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Spatial Distribution and Habitat Selection of Mammals in the vicinity of Lal Suhanra National Park, Pakistan

Huma Khushbakhat[1], Muhammad Altaf[1], Muhammad Imran[2], Muhammad Umer Majeed[3*], Muhammad Ameen[4], Jawad Ahmad[5], Muhammad Waris[6], Muhammad Zohaib[7], and Zahid Sadique Ansari[8]

1. Institute of Forest Sciences, The Islamia University of Bahawalpur, Pakistan
2. Department of Zoology, University of the Punjab, Pakistan
3. Agriculture Science and Resource Management in the Tropics and Subtropics, University of Bonn, Germany
4. Department of Zoology, University of the Sialkot, Pakistan
5. Department of Zoology, The Islamia University of Bahawalpur, Bahawalnagar Campus, Pakistan
6. Department of Zoology, University of Veterinary and Animal Sciences, Lahore, Pakistan
7. Department of Zoology, University of Lahore, Sargodha Campus, Pakistan
8. Department of Biology, Punjab Group of Colleges, Gujranwala, Pakistan

***Corresponding author e-mail:** s55mmaje@uni-bonn.de

SUMMARY

Pakistan has 195 species of mammals and diverse habitats, with three zoogeographical realms: Palearctic, Oriental, and Ethiopian. Approximately two-thirds of the area is mountainous, and abrupt altitude changes result in variations in diversity over short distances. This study aims to determine the geographical distribution of mammalian species, examine habitat preferences based on ecological characteristics such as plant cover, water availability, and land use patterns. The study was conducted from March 2020 to February 2024, in the vicinity of Lal Suhanra National Park. Both direct and indirect methods were used. The research identified 20 mammalian species from 12 families and 6 orders. Results show that certain species, such as the Asian House Shrew (*Suncus murinus*), Northern Palm Squirrel (*Funambulus pennantii*), and House Rat (*Rattus rattus*), are highly ecologically flexible, thriving in diverse habitats, including human-altered areas. Carnivorous and omnivorous species, such as the Jungle Cat (*Felis chaus*), Indian Grey Mongoose (*Herpestes edwardsii*), and Small Indian Civet (*Viverricula indica*), predominantly associate with natural and semi-natural habitats but are less common in urban areas. Desert ecosystems provide unique habitats for species like the Blackbuck (*Antilope cervicapra*), Blue Bull (*Boselaphus tragocamelus*), and Chinkara (*Gazella bennettii*), which thrive in dry conditions but are absent from densely vegetated or human-influenced areas. Rodents such as Cheesman's Gerbil (*Gerbillus cheesmani*) and the Indian Desert Jird (*Meriones hurrianae*) also strongly affinity for desert environments, highlighting their physiological and behavioral adaptations to arid climates.

Keywords: Mammals, Distribution, Diversity, Abundance, Habitat preference, National Park

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INTRODUCTION

More than 5000 mammalian species are reported from the world (Books, 2023). While Pakistan has 195 species of mammals (Roberts, 1997; Roberts, 2005b; Roberts, 2005a). Pakistan has diverse habitat, with three zoogeographical realms: Palearctic, Oriental, and Ethiopian. Approximately two-thirds of the area is mountainous, and abrupt altitude changes result in changes in diversity over short distances (Altaf, 2016). The selection and distribution of mammals' habitats is linked to the many biotic and abiotic factors vital for their existence and reproduction. Distributions may be patterned as uniform, random, or clumped, and most often are dictated by social structure, environmental factors, and resource availability (Altaf et al., 2023). For instance, deer are known to cluster in resource areas, whereas solitary predators occupy more dispersed territories to minimize competition. Mammal habitats are determined by food, environment that includes shelter and protection from enemies, such as forests or deserts (Regolin et al., 2021; Camargo-Sanabria et al., 2025). Changes in seasons also have an effect concerning the availability of resources and may stimulate migrations that allow mammals to survive. The impact of urbanization and deforestation has an effect on the mammals that require these environments, causing the mammal species to adapt (Li et al., 2022).

More importantly, human activities such as urbanization, agriculture, and deforestation have dramatically altered global patterns of habitat selection and the spatial distribution of mammals. Habitat fragmentation and loss compel many species to adapt to smaller, isolated patches of suitable habitat, often resulting in reduced genetic diversity and an increased vulnerability to extinction. Understanding these dynamics is crucial for establishing well-informed conservation measures and enhancing biodiversity in the face of ongoing environmental and climatological change (Theodoridis et al., 2021; Altaf et al., 2023)

The study's gap analysis on the spatial distribution and habitat preferences of mammals in Lal Suhanra National Park in Pakistan emphasizes the importance of conducting a full assessment of mammalian ecology in this unique ecosystem. While prior research has mostly focused on overall diversity (Altaf et al., 2012; Altaf et al., 2014; Altaf, 2016; Sial, 2024), there is a major gap in knowledge regarding species-specific habitat preferences, migratory patterns, and the influence of environmental and anthropogenic factors on mammal distribution. This study pursues to utilize geospatial technologies to determine the geographical distribution of mammalian species, and to analyze habitat preference based on ecological characteristics such as plant cover, availability of water, and patterns of land usage.

MATERIALS AND METHODS

STUDY AREA

Lal Suhanra, also known as the National Park of Pakistan, is located in the Bahawalpur district of Punjab province. This park features a variety of landforms, including desert, forest, and wetland ecosystems. It is situated approximately 35 kilometers east of Bahawalpur and presents a unique combination of forest and desert environments. It straddles the two sides of the desert branch canal and is 51,368 hectares in area. There are 8,491 hectares of green area (irrigated plantations), 40,942

hectares of dry land (desert), and 1,934.4 hectares of wet land (ponds and lakes). The terrain of the park is generally level, dotted with sand dunes varying from 1 to 6 meters in elevation and spanning thousands of acres each. The park has a variety of animal species. Among the desert wildlife, you can find Asiatic wildcats, rabbits, bustards, and deer. The park also hosts various reptiles, including the monitor lizard, Russell's viper, Indian cobra, saw-scaled viper, wolf snake, John's sand boa, and spiny-tailed lizard. In addition, more than 160 bird species inhabit the area, such as the crested honey buzzard, houbara bustard, marsh harrier, shrike, wheatear, kestrel, lark, Egyptian vulture, griffon vulture, hen harrier, laggar falcon, peregrine falcon, Eurasian sparrow-hawk, and barn owl. During mid-winter, the lake regularly attracts common coots and ducks (GOP, 2025).

METHODOLOGY

The study was conducted from March 2020 to February 2024 and data were collected from Lal Suhanra National Park, The Islamia University Bahawalpur and Patisar Lake Park Chack 32 BC (Figures 1 and 2).

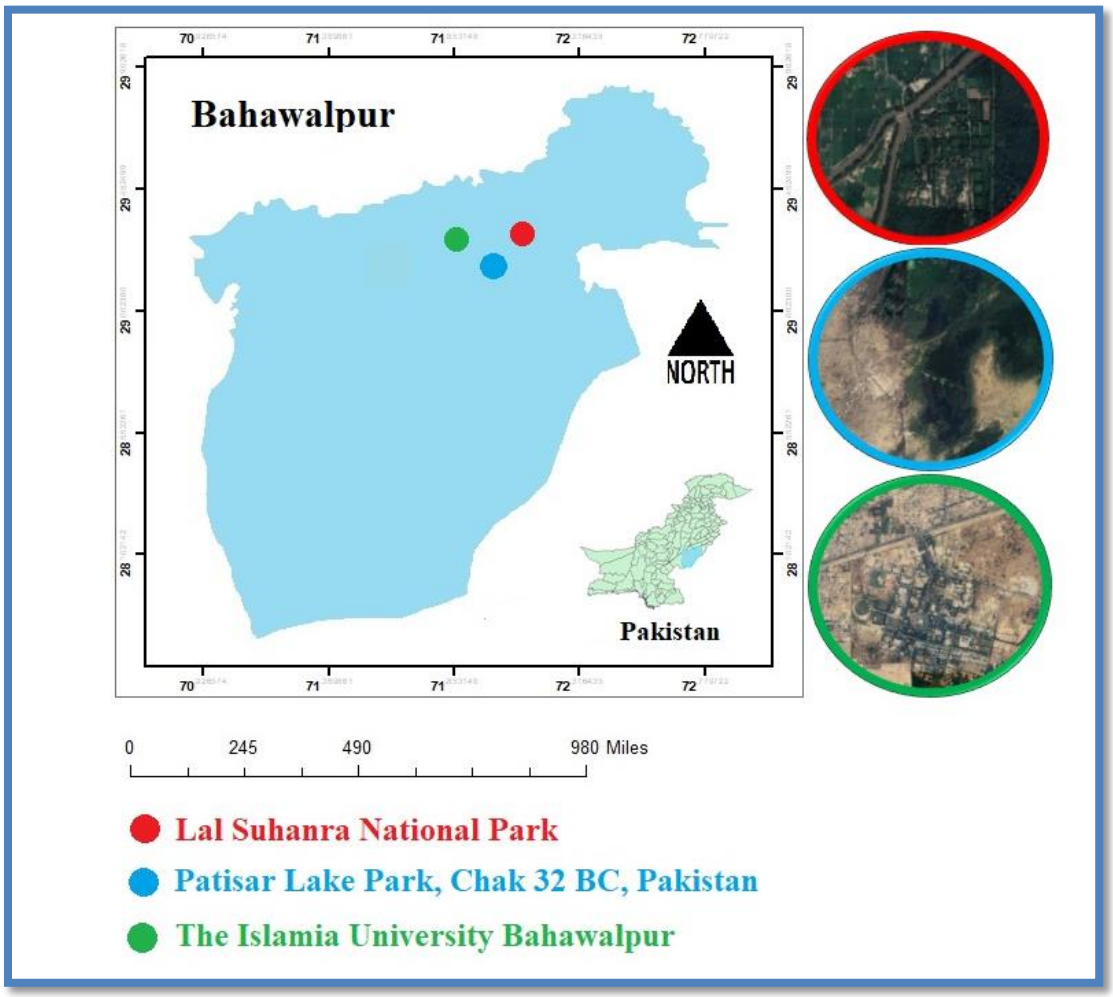

Figure 1: Map of the study area.

The linear count survey method was employed to estimate the population of mammalian fauna in the study area. Both direct methods (such as total counts and vocalizations) and indirect methods including hairs (Chattha et al., 2011; Haider and Altaf, 2018), pugmark, scat analysis (Mandawala and Perera, 2022), and group questionnaire surveys (Altaf et al., 2023) were utilized to assess the area's mammalian diversity. To observe the animals, binoculars (32x50) were used, and field guides were consulted for accurate species identification (Roberts, 2005 a, b).

STATISTICAL ANALYSIS

For the statistical analysis, PAST version 5.1 (Hammert et al., 2001) was utilized to calculate the Simpson diversity index, Shannon diversity index, Evenness index, Margalef richness index, Dominance, and Dentrended component analysis (DCA). DCA was employed to explore the relationships between mammalian fauna and habitat variables. Graphs were created using MS Excel and OriginPro (2023) software.

Figure 2: Landscape of Study area.

RESULTS AND DISCUSSION

The data obtained through respondents entail a complete profile of the respondents. Most respondents were male (*n*=80), whilst a rather smaller number of females *n*= (30) were interviewed. This may be due to cultural or societal influences toward participation in the study. The respondents also had the largest occupational diversity, from students (*n*=44) to housewives (*n*=21), farmers (*n*=16), shopkeepers (*n*=12), teachers (*n*=6), shepherds (*n*=9), hunters (*n*=2) and wildlife specialists (*n*=2). With

this variety of occupations, it is clear that the study involved people from all the different walks of life, providing a comprehensive perspective for the subject under the inquiry. The respondents were primarily aged 18 to 30 (*n*=63), with 31 to 40 years (*n*=30) following. Older participants were in lower numbers, including 51 to 60 (*n*=2), 61 to 70 (*n*=2), and over 71 (*n*=1). This indicates a stronger engagement from younger individuals, possibly due to availability or curiosity. In terms of education, none held a PhD; however, 12 had Master's degrees, 26 had Bachelor's degrees, and 29 had completed middle school. Additionally, 22 had high school diplomas, 9 had matriculated, and 12 were unable to read (Figures 3 and 4). This diversity emphasizes the heterogeneity of respondents and highlights the importance of considering various perspectives when analyzing the data for meaningful insights.

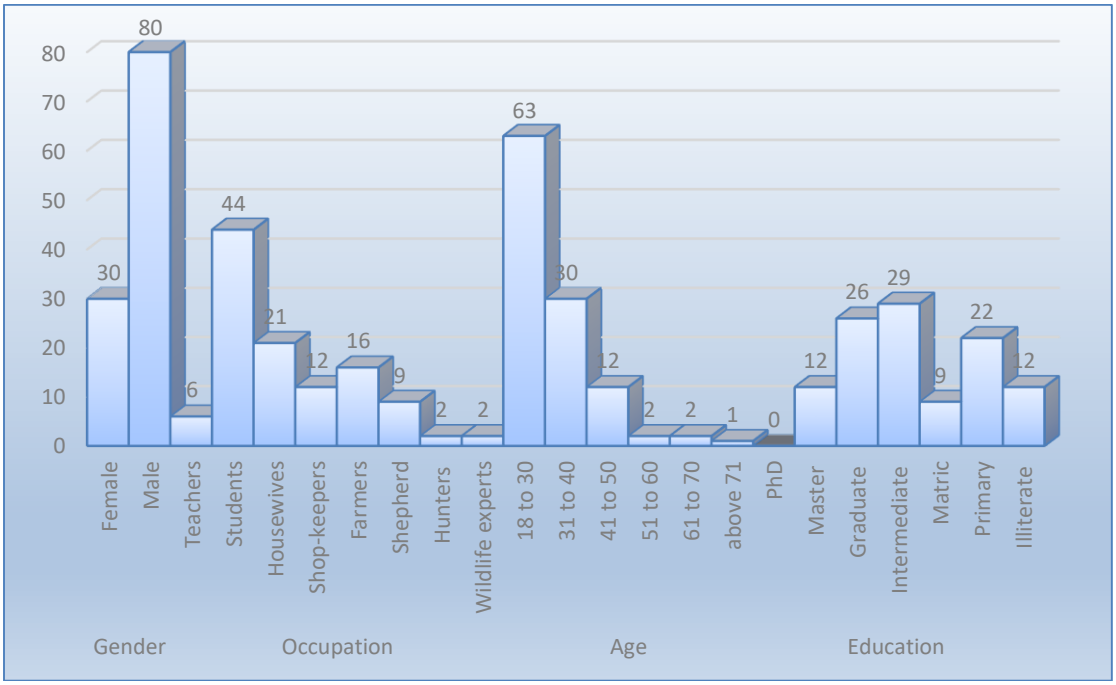

Figure 3: Profile of respondents of study area.

During the research, 20 mammalian species (i.e. *Antilope cervicapra*, *Boselaphus tragocamelus*, *Gazella bennettii*, *Sus scrofa*, *Canis aureus*, *Vulpes vulpes pusillus*, *Herpestes edwardsii*, *Viverricula indica*, *Felis chaus*, *Hemiechinus collaris*, *Suncus murinus*, *Lepus nigricollis*, *Hystrix indica*, *Gerbillus cheesmani*, *Meriones hurrianae*, *Millardia meltada*, *Mus booduga*, *Mus musculus*, *Rattus rattus* and *Funambulus pennantii*) (Table 1) from 12 families (i.e. Bovidae, Canidae, Erinaceidae, Felidae, Herpestidae, Hystricidae, Leporidae, Muridae, Sciuridae, Soricidae, Suidae and Viverridae) and 6 orders (i.e. Artiodactyla, Carnivora, Erinaceidomorpha, Insectivora, Lagomorpha and Rodentia) (Figures 5 and 6) were identified. Sial (2024) reported 12 different species of mammals belonging to 7 families and 4 orders. Additionally, Altaf et al. (2014) observed 15 species of mammals in the Chenab River in Punjab, Pakistan, which were classified into 10 families and 6 orders.

Figure 4: Respondents of study area.

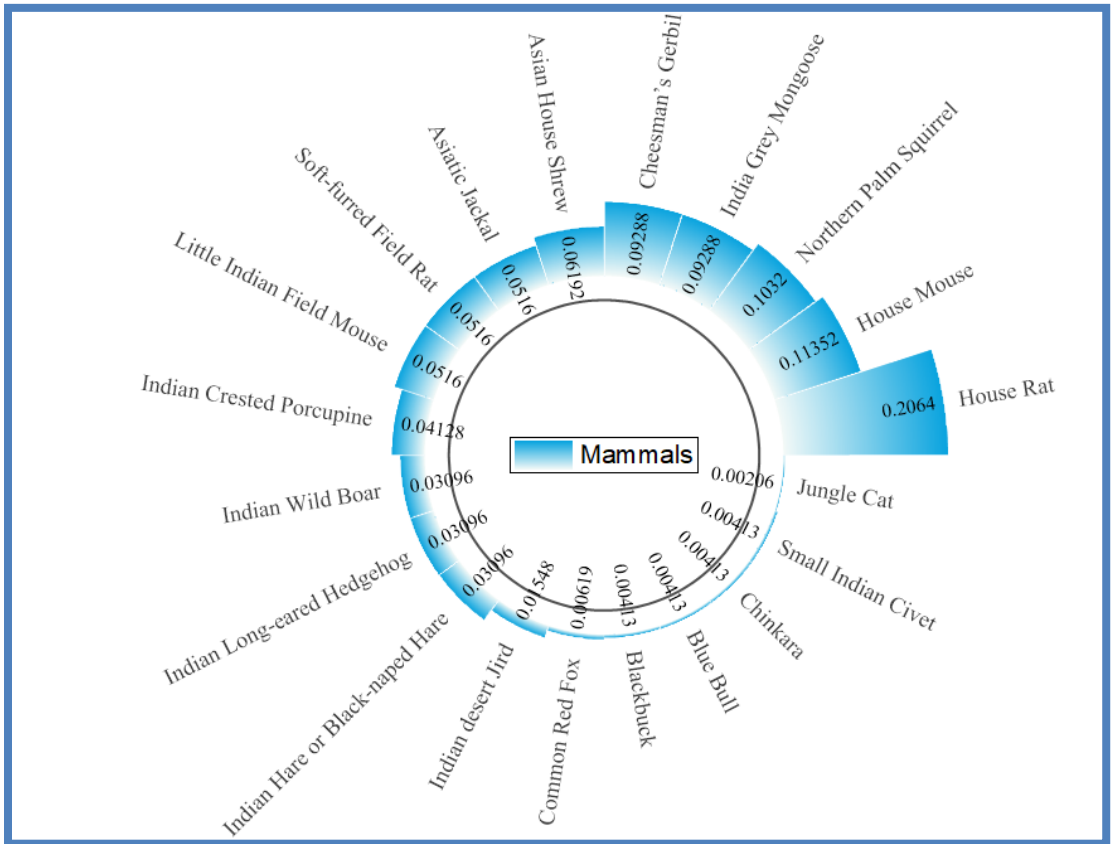

Figure 5: Mammalian species in the study area.

There are 20 species, which indicates moderate species diversity within the ecosystem under study. The Dominance diversity index (i.e. 0.09921) indicates that no one species dominates the community too highly, thereby suggesting a rather well-distributed ecological structure. The Simpson diversity index (i.e. 0.9008) bolsters this finding by indicating a strong likelihood that two randomly chosen individuals are from different species, emphasizing species diversity. The Shannon diversity index (i.e. 2.543) supports this by indicating a well-balanced species composition, with diversity distributed across various taxa. The evenness index (i.e. 0.636) connotes a fairly even distribution of individuals across species, with some species being more numerous than others. The Richness index (i.e. 2.763) connotes a moderate degree of species richness, indicating a rich but not overly complex community structure (Table 2). Together, these indices point towards a stable and functionally diverse ecosystem with a balanced species composition, which can ensure ecological resilience and possible adaptability to environmental change.

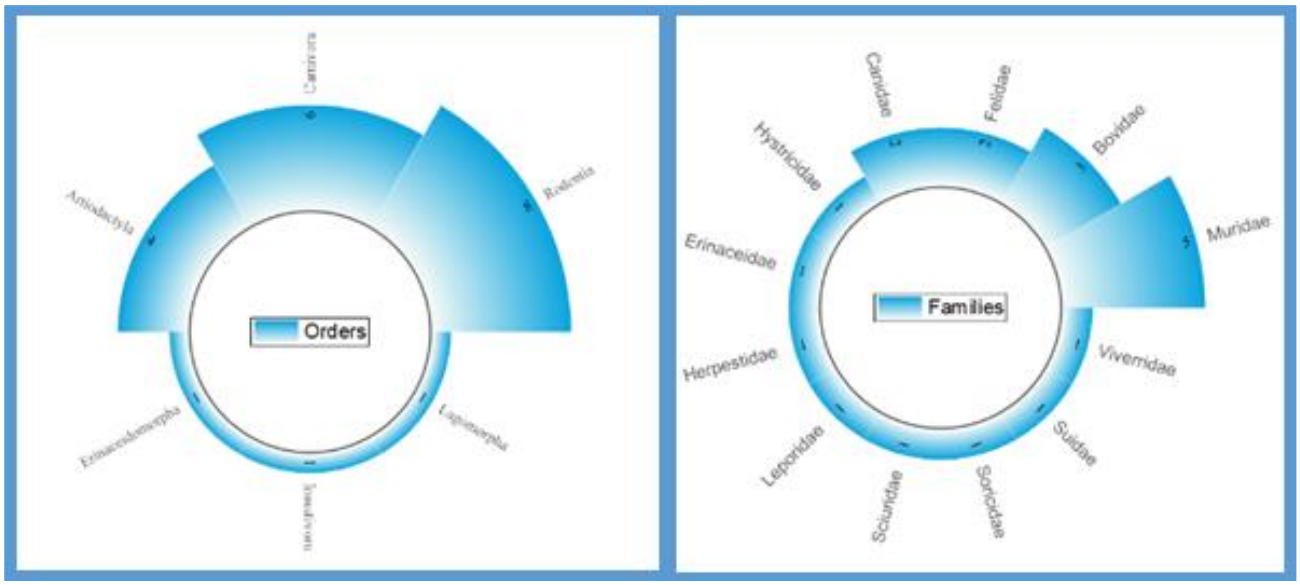

Figure 6: Mammalian orders (Left) and Families (Right) in the study area.

The study area is home to a diverse range of mammal species, each playing important roles in their ecosystems. Take the Indian Grey Mongoose, for example; it has a relative abundance (RA) of 0.0929, making it one of the most frequently spotted animals in the region. This adaptable carnivore lives in grasslands, farmland, and even urban settings, where it hunts for rodents, snakes, and insects, contributing significantly to pest control. Another common resident is the House Rat, which has an even higher RA of 0.2064. This omnivorous rat lives in human settlements and diverse ecosystems, eating on a variety of foods, although it is frequently regarded as a problem due to agricultural damage and disease transmission. The Cheesman's Gerbil has a relative abundance (RA) of 0.0929, making it the most common species in arid and semi-arid environments. It is well-suited to desert environments, eating mostly on seeds, insects, and plants. Its burrowing behavior aerates the soil, benefiting the surrounding ecology. Similarly, the House Mouse has a greater relative abundance of 0.1135 and can flourish in both natural as well as human-modified

habitats. Its omnivorous food and rapid reproduction allow it to dominate places with rich resources of food (Figure 7).

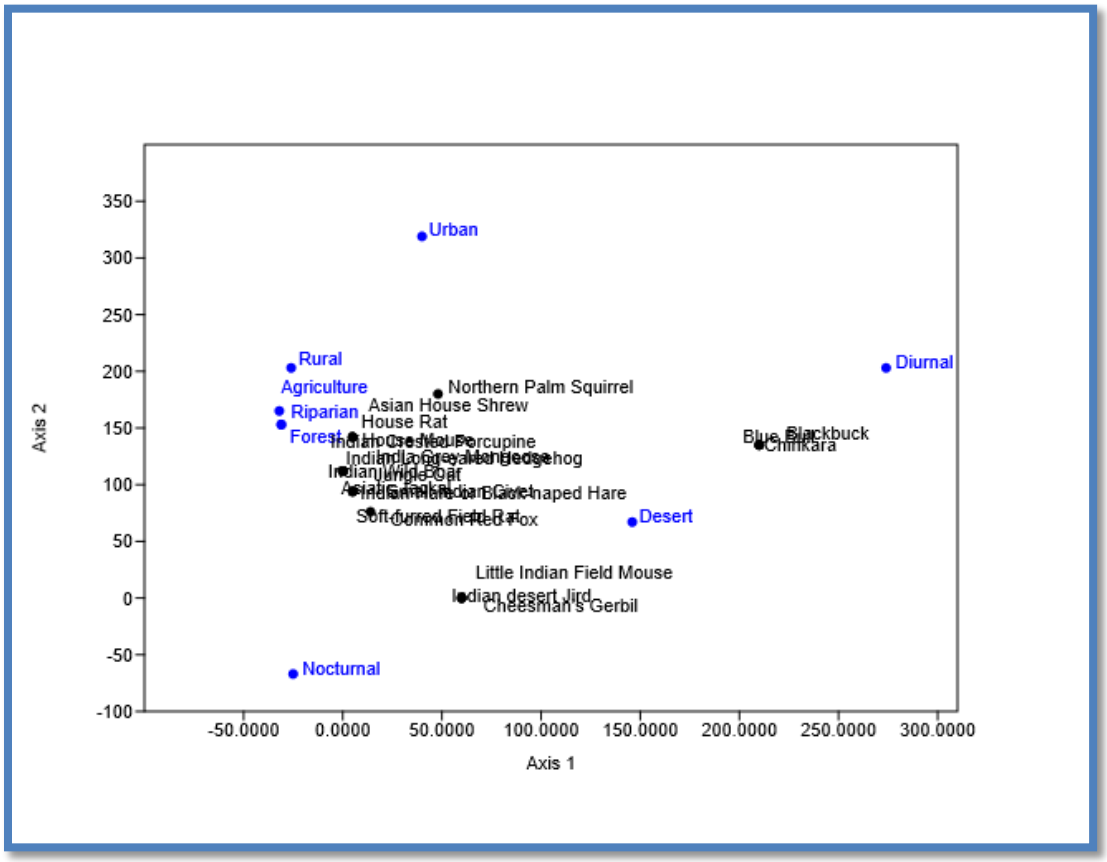

Figure 7: Dentrended component analysis (DCA) of mammalian species in study area.

The Blackbuck, Blue Bull, and Chinkara, each with a relative abundance (RA) of 0.0041, are sensitive herbivores in open grasslands, facing population declines from habitat loss and illegal hunting. The Indian Wild Boar, which has a relative abundance of 0.0310, is an omnivore species. The Asiatic Jackal, with a relative abundance of 0.0516, forages for and preys on small animals, despite being less formidable than the Indian Grey Mongoose. While the Jungle Cat has a relative abundance of 0.0021, the Common Red Fox and Small Indian Civet are enigmatic carnivores, with relative abundances of 0.0062 and 0.0041, respectively. Among smaller mammals, the Indian Long-eared Hedgehog, Asian House Shrew, and Indian Hare contribute to environmental maintenance, with relative abundances of 0.0310, 0.0619, and 0.0310, respectively. Additionally, rodents such as the Indian Desert Jird and Soft-furred Field Rat play a crucial role in this ecosystem (Figure 8).

Habitat and Ecology

Different mammalian species were studied concerning their location across different landscapes forests, riparian zones, deserts, agricultural fields, rural areas, and urban cities. Their activity patterns were divided into the day and night types. Results

suggest that certain species, for instance, the Asian House Shrew (*Suncus murinus*), Northern Palm Squirrel (*Funambulus pennantii*), and House Rat (*Rattus rattus*), are highly ecologically flexible, as they live in diverse habitats, even in human-altered areas. Carnivorous and omnivorous species, such as the Jungle Cat (*Felis chaus*), Indian Grey Mongoose (*Herpestes edwardsii*), and Small Indian Civet (*Viverricula indica*), have a predominant association with natural and semi-natural habitat types, but very little in urban ones (Figure 8).

Desert ecosystems provide unique habitats for species like the Blackbuck (*Antilope cervicapra*), Blue Bull (*B. tragocamelus*), and Chinkara (*Gazella bennettii*), which flourish in dry conditions but are absent from areas with dense vegetation or human activity. Rodents such as Cheesman's Gerbil (*Gerbillus cheesmani*) and the Indian Desert Jird (*Meriones hurrianae*) also show a strong affinity for desert environments, highlighting their physiological and behavioral adaptations to arid climates (Figure 8).

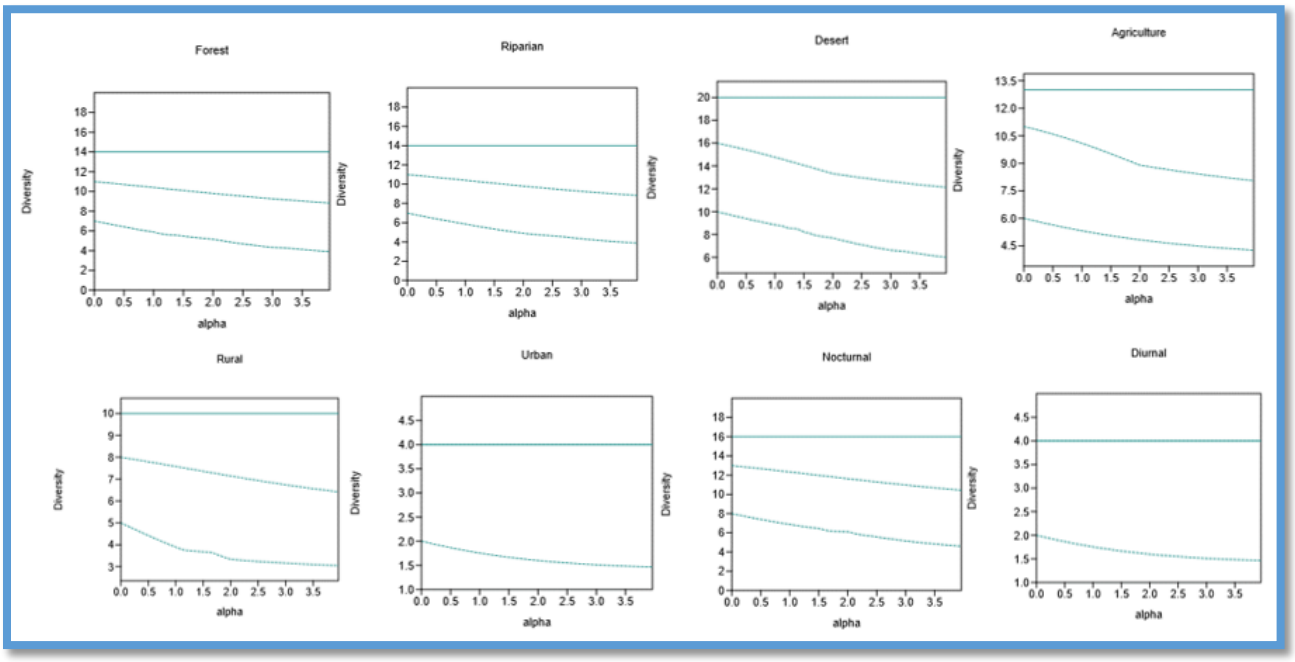

Figure 8: Spatial distribution and habitat preferences of the mammalian species in the study area.

Nocturnal is a common trait among many mammalian species, especially small to medium-sized rodents and carnivores. This behavior likely serves as an adaptation to avoid daytime predators and the extreme temperatures of the day. In contrast, large ungulates, such as the Blackbuck and Blue Bull, exhibit diurnal activity patterns, which may be related to their foraging behaviors and strategies for avoiding predators. Urban environments, known for their high human activity and habitat fragmentation, support highly adaptable species, including commensal rodents like the House Mouse (*M. musculus*) and House Rat (*R. rattus*), which thrive in these anthropogenic settings.

CONCLUSION

This analysis emphasizes different mammalian fauna of Pakistan, which is influenced by its complex topography and ecological conditions. The researches carried out on the periphery of Lal Suhanra National Park identified 20 species of mammals, watching meticulously their habitat selection and adaptability. The Asian House Shrew, Northern Palm Squirrel, and House Rat illustrate hyper adaptivity as these species flourish in both natural and anthropogenically modified ecosystems. Carnivores and omnivores, such as the Jungle Cat and the Indian Grey Mongoose, prefer natural surroundings, whereas desert specialists, such as the Blackbuck and Chinkara, thrive in arid environments. These findings highlight the importance of habitat conservation and sustainable the use of land practices in Pakistan's different kinds of mammals.

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Table 1: Mammalian species in study area.

Sr.	**Order** Family	**English names**	***Scientific name*** **Species Authority**
1	**Artiodactyla** Bovidae	Blackbuck	*Antilope cervicapra* (Linnaeus, 1758)
2		Blue Bull	*Boselaphus tragocamelus* (Pallas, 1766)
3		Chinkara	*Gazella bennettii* (Sykes, 1831)
4	Suidae	Indian Wild Boar	*Sus scrofa* Linnaeus, 1758
5	**Carnivora** Canidae	Asiatic Jackal	*Canis aureus* Linnaeus, 1758
6		Common Red Fox	*Vulpes vulpes pusillus* Blyth, 1854
7	Herpestidae	India Grey Mongoose	*Herpestes edwardsii* (É. Geoffroy Saint-Hilaire, 1818)
8	Viverridae	Small Indian Civet	*Viverricula indica* (Geoffroy Saint-Hilaire, 1803)
9	Felidae	Jungle Cat	*Felis chaus* Schreber, 1777
10	**Erinaceidomorpha** Erinaceidae	Indian Long-eared Hedgehog	*Hemiechinus collaris* Gray, 1830
11	**Insectivora** Soricidae	Asian House Shrew	*Suncus murinus* Linnaeus, 1766
12	**Lagomorpha** Leporidae	Indian Hare or Black-naped Hare	*Lepus nigricollis* F. Cuvier, 1823
13	**Rodentia** Hystricidae	Indian Crested Porcupine	*Hystrix indica* Kerr, 1792
14	Muridae	Cheesman's Gerbil	*Gerbillus cheesmani* Thomas, 1919
15		Indian desert Jird	*Meriones hurrianae* Jerdon, 1867
16		Soft-furred Field Rat	*Millardia meltada* Gray, 1837
17		Little Indian Field Mouse	*Mus booduga* Gray, 1837
18		House Mouse	*Mus musculus* Linnaeus, 1758
19		House Rat	*Rattus rattus* Linnaeus, 1758
20	Sciuridae	Northern Palm Squirrel	*Funambulus pennantii* Wroughton, 1905

Table 2: Diversity induces of mammalian species in present study area.

Diversity indices	Value
Species	20
Dominance diversity index	0.09921
Simpson diversity index	0.9008
Shannon diversity index	2.543
Evenness diversity index	0.636
Margalef/ Richness diversity index	2.763

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Authors' contributions: Khushbakhat and Altaf have designed this project, Khushbakhat, Ahmad, and Majeed have collected data and Khushbakhat and Altaf have written this article; while all authors have critically analyzed this article and approved as final.