater, 1971). They play a several ecological roles, in particular, through browsing and seed dispersal mechanisms, Spotted Deer have a significant impact on forest regeneration processes, making them keystone species (Bagchi et al. 2003; Majumder et al. 2013) Their grazing also influences plant community composition, making them an important species in habitat dynamics. Their population density directly affects predator populations and ecosystem stability (Karanth & Sunquist, 1992). The spotted deer faces several threats despite being listed as Least Concern. Major threats include habitat loss and fragmentation due to agriculture and urbanization, and competition with livestock for grazing resources (Schaller, 1967; Raman, 1997). Poaching for meat and human-wildlife conflict from crop damage also affect populations (Johnsingh, 1983). Additionally, disease transmission from domestic animals and habitat degradation by invasive species reduce their survival chances (IUCN, 2025).

Understanding population demographics, spatial distribution, and habitat requirements represents a foundational element of wildlife conservation and management strategy development. The scientific literature identifies two broad methodological approaches for population assessment: direct methodologies that rely upon observer detection of individual animals, and indirect methodologies that quantify evidence using sign surveys, camera trapping, (de Oliveira et al. 2026; Kelly et al., 2012). These complementary approaches have been increasingly applied to ungulate populations, particularly in relation to habitat assessment and conservation planning efforts (Eberhardt, & Van Etten, 1956; Haleem & Ilyas, 2023).

The present investigation was undertaken to document and characterise the distribution of Spotted Deer within the Kuvempu University campus, adjacent to Bhadra Wildlife Sanctuary. The primary research objectives to quantify the abundance and density across heterogeneous habitat types, temporal activity patterns and assess the influence of anthropogenic disturbance to provide comprehensive baseline data for this population within an understudied geographic region.

## 2. Materials and Methods

### 2.1 Study Area

Present study was carried out in Kuvempu University campus, situated in the village of Shankaraghatta, Shivamogga district, Karnataka State, India. The study site is geographically positioned at 13°42'22" North latitude and 75°30'21" East longitude, at elevations ranging from 680–720 meters above mean sea level. The university campus encompasses 326.21 acres and is characterised by heterogeneous habitat composition. The campus abuts the Bhadra Tiger Reserve and lies within contiguous dry deciduous forest habitat characteristic of the Western Ghats biogeographic region. Temperatures range from 18–36°C. Annual relative humidity fluctuates between 60–75 per cent throughout the year. The region receives approximately 1000–1200 millimetres of annual precipitation, with substantial concentration during the southwestern monsoon season. The dry season (December through May) corresponds with the primary study period, representing a season when wildlife activity patterns are most pronounced and vegetation is less dense, facilitating species detection.

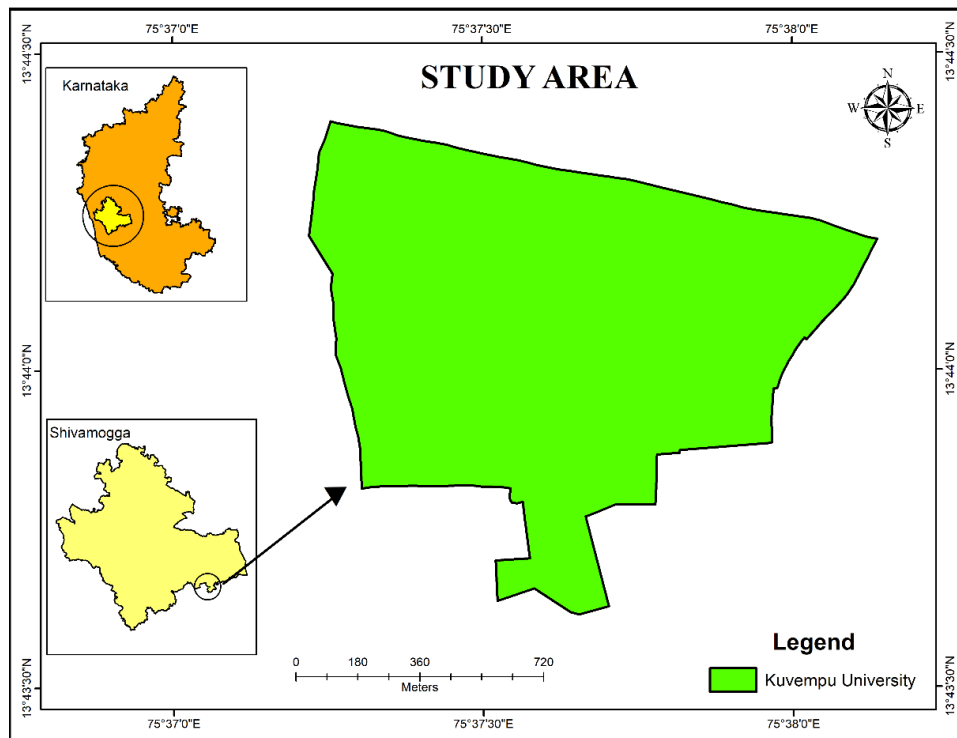


Fig 1: Map of Study Area

## 2.2. Methodology

Study was carried out from January 2025 to June 2025 for the span of 6 months with methodologies such as camera trapping (Avinash et al. 2018), indirect sign surveys (Gopaldaswamy et al.2012), line transect method and opportunistic sighting, and threat assessments. The area was divided 500-meter grids covering the entire area, camera traps were deployed at 15 different locations throughout the forest patch based on trial paths and indirect signs for almost around 120 days. Infrared camera traps were deployed at a height of 30-40 cm along animal trails, operating 24 hours a day and recording, GPS coordinates for each location were collected with the help of Garmin 64S GPS device in order to determine the distribution. Indirect surveys like pellet, and hoof marks were also photographed and GPS locations were noted to know the distribution (Basak et al. 2017). Furthermore, we also recorded ecological and anthropogenic threats like activity of feral dog and other carnivore species in the forest. For this investigation 9, 500mtr line transects were laid along the 3 different habitat types (Forest, Semi disturbed and disturbed). Transect surveys were conducted during the peak activity periods: early morning hours (06:00–09:00) and late afternoon hours (16:00–18:00). To characterise temporal activity patterns of Spotted Deer from camera trap data, the timestamps of all Spotted Deer photographic captures were extracted and compiled. In addition to direct observations of Spotted deer, the investigation systematically recorded indirect evidence of species presence.

## 3. Results

### 3.1 Species Occurrence, Distribution and Density

Camera trap surveys yielded 1247 total photographic captures over the 150-day deployment period. Through camera trap evidences, line transects and indirect signs the presence of the Spotted deer were confirmed at all the three habitat types. Camera traps were deployed at 20 locations along the trail paths in all the three habitat types. Spotted deer are most abundant compared to other animals and ungulates with 26% of sightings along with the spotted deer other ungulates present in the study area are sambar deer, barking deer, mouse deer and wild boar which made up to 14%. Camera trap photographs also comprised other animals like porcupine, mongoose, macaques, langur etc accounting for 21%, Predators like Tiger, Leopard, Dhole and Jackal comprised of 15%, followed by the stray dogs with 12%, then represented by the humans with 7% and least being the false triggers by 5% (Fig: 2). Line transects also displayed the occurrence of the spotted deer at all the three habitat types with greater density being in the semi disturbed habitat with 14.15 followed by the forest with 11.52 and least along the disturbed habitat type 7.41 (Fig 3). Moderate disturbance can enhance the habitat suitability for the spotted deer compared to dense forest and disturbed habitat type.

**Table 1.** Density of Spotted Deer Recorded Along the habitat types

Sl No	Habitat Type	Transect	Number of Sightings	Density
1	Forest	T1	62	11.52
		T2	97	
		T3	152	
2	Disturbed	T1	65	7.41
		T2	33	
		T3	102	
3	Semi disturbed	T1	156	14.15
		T2	107	
		T3	119	

The spatial analysis of Spotted Deer sightings revealed pronounced associations with specific habitat configurations. Using the recorded locations of species occurrence and indirect indicators, a heat map/density map, was plotted to determine the density of probability of occupancy of spotted deer (Fig 4). The density map highlighted the priority zones and revealed the unequal distribution of spotted deer in the study area. Based on the data the occurrence probability was divided into 4 zones (Very high, High, Moderate and Low/Unexplored).

Higher density zones were the areas with semi disturbed habitat type with forest and human habitation. Followed by the moderate zone with less or minimal forest cover, while the low-density area was the fragment forest area and the human habitations with built-up areas, also study contained some patch of forest which was unexplored during the study. Result revealed that the chital prefer areas close to perennial water source. It avoids dense evergreen forests and extremely arid regions, showing a strong association with habitats that provide both forage and cover (Schaller, 1967; Prater, 1971). Areas subjected to human disturbance demonstrated markedly reduced or absent spotted deer presence, due to habitat degradation, disturbance, and increased human activity, which reduce forage. Studies show that decline in the chital in areas with high human density, leading to their preference for protected forests and less disturbed habitats (Karanth & Sunquist, 1992; Madhusudan, 2004).

### 3.2. Indirect Sign Observations

Systematic searches for indirect signs of Spotted Deer presence along survey transects yielded 342 recorded indirect sign observations across all the 9 transects. Hoof marks represented 107 (31 %) of all recorded indirect sign observations, while faecal pellet clusters accounted for 162 (47 per cent) of observations and least was the signs of Antler rub on the tree trunk, which accounted for 73 records occupying 21% of overall indirect sign recordings (Fig 5). Indirect sign detection confirmed Spotted Deer presence in areas where direct sightings were not recorded. Distribution of indirect signs paralleled the spatial pattern of direct sightings, with the highest indirect sign densities in forest and semi disturbed transition zones, and the lowest densities in disturbed areas. This convergence between direct and indirect detection methods strengthens confidence in the spatial distribution patterns identified.

### 3.3. Group size

Group sizes recorded from camera traps and line transect survey, ranged from single individuals to groups of 22 individuals. Every group was observed in all the 3 habitat types; a total of 4 different groups were observed during the study. Spotted deer exhibit a fission-fusion social system, the herd size and composition change frequently based on resource availability and social interactions. They typically form female herds consisting of adult females and fawns, bachelor groups of young or adult males, and mixed herds during the breeding season (Schaller, 1967; Eisenberg & Lockhart, 1972).

### 3.4 Threat

Predator species such as Leopard, Tiger, Dholes, Jackals and Feral dogs were also recorded in the study area. Their presence close to the wildlife areas is a threat due to predation. No major anthropogenic threats to spotted deer were observed during the study apart from the human movement limited to the semi disturbed habitat. The one that can be called a severe threat to the deer was the frequent movement of feral dogs in the forest patched. Feral dogs were frequently sighted along animal trails and forest which pose the risk to the spotted

deer, especially to the fawns and the juveniles. Many studies have revealed that feral dogs can suppress small mammal activity and contribute to localized population declines, particularly in fragmented or semi-disturbed areas (Vanak and Gompper 2009). Feral dogs have turned out to be the major threat to the deer as they chase and injure the deer and occasionally kill the fawns and the weaker ones. The incidents are increasing especially near forest edges and human settlements. Presence of feral dogs in forested areas also induces changes in the behaviour and habitat use of deer in turn increasing stress and reducing in animals (Home et al., 2018; Vanak & Gompper, 2009).

#### 4. Conclusion

This multi method investigation of Spotted Deer distribution within Kuvempu University campus of Bhadra Tiger Reserve has generated comprehensive baseline data characterising distribution patterns, habitat associations, and activity patterns of the spotted deer. The findings clearly demonstrate that Spotted Deer distribution is strongly influenced by habitat structure, and extent of anthropogenic disturbance. Spotted deer (*Axis axis*) show a clear preference for semi-disturbed habitats rather than dense forests as these areas provide better forage availability, visibility for predator detection, and access to water, making them more suitable for feeding and movement, whereas thick forests with limited understory reduce food resources and visibility. Many similar studies have consistently reported higher chital densities in such semi-open habitats (Schaller, 1967; Khan et al., 1996). Indirect sign observation of spotted deer is useful in dense forests where visibility is low and animals are difficult to observe directly (Karanth & Nichols, 2002; Sutherland, 2006). Habitats of chital support a diverse guild of predators including. The varying predator activities influence the spatial distribution, vigilance, and grouping behaviour of spotted deer. The predator-prey dynamics also play a key role in structuring herbivore populations (Karanth & Sunquist, 2000; Hayward et al., 2006). Group size in spotted deer varies from small groups of 5–10 individuals to large herds of 30–50 depending on habitat and resource availability (Schaller, 1967; Raman, 1997). Stray dogs near forest edges act as vectors of diseases that can spread over to wildlife. Effective mitigation includes controlling stray dog populations, restricting dog movement and proper waste management near protected areas (Home et al., 2018; Vanak & Gompper, 2009).

Given the ecological significance of Spotted Deer as a keystone herbivore species and primary prey base for large carnivores, conservation of healthy Spotted Deer populations contributes substantially to broader landscape-scale ecosystem integrity. As present study act as a baseline data future research directions should encompass long-term population monitoring, investigation of predator-prey dynamics and also the impact of climate change on the bio ecology of the spotted deer. Such expanded research initiatives would provide enhanced understanding of the complex ecological interactions and enable more refined conservation management approaches.

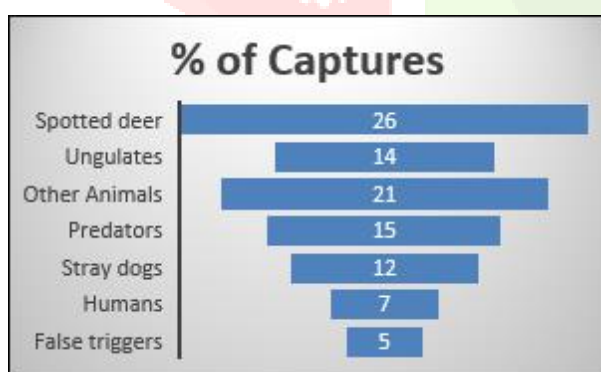


Fig 2: Species wise percentage of camera trap captures

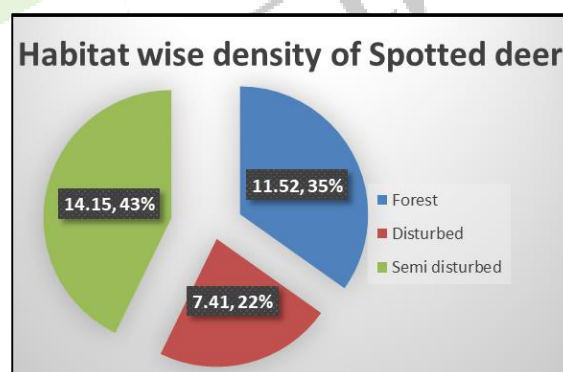


Fig 3: Habitat wise density of the Spotted Deer

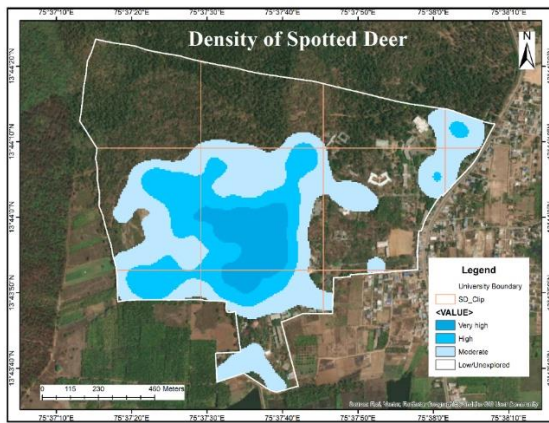


Fig 4: Map showing the Density or Heat map of distribution of the Spotted deer

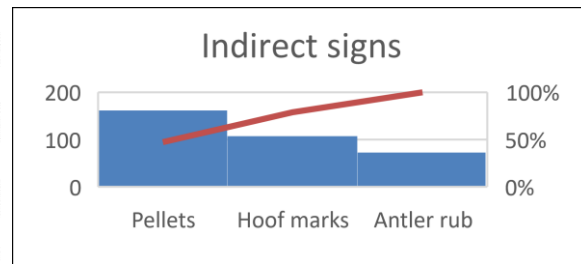


Fig 5: Ratio of the indirect signs of the Spotted deer

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### **COMPETING INTERESTS**

The authors declare that no competing interests exist.

### **AUTHORS' CONTRIBUTIONS**

All authors were involved in the planning and execution of the field surveys at Kuvempu University. The initial draft of the manuscript was prepared collaboratively, and all authors contributed to the analysis, writing, and finalization of the research article.

**PLATE**



**Fig 6: Presence of spotted Deer in the study area**



**Fig 7: Other Ungulates**



**Fig 8: Threat**