Journal of Wildlife and Ecology (2024). 8(1):01-14

Research Paper **Open Access**

Analysis of Avian communities under different Urban Habitats in District Layyah, Punjab, Pakistan

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Citation: Khan, M., H. Israr, K. Fatima, T. Laraib, S. Batool, H. Ayoub, U. Ali, Z. Shaheen, and I. Nawaz. 2024. Analysis of Avian communities under different Urban Habitats in District Layyah, Punjab, Pakistan. Journal of WIldlife and Ecology. 8: 1-14.

SUMMARY

The avifauna diversity of the densely populated and agriculturally important district of Layyah in the Punjab province was studied for a period of one year. The area was originally part of a desert but has been transformed into urban and agricultural landscapes. The increasing fragmentation of bird habitats is a consequence of rapid urbanization. These habitats play a vital role as essential sanctuaries for urban bird communities. The present study was planned to assess the avian diversity of urban, peri-urban, and rural areas in the Layyah district. The data were analyzed using computer-based software PAST to record diversity indices. A total of 48 avian species were observed in the urban areas of Layyah. It was observed that the diversity was richer in peri-urban habitats compared to urban habitats. It can be concluded from the present study that food, shelter, and nesting habitats are the main factors that influence avian diversity, and urban habitats are favorable for generalist bird species. This approach allowed us to identify omnivorous, carnivorous, insectivorous, granivorous, and piscivorous guilds among the bird populations. Additionally, the transect method was used to determine coordinates for various locations. Nevertheless, even green areas and passages are crucial for conserving birds in urban environments where extensive forested areas have decreased. Conservation strategies need to prioritize the management of urbanization.

Keywords: Biodiversity, Bird guilds, Urbanization Gradient, Habitat

Received: 25-01-2024	**Revised**: 12-02-2024	**Accepted**: 23-2-2024

INTRODUCTION

One of the main threats to biodiversity is urbanization (Korányi et al., 2021a; Korányi et al., 2021b), and another threat is pesticides (Faiz, 2022; Hussain and Tanveer, 2023), fragmentation, and loss of natural habitats (Mackay et al., 2017; Rahman et al., 2023). Urban green spaces not only provide crucial habitats for wildlife but also yield numerous economic and social advantages for the general public. In urban green spaces, wildlife, especially bird groups, provide a wide range of ecological services. For example, by feeding on pests, insectivorous guilds can control the number of pests in urban green areas and woods (Meffert and Dziock, 2013). Birds that consume fruit and grains may help spread seeds and pollinate crops in green areas. Thus, sensible preservation of urban green space (such as gardens, parkland, and green parks) can have a significant positive impact on ecological services by promoting long-term wildlife coexistence and biodiversity (Devictor et al., 2008).

Research has revealed a decline in urban biodiversity. There is a notable homogenization phenomenon along the "urban–suburban" gradient, which leads to a

decline in specialized species and an increase in the percentage of generalists in urban areas (Altaf, 2016; Asefa et al., 2017; Ashraf et al., 2018; Altaf, 2021; Altaf et al., 2021). The majority of species are extremely sensitive to urbanization, even though some can endure in heavily populated areas and withstand the impacts of habitat fragmentation (Chamberlain et al., 2017). They primarily live in suburban or outer suburban natural and semi-natural settings. These occurrences are crucial indicators of "ecological stress," driving birds to travel passively through agricultural areas, woodlands, and patches of forest in search of high-quality habitat (Shimelis and Thirgood, 2011). These neighborhoods are usually less developed, receive less foot traffic, and are less affected by urbanization than the city center. Moreover, the response of bird communities in urban parks and natural forests to the size and structure of their habitats varies in multiple spatial dimensions (Wang et al., 2014). Because the effects of changes in urbanization have functional or ecological consequences (Rahman et al., 2021), the species richness of bird groups in highly developed areas may be less than that of original habitats within the same geographic area (Yang et al., 2020).

Furthermore, bird assemblages at the functional level exhibit distinct responses to urbanization across various spatial dimensions. Therefore, it is essential for local government decision-making and the management of natural spaces to comprehend how urbanization affects bird groups' aggregation patterns (Otieno and Mutati, 2021). As urban landscapes grow, they often replace ecosystems with man-made features such as houses, streets, and buildings. This transformation brings about various disturbances and adverse effects on different forms of life. In light of these transformations, it is vital to gain a comprehensive understanding of how these environmental shifts influence the ecological processes and biodiversity that are important for upholding the quality of human life and the accurate functioning of the urban environment (McDonald et al., 2013). Avian represents a diverse group and is particularly responsive to the environmental changes in human-altered land sites (Morante-Filho et al., 2015). Certain bird species exhibit higher adaptability to urban environments than others (Aronson et al., 2014), reflecting varying degrees of sensitivity to the challenges of urbanization (Blair, 1999). The composition of urban vegetation, including elements like street trees, gardens, and natural habitat patches, plays a vital role in sustaining bird populations within urban areas (Litteral and Wu, 2012).

Considering that various avian species utilize urban rich vegetation to varying extents (Litteral and Wu, 2012), it's crucial to account for these differences when assessing the impact of the urban environment on avian communities. Approaches to functional diversity, which focus on the value and range of functional features within a community, provide valuable insights into how human activities influence biodiversity. Functional diversity indices, rather than attempting to encapsulate all aspects in a single value, help reveal the processes shaping communities and how biodiversity interacts with environmental constraints (Mouchet et al., 2010). The combination of these indices with taxonomic information enables the identification of organisms sensitive to anthropogenic disturbances and those that can thrive in human-altered landscapes. Despite the rapid and intense urbanization experienced by Neotropical cities, which are among the most urbanized globally, there remains a notable lack of research in this geographical area concerning the effects of urbanization on bird populations (Sethi and Schepers, 2014). This study's objective is to know the effect of vegetation on diversity and the urbanization impact on the avian species of the study area.

MATERIALS AND METHOD

The information was collected between June 2022 and May 2023. The data was collected on monthly basis from different sites of Layyah, Punjab, Pakistan, in the early morning and evening before sun set show in (Figure 1).

STUDY AREA

The Punjab region of Pakistan contains the Layyah District, which is situated in the southern region of the province. The headquarters of the Layyah District is located in Layyah City. The word "Layyah" is derived from "Lai," which means shrub. Kamal Khan, a Mirani Baloch and a descendant of Dera Ghazi Khan, established the city sometime around 1550, as shown in Figure 1. Layyah was later moved to the newly formed district of Mianwali in 1901 and was subsequently added to the Muzaffargarh District. Layyah Tehsil was elevated to district headquarters in 1982, consisting of Layyah, Karor Lal Eisan, and Choubara Tehsils. According to the 1998 census, the population of the district was 2 million. District Jhang borders Layyah District to the east, while District Bhakkar borders it to the north. On its western side, the River Indus flows through the districts of D.G. Khan and Muzaffargarh. The Layyah District covers an area of 6291 square kilometers and is 75 kilometers wide and 88 kilometers long between the North and South Poles (Tenforde et al., 2020).

SAMPLING CRITERIA

During the bird survey, I covered an area of approximately 1500 square meters. I used the 8-transect method to count the birds. The radius of each site was approximately 5 meters. The shorter distance between transects was set at 50 meters, and I tried to distribute the transect locations as widely as possible (Xu et al., 2022). I calculated the coordinates of each site in north and east pol shown in (Table 1).

Table 1: Study areas of Distric Layyah.

Study Area	Area Unit 1	Coordinates	Area Unit 2	Coordinates
Urban with vegetation	School	30º46′13.44”N 70º55′54.30”E	Parks	30º45′35.45”N 70º56′40.56”E
Urban without vegetation	Railway station	30º45′40.21”N 70º56′5.74”E	Grounds	30º45′27.38”N 70º55′57.08”E
Peri Urban	Houses	30º45′36.71”N 70º55′44.28”E	Plot with shrubs	30º 45′41.85”N 70º55′44.63”E
Rural and agricultural field	Yards	30º45′15.63”N 70º56′30.10”E	Cultivated Area	30º46′24.96”N 70º56′36.97”E

Field Survey

The number and variety of urban birds were surveyed throughout the year, from June 2022 to May 2023. A monthly survey was conducted from sunrise to sunset to examine every opportunity. Thus, the study period was only available between sunrise and nightfall. Urban areas with vegetation, urban areas without vegetation, peri-urban areas, rural areas, and agricultural areas were the five sampling sites that were visited repeatedly on separate days during each month (Figure 1). Each month consisted of four visits, and during certain intervals of the study, the area was also visited. To gauge the variety and number of birds in urban and rural regions, point counts were performed. Numerous random point counts were quantified. Data

collection involved both direct and indirect methods. The direct method encompassed field area observation by observers, while indirectly the information was obtained from local residents and hunters. Birds were enumerated using binoculars and spotting scopes, and a digital camera was used to photograph the birds for later identification. Several practical guides were consulted for the identification of avian fauna.

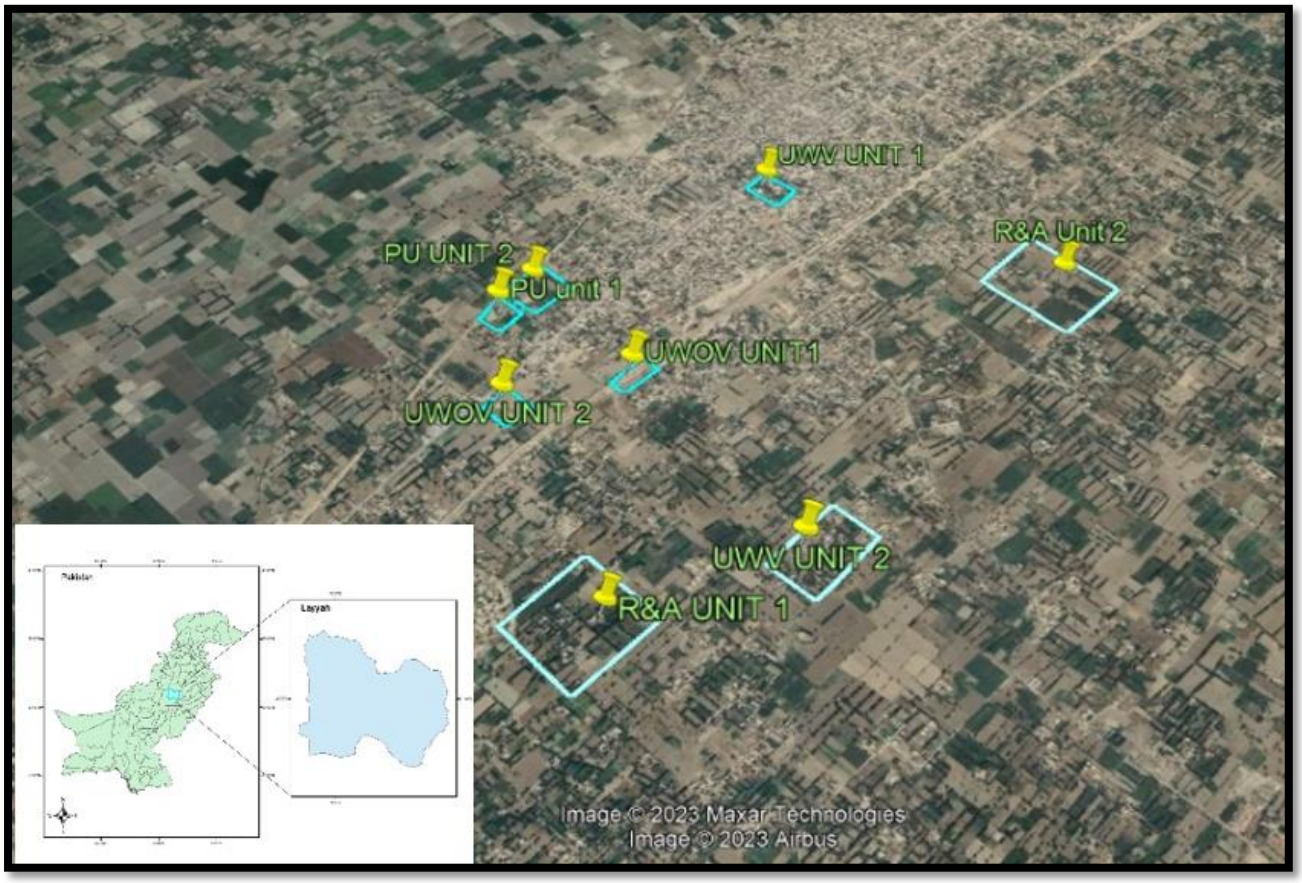

Figure 1: Map of District Layyah.

Classification of Urbanization Type

Urban with vegetation: I saw various types of vegetation where birds were perched. There were different kinds of plants and a variety of birds in this area. I counted the number of birds here and made notes. It was an urban area with vegetation as well. (2) Urban without vegetation: In the area where I was, there was no vegetation, and the number of birds was also quite low. This was because the birds could only be found perched on wires, roofs, or the ground. There was no food available for them here, which is why the bird population was scarce. This area was essentially an empty plot of land located by the railway side. (3) Peri Urban The peri-urban area is where the rural area ends and the city area begins. Here, there was a greater variety of birds, and their numbers were also higher. I collected data from this area on a monthly basis. (4) Rural and agricultural field: In the rural areas, a significant number of small birds were counted. There was a higher diversity of small birds here, which perched on small twigs every morning. The data was collected from agricultural fields where many birds were obtaining their food. Their numbers were also relatively high because these birds relied on insects and grains from agricultural crops as their food source. I collected data from this location on a monthly basis shown in (Table 4).

DATA ANALYSIS

The data analysis was taken by using version 3, PAST (Hammer, 2001) to find out the species number, Shannon diversity, Individuals, Dominance, Simpson_1-D, Evenness, Brillouin, Chao-1, Principal Component Analysis (PCA) and Cluster Analysis. PCA was used to determined and measure the variables of bird fauna and relation with their habitat. Cluster analysis is used to observe similarities in different habitats.

RESULTS

Bird surveys were conducted over the course of one year, and a total of 48 species were recorded across different habitats in Layyah (Table 1). The highest species abundance was observed in the Urban with Vegetation (UWV) habitat, followed by Unit 1 (School) and Unit 2 (Park). Urban without Vegetation (UWOV) had a lower abundance, followed by Unit 1 (Railway Station) and Unit 2 (Ground). The lowest abundance was observed in the urban without vegetation habitat (UWOV), followed by an area of peri-urban (PU). Unit 1 (Houses) and Unit 2 (Plots with Shrubs) had slightly higher abundance, and the Rural and Agricultural areas had the highest abundance, especially in Unit 1 (Yards) and Unit 2 (Cultivated areas).

The present study focused on four different types of habitats (Urban with Vegetation, Urban without Vegetation, peri-urban, and Rural and Agricultural areas) in the Layyah district. Field observations were conducted on a monthly basis throughout the year to assess the diversity, abundance, and seasonal variation of wild avian species. A total of 48 avian species were identified from three different sampling sites in the Layyah district. In terms of distribution, 37 species were resident (R), four species were winter visitors (WV), four species were summer breeders (SB), one species was a passerine migrant (PM), and one species was a summer visitor (SV) (Figure 2).

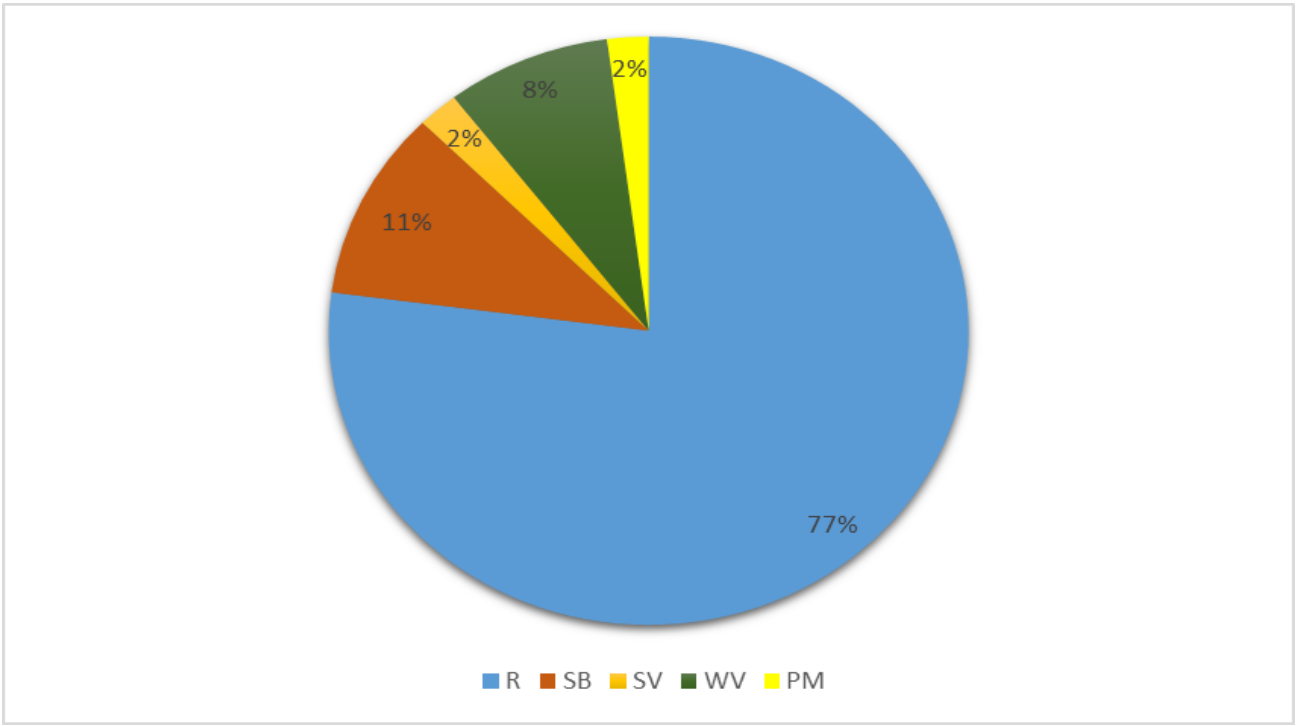

Figure 2: Graphical percentage of distribution of bird.

Data on bird populations were collected four times each month. The number of birds varied each month, with higher ratios observed in December, January, and March. In June, there were fewer birds, but the following month, July, showed an increase in bird numbers. Based on the data collection, eight sites were selected to gather information (Figure 3).

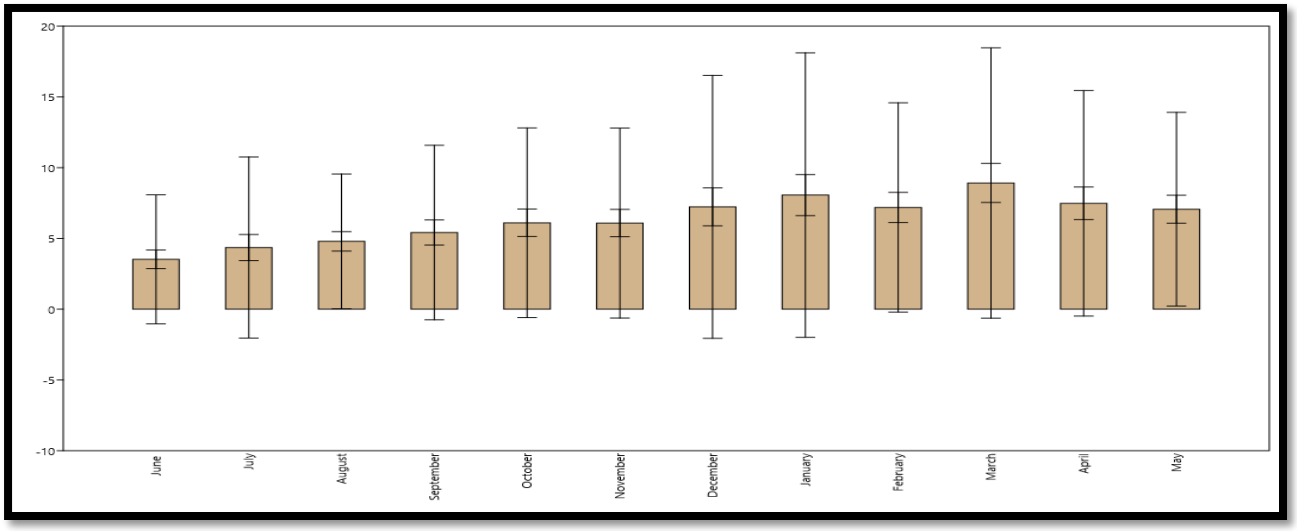

Figure 3: Monthly Data collected from study area.

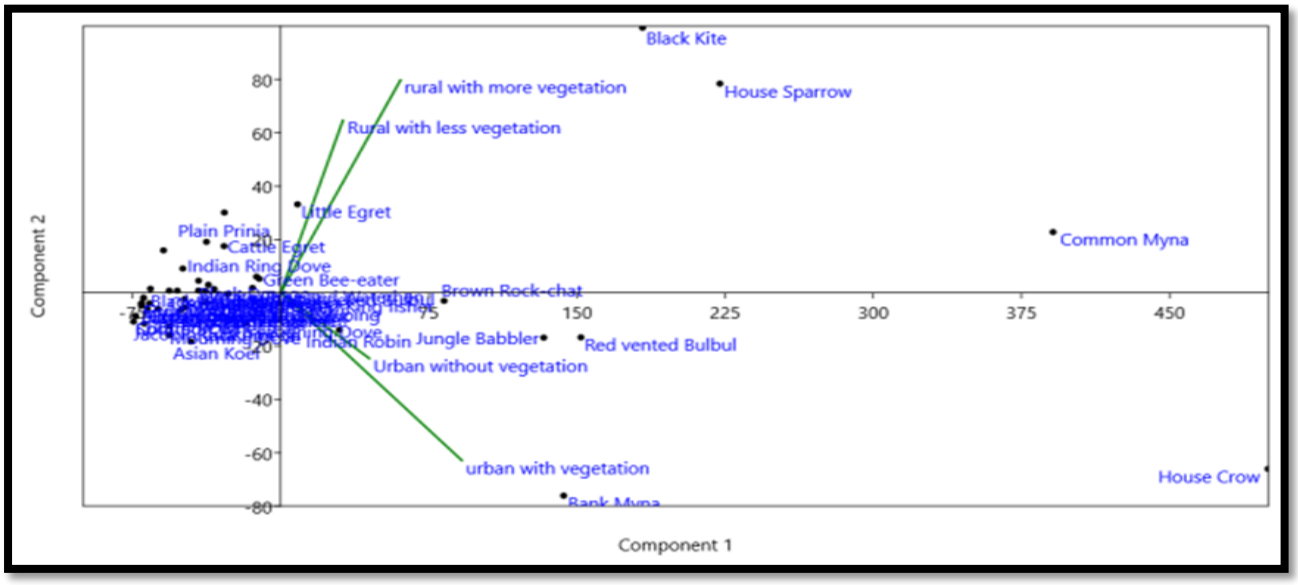

Figure 4: Principal component analysis (PCA) graph.

The first two axes of the PCA explained 97.3727 % of sampled variation of avian community (Component 1: 92.834 %; component 2: 4.5387 %). The variables included in component 1 are UWV (r=0.74642), UWOV (r=0.36539), PU (r=0.49362), and R&A (r=0.25628). The magnitude and direction of component 1 is synthesized the response of bird's community to urban and peri urban habitat as well as can be documented as a gradient of development extent. The component 2 variables are (UWV: r=-0.51169; UWOV; r=-0.20053; PU: r= 0.64911; R&A: r=0.52595). Each principal component is not related with previous calculated data, similarly, variables of component 1 are not related with component 2 variables.

Mostly variables of habitats are not related significant with other PCA component, shoe the principal factor shaping the community of birds shown in (Figure 4).

In bird's guild the numbers of omnivores were more in every site because they rely on all type of food the number of omnivores were 20 in all sites shown in (Table 2). The number of carnivores was 8 in study sites, because they feed on meat. 11 insectivorous birds were present there. The number of Granivore was 6 and piscivorous birds was 3 in (Figure 5); while the status of urban birds (i.e., VU=45, LC=2, EC=1) show in (Figure 6).

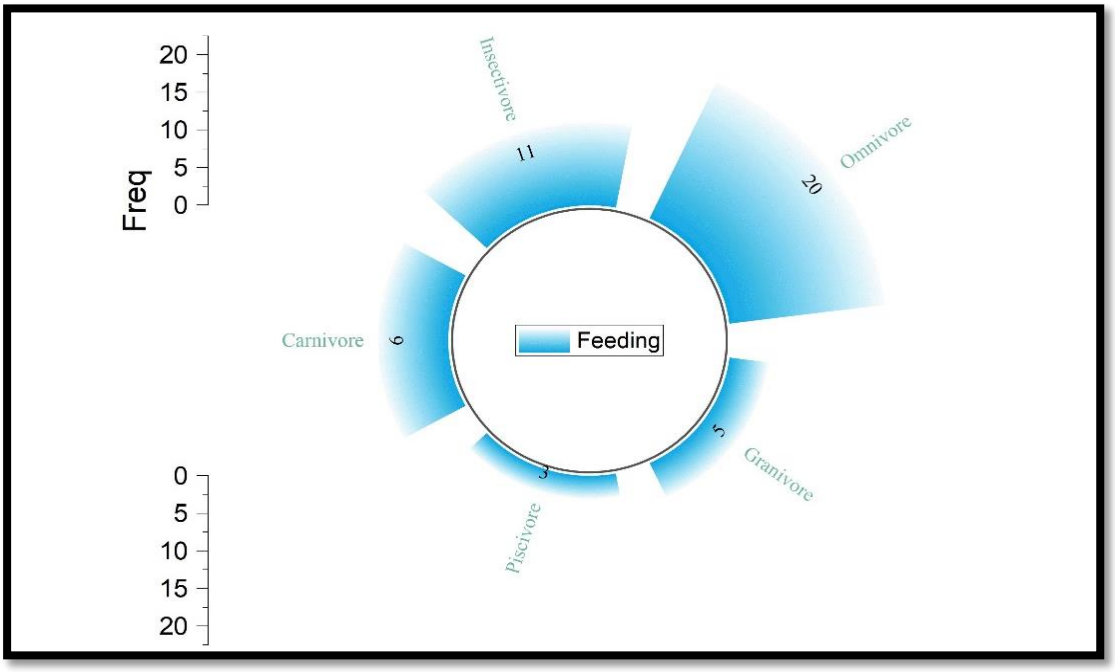

Figure 5: Feeding habits of bird species in urban landscape of Layyah.

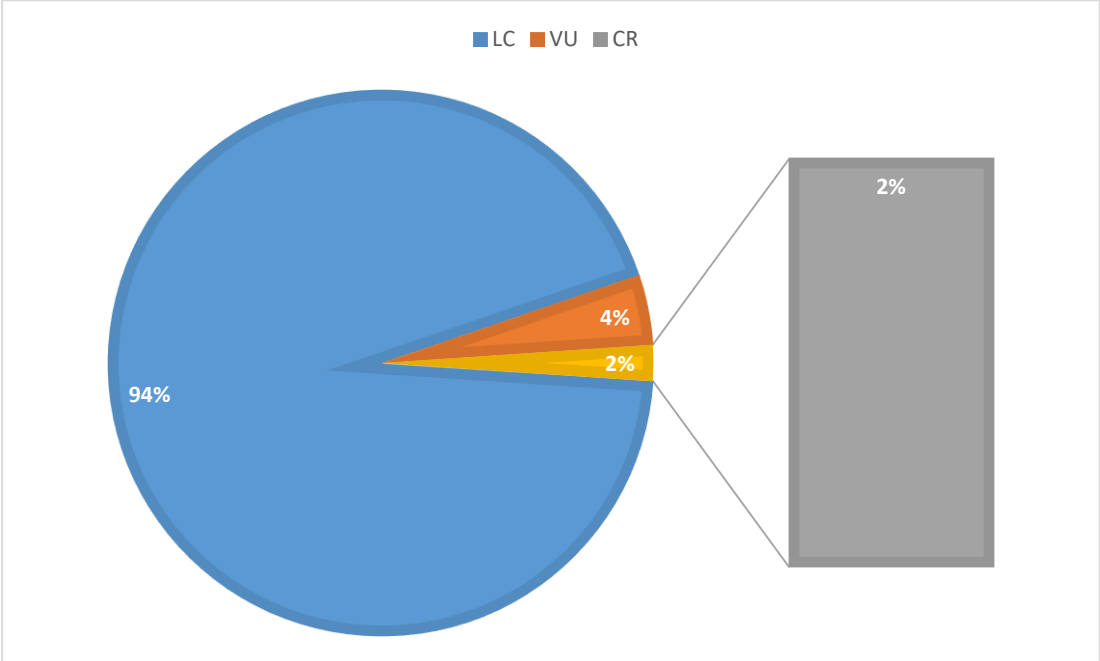

Figure 6: Status of avian fauna in different study sites of Layyah. Note: VU=Vulnerable; LC= Least concern; CR= Critically endangered.

Table 2: Bird guild in Layyah sites of urbanization.

Types of area	Grouping variables	Relative Abundance
	Omnivorous guild	0.119
	Carnivorous guild	0.016
UWOV	Insctivorous guild	0.022
	Granivorous guild	0.010
	Piscivorous guild	0.006
	Omnivorous guild	0.231
	Carnivorous guild	0.024
UWV	Insctivorous guild	0.039
	Granivorous guild	0.020
	Piscivorous guild	0.011
	Omnivorous guild	0.167
	Carnivorous guild	0.018
PU	Insctivorous guild	0.032
	Granivorous guild	0.013
	Piscivorous guild	0.015
	Omnivorous guild	0.137
	Carnivorous guild	0.033
R&A	Insctivorous guild	0.044
	Granivorous guild	0.017
	Piscivorous guild	0.026

Note: UWV= Urban with vegetation; UWOV= urban without vegetation; PU= peri urban; R&A= Rural and agricultural areas.

Large-scale agricultural intensification has a detrimental effect on bird diversity due to indirect effects, including the use of chemicals, fewer nesting sites, bird deaths caused by farming practices, and a significant increase in predation rates after crop harvest. Furthermore, it has been demonstrated that areas with abundant trees and a large bird population have a mutually beneficial relationship. This is because trees provide food and shelter for birds. Additionally, research has shown that bird diversity has increased in ditches, ecotones, and marginal regions. Birds are attracted to farmsteads, which are structures with agricultural space. Studies on bird ecology indicate that predation is causing a decline in bird populations. The number of predators has risen in agricultural areas, making birds more susceptible to predation.

I had noted the status of various birds, among which there were 45 birds classified as "Least Concern" (LC), 2 birds as "Vulnerable" (VU), and 1 bird as "Critically Endangered" (CR). The "Least Concern" birds were represented by a blue color in the figure, constituting 94% of the total. "Vulnerable" birds made up 4%, and "Critically Endangered" birds accounted for 2% of the total. (Figure 6).

DISCUSSION

While urban parks are primarily designed for the well-being of humans, their inclusion of bird species can significantly enhance the enjoyment of people and also offer opportunities to learn about wildlife. Furthermore, the significance of green spaces for urban birds is increasingly recognized and has been demonstrated in numerous studies (MacGregor et al., 2011). Urban parks and gardens can offer suitable habitats for a variety of bird species, beyond those that are adapted to urban

environments, and non-native species like the common myna, which are prevalent in cities, as observed in our study. Therefore, by studying the impact of the characteristics of urban gardens and parks on bird species richness, diversity, and community structure, we can gain a better understanding of their effects.

It is observed that species richness increases with the diversity of habitats (Hortal et al., 2009; Isah et al., 2023; Shakil et al., 2023), and urban birds are no exception. However, we discovered that none of the 8 environmental factors we investigated had an impact on the diversity of bird species. This finding suggests that birds in urban settings can be less picky about their habitat preferences and will consequently inhabit any accessible green area. On the other hand, we discovered a positive relationship between bird species diversity and shrub species richness. Since it takes into account both the proportional quantity of the species present and the total number of species present, we believe that this assessment of the composition of birds is more reliable than the assessment of bird species richness. This second finding is similarly in line with earlier studies that demonstrated the importance of bushes for several forest birds in urban gardens (Xu et al., 2022).

My research findings have shown that urbanization has an impact on the overall bird species diversity and alpha diversity in areas with vegetation. However, it does not significantly affect bird abundance. In urban areas with vegetation, we observed a total of 2,446 individual birds, which is higher than in urban areas without vegetation, where the number of individuals was 1,258. Furthermore, in rural and agricultural areas, we recorded 1,926 individuals, surpassing the count in peri-urban areas, which stood at 1,904 (Guerrero-Ramírez et al., 2021).

Because of the rising population, which has caused birds to depend more on artificial food sources, we saw more birds in urban areas. For instance, crows, house sparrows, red-vented bulbuls, and common mynas all eat a variety of foods in metropolitan settings, including leftovers from fish and livestock markets and street food. These birds are frequently spotted near educational institutions, where they eat a variety of foods such as homemade bread, munchies, and candies. The increased bird numbers in these places are also influenced by the abundance of flora. On the other hand, conflicting research has revealed that greater levels of urbanization allow some species to grow quickly and have a significant capacity to flourish and expand, resulting in a species diversity that is unique compared to other areas (Endris et al., 2017).

For instance, I discovered a sizable population of house sparrows, which are regarded as an indicator species of urban habitats, in highly urbanized areas and the peri-urban surroundings. This is because house sparrows, despite the detrimental effects of urbanization, can survive by eating leftover human food and household waste. House sparrows may locate many acceptable nesting spots in cities, so urban conditions do not prevent them from building their nests. Numerous habitat types are available in urban settings for different bird species to use as homes, and the dense vegetation in these regions can increase the safety of these habitats for birds (Cheng et al., 2019). Apart from that, in urban areas without vegetation, the bird populations were lower because there were no trees. In such areas, birds were often seen on wires, the ground, roofs, or branches. At railway stations, after passing through the railway tracks, birds would consume various types of food available from passengers, such as biscuits and bread.

From my results, it becomes clear how urbanization affects the diversity and richness of insectivorous and omnivorous guilds. Birds show a greater variety in areas with more vegetation, where the population is lower but there are more trees. Less

urbanized areas help preserve the canopy of woodland and provide vertical plant shelters for birds, which attract a wider range of bird species (Korányi et al., 2021c). The distribution and diversity of omnivorous and insectivorous associations are minimally affected by urban habitat changes or urbanization. This is because these guilds have low food and environmental requirements and have a broader range of available assets. Similar conclusions have been drawn from earlier studies. Due to inadequate waste management, urban wildernesses are more readily available to the omnivorous association.

Under the three various types of urbanization, the functional diversity of avian species varies. In urban regions, there was a strong and positive association between the species richness and variety of the omnivorous and insectivorous guilds. It suggests that the two associations can coexist in urban regions with plenty of living resources without being excluded due to competition, which could result in overlapping particular functions (Mbiba et al., 2021). However, in the peri-urban area, the omnivorous guild indicated that the relationship between diversity and abundance of species was negative, indicating the possibility of competitive species' impact on food and plant groups under this type of urban environment, which could result in the duplication of species roles and a lack of resources (De Groot et al., 2021).

Apart from the diversity of birds, I observed some cats, dogs, and people there. In places where cats, dogs, and people were present, the number of birds was lower. Cats used to prey on the birds, which is why their numbers were reduced in that area. Birds were scared of people, and they didn't come there. Due to the presence of these animals, the bird population in that area was significantly reduced. Birds have been demonstrated to be negatively impacted by human presence in the past. Similar findings also reveal that fewer bird species were discovered in gardens with a large dog population. Given that we discovered no significant relationship between the presence of dogs and the percentage of shrubby plots, it seems unlikely that this result is due to the fact that dogs and people prefer parks with more open space and lawns than those that are home to birds. Future studies on biological conservation must delve further into the environmental variables that can impact avian diversity on various scales. The forms of urban green space and their effects, as well as research on habitat or landscape. Individual or population behaviors of different bird species can represent how the built environment of cities affects them (Opoku et al., 2020). For instance, climate change may affect bird migration paths and even when they roost along the journey. The evolution of bird communities may be impacted by changes in the urban environment, with the most pressing issue at the moment being the homogeneity of urban bird groups.

This might have partially influenced our findings, particularly in the evaluation of avian diversity. Additionally, because the five parks are close together, it is probable that on some instances the same people have been tested as well as in the parks. Producing an infinite number of non-independent observations as a result of replicates. Therefore, a critical research issue that has to be resolved is how to account for ecosystem limits when analyzing how the target species responds to its environment (Curzel et al., 2021).

CONCLUSION

The variation in landscapes plays a vital role in influencing the dispersal and variety of bird species. Through our data analysis, we can forecast how bird variety and distribution will be impacted within specific landscape gradients. Bird species are

highly responsive to the effects of human activity. When it comes to the preservation and restoration of avian species, particularly in terms of forest biodiversity, the emphasis should be on large-scale efforts. We employed various strategies to assess diversity. Through data analysis, we examined the count of individuals, species, dominance, and evenness. Using this data, we compared different sites to determine bird diversity. It was noted that the diversity was richer in peri-urban habitats as compared to urban habitats. Additionally, I also utilized the transect method to determine coordinates for various locations. Nevertheless, even green areas and passages are crucial for conserving birds in urban environments where extensive forested areas have decreased. Conservation strategies need to prioritize the management of urbanization.

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Table 3: Statistical analysis of avifauna of study areas

Diversity indices	UWV	UWOV	PU	R&A
Taxa_S	38	34	48	48
Individuals	2446	1258	1904	1926
Dominance_D	0.08363	0.07828	0.07043	0.03786
Simpson_1-D	0.9164	0.9217	0.9296	0.9621
Shannon_H	2.914	2.921	3.155	3.523

Evenness_e^H/S	0.4851	0.5461	0.4888	0.7062
Brillouin	2.875	2.86	3.096	3.462
Menhinick	0.7683	0.9586	1.1	1.094
Margalef	4.742	4.624	6.224	6.214
Equitability_J	0.8011	0.8285	0.8151	0.9101
Fisher_alpha	6.386	6.439	8.947	8.923
Berger-Parker	0.1881	0.1653	0.1408	0.08307
Chao-1	38	34	48	48

Table 4: Diversity of Urban birds in study area.

Common Name	Scientific Name	Distribution	Status	Feeding Type	Total	RA
Asian Koel	*Euedynamys scolopacea*	SB	LC	Omnivore	44	0.012
Alexandrine Parakeet	*Psittacula eupatria*	R	LC	Omnivore	24	0.007
Bank Myna	*Acridotheres ginginianus*	R	LC	Omnivore	184	0.050
Black Kite	*Milvus migrans*	R	LC	Omnivore	240	0.066
Brown Rock-chat	*Cercomela fusca*	R	LC	Carnivore	114	0.031
Black rumped Flameback	*Dinopium benghalense*	R	LC	Omnivore	18	0.005
Black Partridge	*Francolinus francolinus*	R	VU	Omnivore	32	0.009
Black Drongo	*Dicrurus macrocercus*	R	LC	Insectivore	66	0.018
Bay back Shrike	*Lanius vittatus*	SV	LC	Carnivore	18	0.005
Common Myna	*Acredotheres tristis*	R	LC	Omnivore	147	0.040
Common Moorhen	*Gallinula chloropus*	R	LC	Omnivore	19	0.005
Cattle Egret	*Bubulcus ibis*	R	LC	Piscivore	88	0.024
Common Quail	*Coturnix coturnix*	SB	LC	Omnivore	36	0.010
Eurasian Hoopoe	*Upupa epops*	R	LC	Insectivore	74	0.020
Intermediate Egret	*Egretta intermedia*	R	LC	Piscivore	152	0.042
Grey Partridge	*Francolinus pondicerianus*	R	LC	Granivore	24	0.007
Goshawk	*Accipiter gentilis*	WV	VU	Carnivore	8	0.002
Green Bee-eater	*Merops orientalis*	R	LC	Insectivore	100	0.027
Greater Coucal	*Centropus sinensis*	R	LC	Carnivore	26	0.007
House Crow	*Corvus splendens*	R	LC	Omnivore	336	0.092
House Sparrow	*Passer domesticus*	R	LC	Omnivore	240	0.066
Eurasian sparrow Hawk	*Accipiter nisus*	WV	CE	Carnivore	18	0.005
Indian Roller	*Coracias benghalensis*	R	LC	Carnivore	62	0.017
Indian Robin	*Saxicoloides fulicatus*	R	LC	Omnivore	98	0.027
Indian pond Heron	*Ardeola grayii*	R	LC	Omnivore	84	0.023
Jungle Babbler	*Turdoides striatus*	R	LC	Insectivore	168	0.046

Jacobin Cuckoo	*Clamator jacobinus*	SB	LC	Carnivore	4	0.001
jungle Prinia	*Prinia sylvatica*	R	LC	Insectivore	34	0.009
Little Egret	*Egretta garzetta*	R	LC	Piscivore	140	0.038
Mourning Dove	*Zenaida macroura*	R	LC	Granivore	30	0.008
Laughing Dove	*Streptopelia senegalensis*	R	LC	Granivore	76	0.021
Purple Sunbird	*Nectarinia asiatica*	SB	LC	Omnivore	56	0.015
Eastern Pied Wheatear	*Oenanthe picata*	WV	LC	Insectivore	26	0.007
Plain Prinia	*Prinia inornata*	R	LC	Insectivore	62	0.017
Pied Bush-chat	*Saxicola caprata*	SB	LC	Insectivore	22	0.006
Large Pied Wagtail	*Motacilla maderaspatensis*	R	LC	Insectivore	26	0.007
Red vented Bulbul	*Pycnonotus cafer*	R	LC	Omnivore	184	0.050
Rufous Treepie	*Dendrocitta vagabunda*	R	LC	Omnivore	34	0.009
Rock Pigeon	*Columba livia*	R	LC	Granivore	114	0.031
Red wattled Lawping	*Hoplopterus indicus*	R	LC	Insectivore	78	0.021
Spotted Owl	*Athene brama*	R	LC	Omnivore	14	0.004
Common Wheatear	*Oenanthe oenanthe*	WV	LC	Insectivore	20	0.005
White cheeked Bulbul	*Pycnonotus leucogenys*	R	LC	Omnivore	56	0.015
White-throated King fisher	*Halcyon smyrnensis*	R	LC	Carnivore	60	0.016
Oriental White eye	*Zosterops palpebrosa*	R	LC	Omnivore	28	0.008
Indian Ring Dove	*Streptopelia decaocto*	R	LC	Granivore	110	0.030
Yellow Bittern	*Ixobrychus sinensis*	PM	LC	Carnivore	38	0.010
White-Breasted Waterhen	*Amaurornis phoenicurus*	R	LC	Omnivore	24	0.007

Note: UWOV= urban without vegetation; PU= peri urban; R&A= Rural and agricultural areas.

***Competing interests**:* Authors have declared that no competing interests exist.
***Funding**:* Authors have no source of funding for this research work.
Authors' contributions: Khan has designed this project, collected data and written this article; while All authors have critically analyzed this article and approved as final.