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# Spatial distribution and Habitat Preferences of Avian and mammalian species in human settled area of Central Punjab, Pakistan

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**SUMMARY**

Until the mid-20th century, urban studies were largely overlooked, making it challenging for scientists to understand the urban ecosystem and its impact on wildlife. Thus, this study was designed to examine bird and mammalian diversity and habitat preferences in the rural and urban landscapes of Central Punjab. Diversity indices were calculated using PAST and OriginPro software. The existing checklist includes 18 bird species and 9 mammal species. Diversity indices reveal that both Aves and Mammalia classes demonstrate high diversity within the urban landscape of Central Punjab. The Simpson-Wiener diversity index shows a slightly higher value for Aves (H'=0.7962) compared to Mammalia (H'=0.7811). Similarly, the Shannon diversity index is marginally greater for Aves (S=1.909) than for Mammalia (S=1.848). The study identified the most common avian species in the area, including the House Crow (relative abundance, RA=0.358), Common Swallow (RA=0.179), Little Swift (RA=0.143), Common Myna (RA=0.107), Indian Kite (RA=0.098), and House Sparrow (RA=0.034). In contrast, the most common mammalian species observed were the House Mouse (RA=0.403), House Rat (RA=0.209), and House Shrew (RA=0.060).

**Keywords:** Gujrat, Avian diversity, Mammalian species, Rural, Urban

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## INTRODUCTION

Urban study is completely neglected with other study between till mid of 20th century and this is where urban study was found from 1960s to 1970s (Humbal et al., 2023). So urban ecosystem was a challenge for scientist (Remme et al., 2021). All of this was due to the rapid rise in population during that time, had adverse effects on most avian and mammalian species (Puplampu and Boafo, 2021). In addition, ten percent of the Earth's total surface area is now categorized as urban territory, and the rate of urbanization continues to be remarkable (Puplampu and Boafo, 2021). The vast majority of the population lives in cities, and it is growing by the day. The massive rise of metropolitan centers will undoubtedly continue to alter the global ecology, with far-reaching consequences for flora and fauna diversity around the planet (Dodman et al., 2023).

Scientists have documented over 9000 bird species (Barrowclough et al., 2016) and 5000 mammal species worldwide (Mychajliw, 2023). Pakistan, situated at the intersection of three of the six biogeographic regions - Palearctic, Oriental, and Ethiopian - boasts a diverse array of flora and fauna. The country encompasses 225 wetlands, and its abrupt elevation changes result in rapid shifts in biodiversity across short distances (Altaf et al., 2014). Within Pakistan's borders, observers have recorded more than 668 bird species (Grimmett et al., 2008; Grimmett et al., 2016) and 195 mammal species (Roberts, 1997).

Wild birds and mammals are affected by climate change, and even minor temperature shifts impact their diversity (Ali et al., 2016; Altaf et al., 2018) and distribution (Altaf et al., 2012; Thakur et al., 2021). Furthermore, alterations in climate significantly affect the morphology, phenology, physiology, and life history of birds and mammals (Rubenstein et al., 2023). Variations in temperature have a direct impact on avian and mammalian diversity since higher temperatures raise the water needs of birds and mammals, making this situation concerning for species living in desert and tropical regions (Cunningham et al., 2021; Riddell et al., 2021). Likewise, numerous unrecognized effects such as new diseases and invasive species are linked to climate change.

However, these urban ecosystems differ from the natural habitats into the original habitats and new even larger residential areas have been split, as well as native species have been replaced by invasive species (Imran et al., 2021; Tedeschi et al., 2022). In contrast, rural regions featuring vegetation and ponds increase the diversity of certain species by offering foraging and nesting locations. In densely populated urban regions, the number of bird species is decreasing. Urbanization affects various avian and mammalian species in different ways (Poisson et al., 2024). Urbanization benefits omnivorous species, with avian and mammalian ones being predominant, while specialist avian and mammalian species suffer more adverse effects from urbanization. Avian and mammalian species are efficient evidence of environmental health. The principal risks to avian species include increased farming, urbanization, illegal hunting, contaminants, and the process of urban ecosystem research is critical to comprehension of these issues, as well as the condition of bird and mammalian species in urban environments. This study aims to evaluate the avian and mammalian diversity in human settled landscapes of Central Punjab, Pakistan.

## MATERIALS AND METHODS

Data were collected from the rural and urban sites of Gujrat day and night hours. Data collected from human settled areas (i.e. rural and urban) from May 2020 to August 2022. Data were collected from central Punjab, Pakistan i.e. Mandi Bahauddin (i.e. Model town and Phalia), Gujrat (i.e. Shadman Colony and Kunjah) and Gujranwala (Muhafiz Town and Qila Didar Singh) (Figure 1).

### STUDY AREA

Punjab is a significant geopolitical, cultural, and historical region in South Asia, situated in the northwestern part of the Indian subcontinent. It encompasses areas of present-day eastern Pakistan and northwestern India. The region developed around settlements along five rivers and has agriculture as its primary economic activity,

which has shaped Punjabi culture. Punjab became a vital agricultural hub, particularly following the Green Revolution from the mid-1960s to the mid-1970s (Khan et al., 2024).

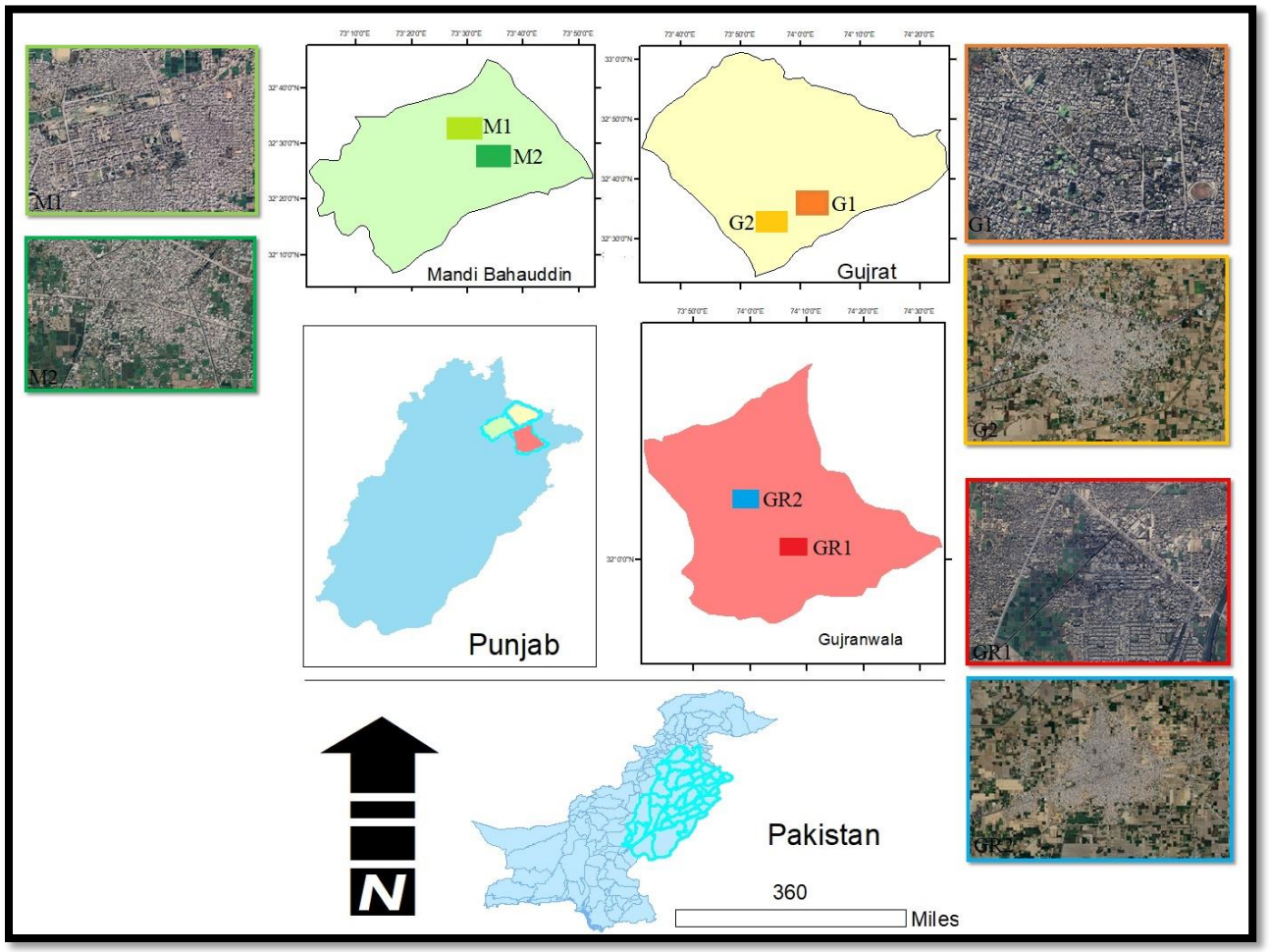


**Figure 1: Map of study area.**

***Climate***

The metropolitan region is located in a tropical thorn forest environment, experiencing temperature fluctuations ranging from 0°C during winter to 45°C in summer. Central Punjab climate is characterized as hot semi-arid, though it comes close to being categorized as a humid subtropical climate influenced by monsoons due to its moisture levels.

***Floral diversity***

The main crops grown include sugarcane, rice, wheat and corn. The natural flora consists of semal, jamun, bohr, beri, dharek, neem and pipal.

**METHODOLOGY**

The avian and mammalian diversity was documented through linear count survey through direct and indirect methods. Field Guides, books, articles were studied to

identification of avian species (Roberts, 1991, 1992; Grimmett, 1998; Mirza and Wasiq, 2007) and mammalian species (Roberts, 2005b, a).

## STATISTICAL ANALYSIS

The avian and mammalian species diversity indices were calculated and graphs were designed with the help of PAST version 4.1C (Hammert, 2001), OriginPro, Version 2023b and MS Excel 2010.

## RESULTS AND DISCUSSION

In this survey, a total of 18 species (i.e. Spotted Little Owlet, Common Hoopoe, Blue Rock Pigeon, Common Swallow, Indian Ring Dove, Oriental Trutle Dove, Little Swift, Common Rock chat, Red-wattled Lapwing, Common Babbler, Bank Myna, Common Myna, House Crow, Indian Kite, Purple Sunbird, House Sparrow, Red-vented Bulbul, Cattle Egret, Golden jackal, House mouse, House rat, House shrew, Indian crested porcupine, Indian grey mongoose, Indian wild boar, Northern palm squirrel and Small Indian mongoose) of bird (Table 1), belong to 16 genera (i.e. *Streptopelia*, *Acridothere*, *Athene*, *Upupa*, *Columba*, *Hirundo*, *Apus*, *Cercomela*, *Hoplopterus*, *Turdoides*, *Corvus*, *Milvus*, *Nectarinia*, *Passer*, *Pycnonotus* and *Bubulcus* (Figure 2), 15 families (i.e. Columbidae, Sturnidae, Strigidae, Upupidae, Hirundinidae, Apodidae, Turdidae, Charadrius, Timaliidae, Corvidae, Accipitridae, Nectariniidae, Passeridae and Pycnonotidae, Ardeida) (Figure 3), while 8 orders (i.e. Passeriformes, Columbiformes, Strigiformes, Coraciiformes, Apodiformes, Charadriiformes, Accipitriformes and Pelecaniformes) (Figure 4) were recorded.

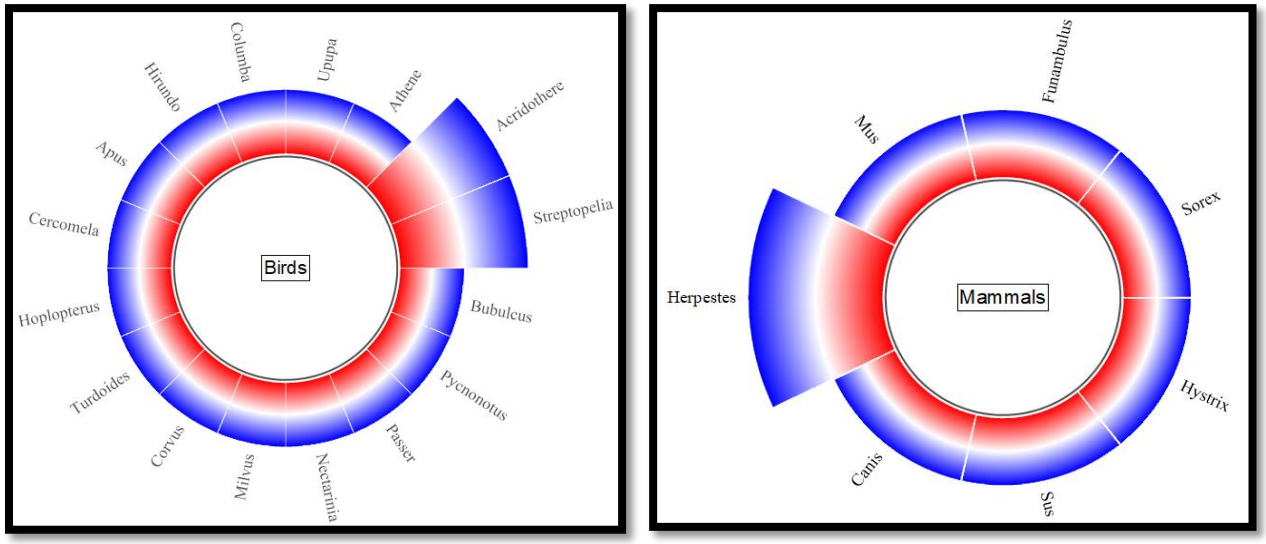


**Figure 2: Genera of bird (n=16) and mammals (n=7) in study area.**

On the other side, 9 mammalian species (i.e. Golden jackal, House mouse, House rat, House shrew, Indian crested porcupine, Indian grey mongoose, Indian wild boar, Northern palm squirrel and Small Indian mongoose) (Table 1), belong to 7 genera (i.e. *Sorex*, *Funambulus*, *Mus*, *Herpestes*, *Canis*, *Sus* and *Hystrix*) (Figure 2), families (i.e. Muridae, Herpestidae, Canidae, Soricidae, Hystricida, Suidae and

Sciuridae) (Figure 3), orders (i.e. Carnivora, Rodentia, Eulipotyphla and Artiodactyla) (Figure 4) were recorded from the study area (Table 2).

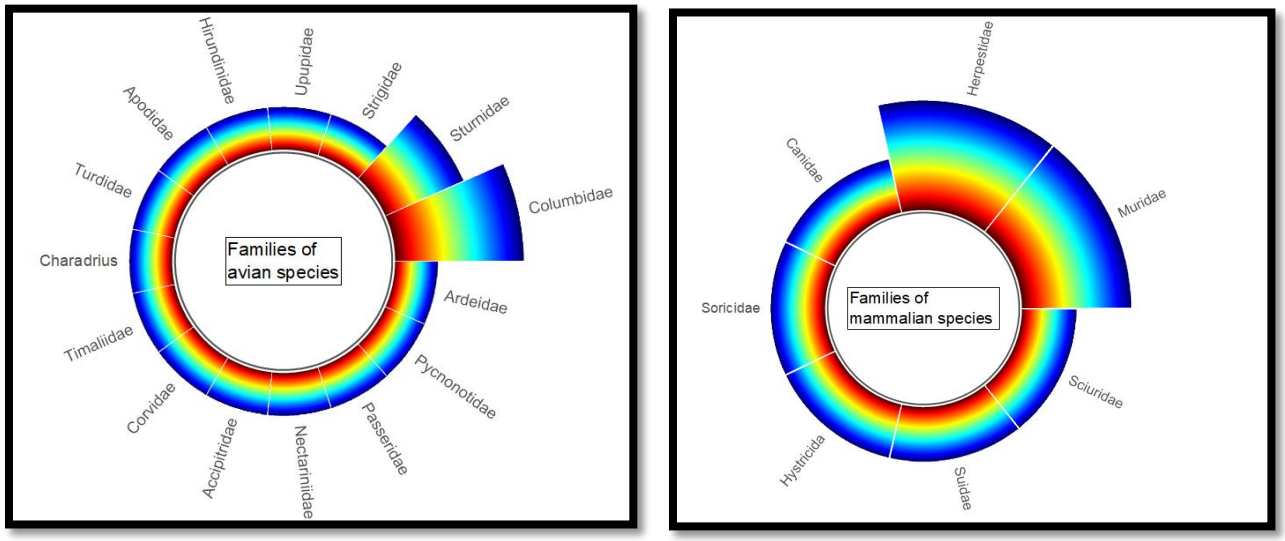


**Figure 3: Families of avian (n=15) and mammalian species (n=7) in study area.**

Altaf et al. (2012) noted birds and mammal species from rural and urban area of Gujranwala. The data were collected from towns, parks, gardens, grounds, railway track and canals passing through the city and open areas. The current checklist consists of 41 species of birds and 11 species of mammals. The data were collected. Altaf (2021) reported a total of 22 avian species in Gujranwala's metropolitan areas, and researchers discovered that food, shelter, and nesting habitats are the most important elements influencing avian diversity, with urban settings favoring generalist birds. According to Rahman et al. (2021), birds are considered excellent biological indicators, capable of highlighting key conservation issues within ecosystems. The diversity of avian species faces significant threats from human-induced factors, including the destruction of forests, deterioration of habitats, alterations to landscapes, and the overall decline in habitat quality.

Diversity indices indicate that both classes, Aves and Mammalia, exhibit high diversity in the urban landscape of Gujrat. The Simpson-Wiener diversity index is slightly higher for Aves (H'=0.7962) compared to Mammalia (H'=0.7811). Similarly, the Shannon diversity index is also marginally higher for Aves (S=1.909) than for Mammalia (S=1.848) (Figure 5). Altaf et al. (2018) and (2016) found that the Shannon-Wiener diversity index was higher in forest habitats (4.261) compared to urban landscapes (2.247). Altaf (2021) documented that urban habitats demonstrate considerable diversity, with a Simpson diversity index of 0.8501 and a Shannon diversity index of 2.145. However, Altaf et al. (2023) reported that forest habitats had the highest Simpson index (0.8828) and Shannon-Wiener index (2.398) compared to urban habitats.

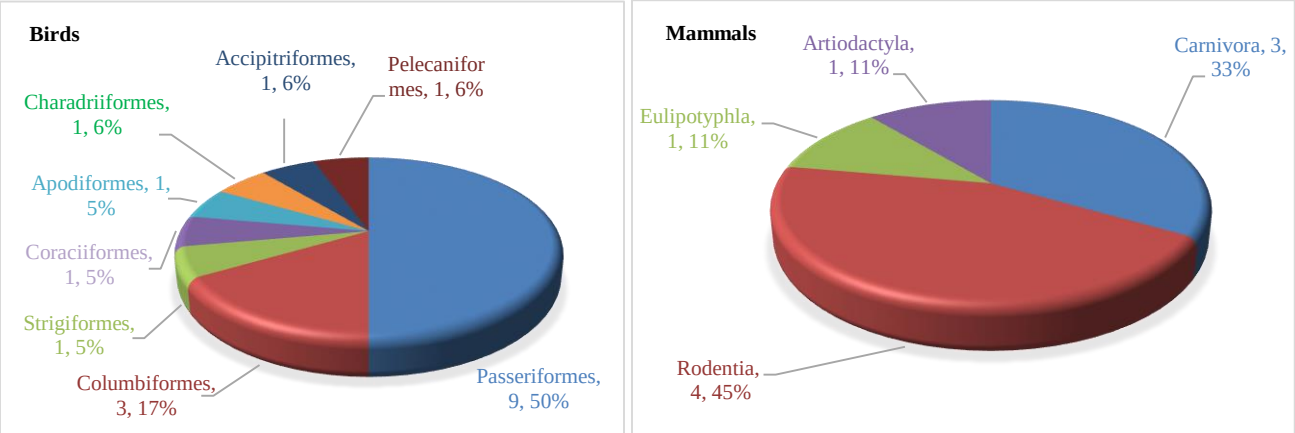


**Figure 4: Orders of bird (n=8) and mammals (n=4) in study area.**

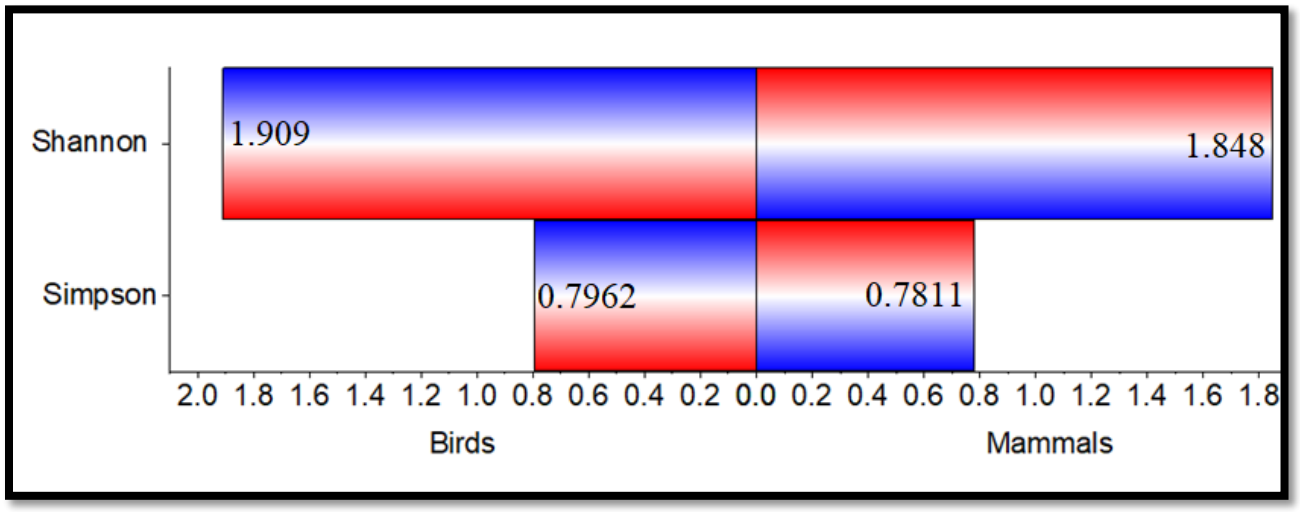


**Figure 5: Diversity indices of avian and mammalian species in study area.**

During study noted that out of total, 14 avian species are resident, 3 are winter visitor, and 1 is summer breeder, while all the mammalian species are the resident of study area (Figure 6). Altaf (2021) documented that out of total (i.e. 22 avian species), 16 resident, 3 winter visitor and 1 year round visitors), while Altaf et al. (2012) documented that all the mammals are resident in the study area.

During study noted that House Crow (relative abundance i.e. RA=0.358), Common Swallow (RA=0.179), Little Swift (RA=0.143), Common Myna (RA=0.107), Indian Kite (RA=0.098) and House Sparrow (RA=0.034) are most common avian species in study area. While House mouse (RA=0.403), House rat (RA=0.209), House shrew (RA=0.060) are the most common mammalian species in the study area (Table 1). Altaf et al. (2012) documented that Northern palm squirrel, House rat, and House mouse are common mammalian species as well as Myna Very, Bank Myna, House Crow, House Sparrow are common avian species in urban areas of Gujranwala. Altaf (2021) documented that common swallow, Indian kite, house crow, common myna, little swift, house sparrow, common babbler, bank myna and common rock chat were to abundant birds of the study area.

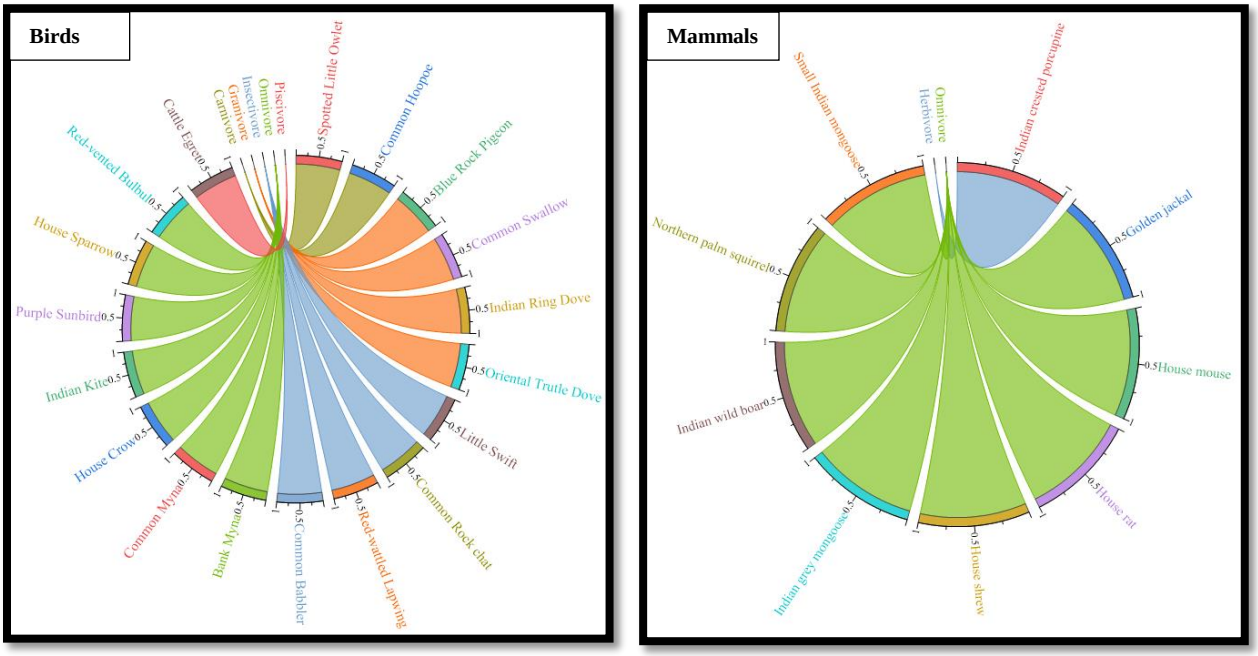


**Figure 6: Feeding habits of bird and mammals in study area.**

Feeding habitats of avian species are as 6 omnivore, 4 insectivore, 4 Granivore, 2 carnivore and 1 Piscivore), while Feeding habitats of avian species are as 8 Omnivore and 1 Herbivore (Figure 7). Urbanization creates different impacts on the different avian and mammalian species. Altaf et al. (2023) and Altaf (2016) are documented that urbanization favors omnivores species as compared to over specialist species and others feeding habits. Few mammal species were observed in urban environments rather than forests, these species preferred partially or completely damaged areas. The Indian crested porcupine, Indian wild boar and desert hare, typically inhabit woodland areas. However, Asiatic jackal, crested porcupine, and Indian wild boar visit into rural areas at night and in the absence of humans. This observation is supported by other studies. Species like northern palm squirrels, small Indian mongooses, Mediterranean pygmy shrews, Asiatic jackals, soft-furred field rats, tend to favor mildly disturbed habitats. In contrast, house shrews, house rats, and house mouse thrive in completely disturbed environments.

These bird species such as the purple sunbird, red-wattled lapwing, bank myna, little brown dove, Indian kite, Indian ring dove, house crow, common myna, common rock chat, house sparrow and blue rock pigeon are seen in various locations including rural areas, suburban regions, densely populated urban areas, low-traffic roads, and even busy highways. These species are frequently observed on the wires, towers, trees, and soaring close to the roads. Black kites typically build their nests at the tops of the tallest towers, while crow's nest on shorter towers and trees. The Oriental turtle dove is found in suburban and rural regions, often seen perched on trees. The common hoopoe is observed on the ground (Figure 8). Red-vented bulbul is frequently observed in trees and also constructs its nest on trees in both rural and urban environments (Figure 9).

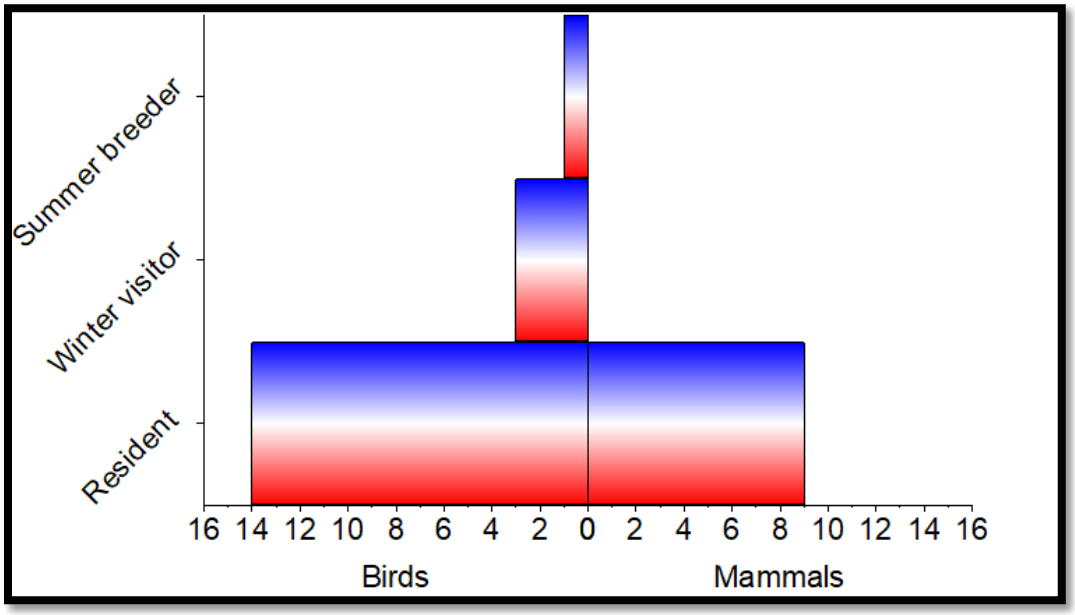


**Figure 7: Distribution of avian and mammalian species in study area.**

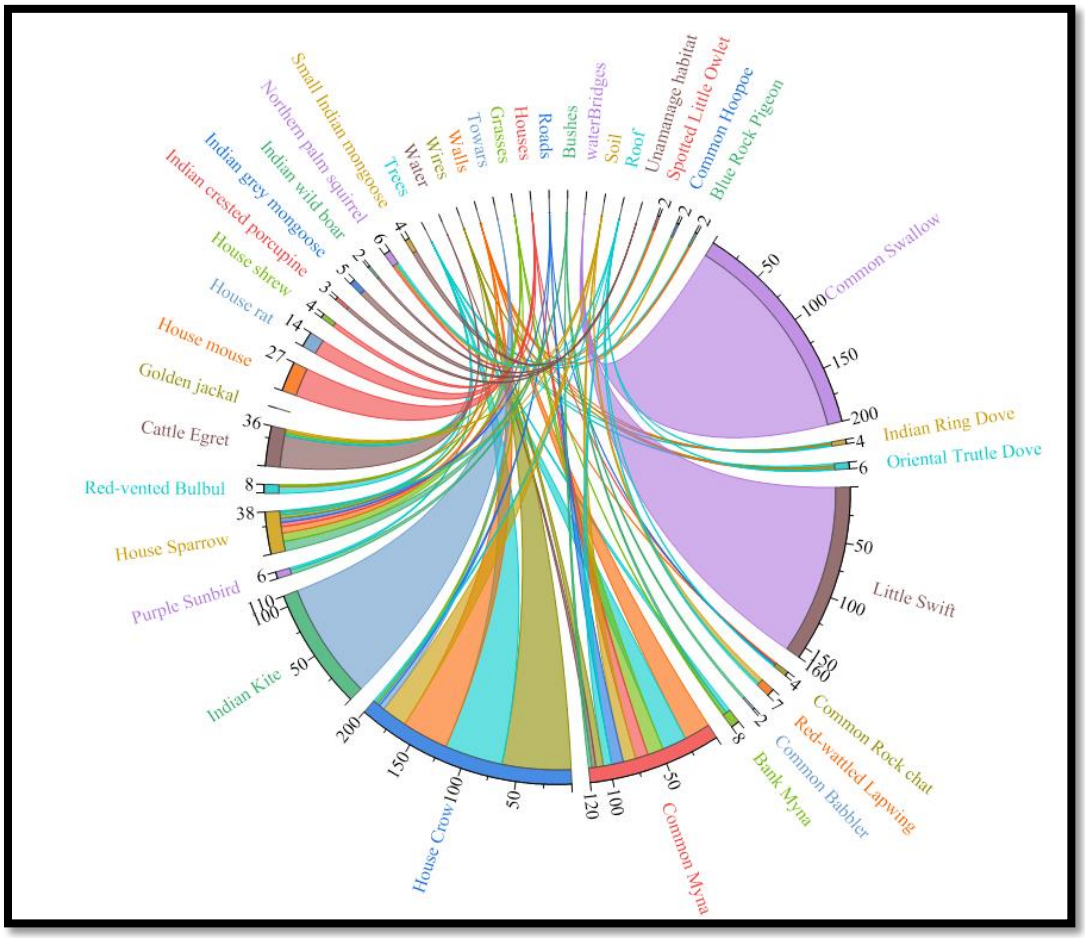


**Figure 8: Distribution of birds and Mammals in vicinity of human residential area.**

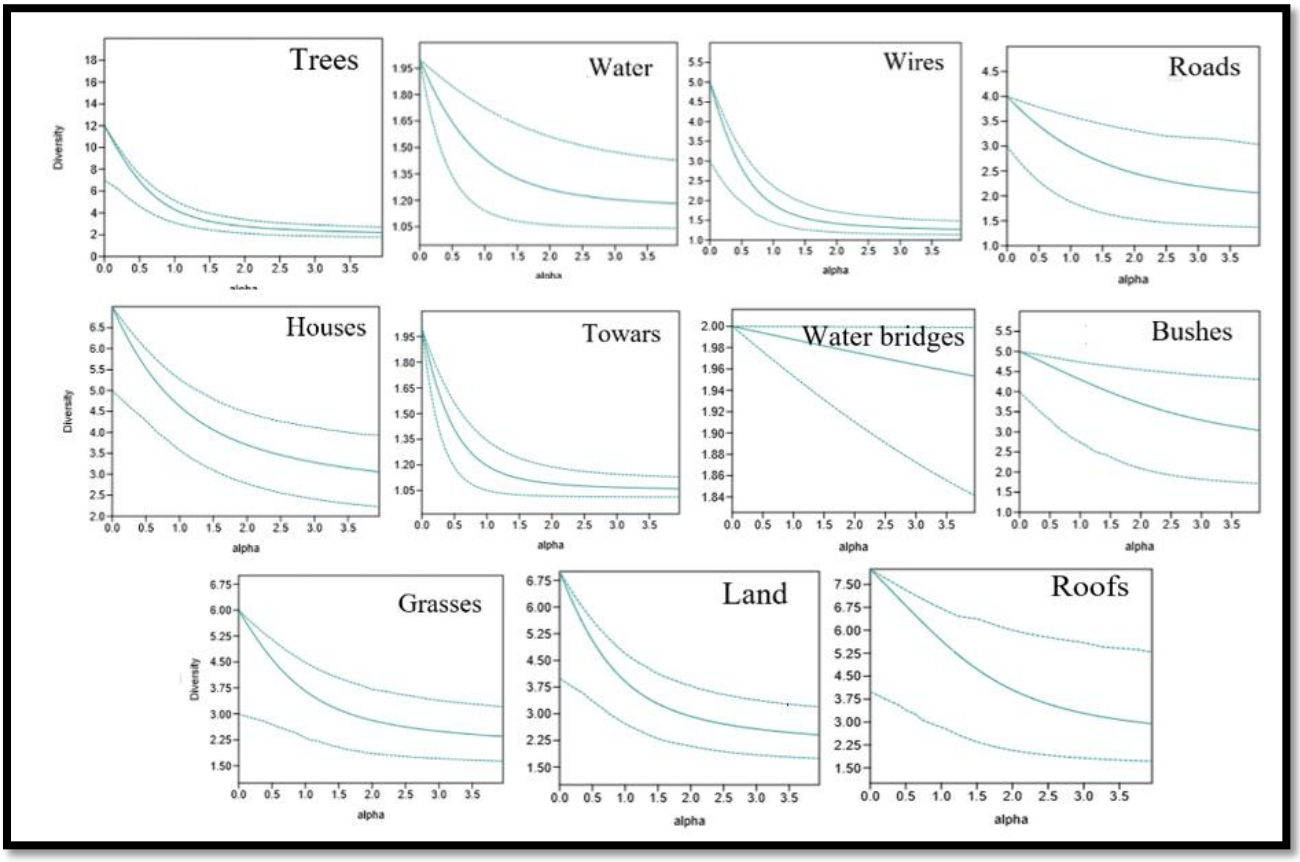


**Figure 9: Habitat preferences of avian and Mammalian species in vicinity of human residential areas of Central Punjab.**

The findings indicate that the availability of food in open environments is the main factor influencing the distribution of bird (Altaf et al., 2013; Altaf et al., 2018) and mammal species (Altaf et al., 2023). Both urban and rural areas provide food and artificial shelters, such as rooftops and interior spaces (Miller et al., 2022; Šálek et al., 2025). In urban areas, discarded waste acts as a food source for avian and mammalian populations (Carpenter and Savage, 2021). These observations suggest that the presence of open areas with accessible food resources is important in determining the spatial distribution of these species.

## CONCLUSION

In conclusion, food, shelter, and habitats are the key elements influencing biodiversity in native regions; urbanization positively affects omnivorous and insectivorous bird populations. Herbivores, frugivores, carnivores, and granivores show a negative relationship with urbanization. It is observed that urbanization increases the diversity and abundance of birds in semi-intensive areas while reducing both population size and species count in areas of intensive urbanization.

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## Table 1: Diversity of avian species in study area.

| Sr. | Name, Family, Order | Feeding habit | Status and distribution | RA |
|---|---|---|---|---|
| 1 | Spotted Little Owlet, *Athene brama* Strigidae, Strigiformes | Carnivore | LC, Resident | 0.002 |
| 2 | Common Hoopoe, *Upupa epops* Upupidae, Coraciiformes | Carnivore | LC, Resident | 0.004 |
| 3 | Blue Rock Pigeon, *Columba livia* Columbidae, Columbiformes | Granivore | LC, Resident | 0.002 |
| 4 | Common Swallow, *Hirundo rustica* Hirundinidae, Passeriformes | Granivore | LC, Winter visitor | 0.179 |
| 5 | Indian Ring Dove, *Streptopelia decaocto* Columbidae, Columbiformes | Granivore | LC, Resident | 0.004 |
| 6 | Oriental Trutle Dove, *Streptopelia orientalis* Columbidae, Columbiformes | Granivore | LC, Winter visitor | 0.005 |
| 7 | Little Swift, *Apus affinis* Apodidae, Apodiformes | Insectivore | LC, Resident | 0.143 |
| 8 | Common Rock chat, *Cercomela fusca* Turdidae, Passeriformes | Insectivore | LC, Winter visitor | 0.004 |
| 9 | Red-wattled Lapwing, *Hoplopterus indicus* Charadrius, Charadriiformes | Insectivore | LC, Resident | 0.006 |
| 10 | Common Babbler, *Turdoides caudatus* Timaliidae, Passeriformes | Insectivore | LC, Resident | 0.002 |
| 11 | Bank Myna, *Acridothere ginginianus* Sturnidae, Passeriformes | Omnivore | LC, Resident | 0.007 |
| 12 | Common Myna, *Acridothere tristis* Sturnidae, Passeriformes | Omnivore | LC, Resident | 0.107 |
| 13 | House Crow, *Corvus splendens* Corvidae, Passeriformes | Omnivore | LC, Resident | 0.358 |
| 14 | Indian Kite, *Milvus migrans migrans* Accipitridae, Accipitriformes | Omnivore | LC, Resident | 0.098 |
| 15 | Purple Sunbird, *Nectarinia asiatica* Nectariniidae, Passeriformes | Omnivore | LC, Summer breeder | 0.005 |
| 16 | House Sparrow, *Passer domesticus* Passeridae, Passeriformes | Omnivore | LC, Resident | 0.034 |
| 17 | Red-vented Bulbul, *Pycnonotus cafer* Pycnonotidae, Passeriformes | Omnivore | LC, Resident | 0.007 |
| 18 | Cattle Egret, *Bubulcus ibis* Ardeidae, Pelecaniformes | Piscivore | LC, Resident | 0.032 |
| **Simpson-wiener diversity index** | | | | **0.7962** |
| **Shannon diversity index** | | | | **1.909** |

**Table 2: Diversity of mammalian species in study area.**

| Sr. | Name, Family, Order | Feeding habit | Status and distribution | RA |
|---|---|---|---|---|
| 1 | Golden jackal, *Canis aureus* Canidae, Carnivora | Omnivore | LC, Resident | 0.030 |
| 2 | House mouse, *Mus musculus* Muridae, Rodentia | Omnivore | LC, Resident | 0.403 |
| 3 | House rat, *Rattus rattus* Muridae, Rodentia | Omnivore | LC, Resident | 0.209 |
| 4 | House shrew, *Suncus murinus* Soricidae, Eulipotyphla | Omnivore | LC, Resident | 0.060 |
| 5 | Indian crested porcupine, *Hystrix indica* Hystricida, Rodentia | Herbivore | LC, Resident | 0.045 |
| 6 | Indian grey mongoose, *Herpestes edwardsii* Herpestidae, Carnivora | Omnivore | LC, Resident | 0.075 |
| 7 | Indian wild boar, *Sus scrofa* Suidae, Artiodactyla | Omnivore | LC, Resident | 0.030 |
| 8 | Northern palm squirrel, *Funambulus pennantii* Sciuridae, Rodentia | Omnivore | LC, Resident | 0.090 |
| 9 | Small Indian mongoose, *Urva auropunctata* Herpestidae, Carnivora | Omnivore | LC, Resident | 0.060 |
| **Simpson-wiener diversity index** | | | | **0.7811** |
| **Shannon diversity index** | | | | **1.848** |

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