

Ornithofauna Diversity of Tehsil Pakpattan, Punjab, Pakistan

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To cite this article:

Muhammad Amir Sial. (2024). Ornithofauna Diversity of Tehsil Pakpattan, Punjab, Pakistan. *Ecology and Evolutionary Biology*, 9(1), 14-21. <https://doi.org/10.11648/j.eeb.20240901.13>

Received: December 25, 2023; **Accepted:** January 6, 2024; **Published:** January 23, 2024

Abstract: Tehsil Pakpattan is situated in the Doab region of Punjab, Pakistan, along the Sutlej River. The aim of the present study was to evaluate the avian biodiversity of Tehsil Pakpattan. The study included the evaluation of species diversity, IUCN Red List status, migratory description, and feeding habits of the bird populations of Tehsil Pakpattan. Regular surveys were conducted at 10 different localities in Tehsil Pakpattan, including Islam Colony, Kanipur, Farid Kot, 14 S/P, Chak Khagga, Musawal, 8 S/P, Noorpur, Green Town, and Bonga Niaz Khan, from January 2022 to April 2023. The Shannon Wiener diversity index value ($R' = 3.41$) indicated the notable diversity of the bird populations in the study area. A total of 1884 individuals representing 41 species, 30 families, and 12 orders were recorded. The highest diversity was in the order Passeriformes. The most common birds in the observed population were cattle egrets ($n = 160$), house crows ($n = 150$), Asian green bee eaters ($n = 100$), rock pigeons ($n = 100$), brown rock chats ($n = 98$) and house sparrows ($n = 90$). Among all the species, 34 were residents, 2 were summer breeders, and one was a winter visitor. Thirty-seven (75.60%) of the bird species belonged to the least concern (LC), 2 (4.87%) were nearly threatened (NT), and 2 (4.84%) were vulnerable (VU) categories of the IUCN Red List.

Keywords: Aves, Ornithofauna, Pakpattan, Birds of Pakistan, Bird Diversity

1. Introduction

Birds belong to the class Aves, making it the only group of Phylum Chordata to have feathered vertebrates. Class Aves comprises more than 10,000 bird species, making them the most diverse group of vertebrates [16]. Pakistan has a highly diverse set of avifauna comprising more than 790 bird species [1, 17]. Among all vertebrate groups, the class Aves is the most diverse and best studied. Undoubtedly, birds are eye-catching and permeating creatures of nature [8]. High agility results in their presence globally in approximately all habitats. Birds are highly diverse, widely recognized, and valuable living creatures that serve as valuable indicators for tracking global biodiversity patterns. They are easily observable and provide useful insights into biodiversity. A flourishing bird population indicates environmentally friendly and sustainable growth and improved environmental health. In addition, birds have important ecological, biological, and financial contributions, including pollination, seed

dispersal, nutrient cycling, pest control, and scavenging [3, 19]. Unfortunately, over the past few decades, the human population has been increasing at an exponential rate; as per the projected numbers, the world population will reach a gigantic number of 9.7 billion in 2050 and 11.2 billion by the end of the 21st century [4]. Substantial growth in the human population, unplanned expansion of urban settings, and lack of knowledge about wildlife are posing various beildering threats to precious bird species, including illegal hunting and shooting, habitat destruction, environmental pollution, and illegitimate trade. Due to these astonishing threats, bird diversity is declining rapidly [5, 6]. The area of Tehsil Pakpattan is situated along the bank of the Sutlej River in the Bari Doab Region of Punjab. The climate of Tehsil Pakpattan is dry, damp, and sizzling in summer, and winters are dry, cool, and short in duration. Around the year, the temperature varied from 42°F to 105°F and was barely less than 38°F or above 112°F (GOP, n.d.). Furthermore, notably, no study has been conducted in the area of Tehsil Pakpattan to date

regarding the estimation and assessment of bird diversity. However, studies regarding the impact of deforestation and avian population dynamics have been carried out in adjoining areas such as District Okara [1, 2]. Hence, the present study evaluated the IUCN status, migratory behavior, and feeding habits of the avifauna of Tehsil Pakpattan.

2. Materials and Methods

2.1. Study Area

The study was conducted in 10 urban, agri-rural Forests agri-rural, and rural localities of Tehsil Pakpattan, Punjab, Pakistan (Table 1). Pakpattan is one of the two tehsils in the district Pakpattan of Pakistan. Tehsil is a term for the sub administrative branch in the Provincial governing setup of Pakistan. The Tehsil headquarters of Pakpattan is located in the city of Pakpattan. A total of 0.9 million people live in rural vicinities.

2.2. Surveying and Data Collection

For data collection, regular surveys were conducted from January 2022 to April 2023 on a weekly basis. Birds were observed using binoculars (10×50 mm) and the direct vision method (naked eye), while some of the birds were identified using the sound capture feature of the BirdNET mobile application developed by the Cornell Lab of Ornithology, Cornell University, USA. The identification of these species was confirmed by Books and field guides of ornithology, including “Birds of Pakistan” and “Ornithology in laboratory and field” [14, 15]. The bird count for population density estimation was carried out using the transect count method devised by Emlen J. T. [20].

2.3. Statistical Analysis

For the statistical analysis of the data, the Shannon–Wiener diversity index (H'), species evenness index, Simpson's diversity index (I_{simpson}), Simpson's dominance index (D_{simpson}), and Margalef's index (I_{Margalef}) were calculated using Microsoft Excel (MS Excel) version 2019 (Table 2). Graphical representations, tables, and graphs were generated using MS Excel version 2019.

3. Results

3.1. Composition of Avian Diversity

Preponderantly, 1884 individual birds belonging to 41 species, 30 families, and 12 orders were sighted in the study area. The results revealed that the order Passeriformes was the most diverse among all the orders. Out of the 41 species, 19 belonged to the order Passeriformes, 4 to Coraciiformes, 4 to Charadriiformes, 3 to Columbiformes, 2 to Cuculiformes, 2 to Bucerotiformes, and 2 to Galliformes, one each from Pelecaniformes, Piciformes, Ciconiiformes, Strigiformes, and Accipitriformes (Figure 1). The percentage of individual birds indicated that the order Passeriformes was the richest in diversity among the other orders in the study area (Figure 2).

3.2. Diversity Indices

The outcomes for various diversity indices were recorded as Shannon Wiener's Diversity Index (H') 3.4185, Species Evenness index 0.4533, Simpson's Diversity Index (I_{simpson}) 0.9601, Simpson's dominance index (D_{simpson}) 0.0398 and Margalef's index 5.30422906 (Table 2).

3.3. IUCN Red List Status of Avifauna

The results revealed that 2 species (*Sterna aurantia* and *Columba eversmanni*) were vulnerable (VU) and 2 (*Limosa limosa* and *Mycteria leucocephala*) were near-threatened (NT), and the remaining species ($n = 34$) were least concern (LC) species in the IUCN Red List (Figure 3).

3.4. Migratory Status

The majority of the recorded bird population was composed of resident species. The results showed that 75.60% ($n = 31$) of the birds were residents, 21.95% ($n = 9$) were summer breeders, and 2.43% of the species ($n = 1$) were winter visitors.

3.5. Feeding Habits

The plurality of the birds was Insectivores ($n = 17$), while the other species were Omnivores ($n = 9$), Carnivores ($n = 6$), Frugivores ($n = 2$), Granivores ($n = 2$), Piscivores ($n = 2$), Scavengers ($n = 2$), and Nectarivores ($n = 1$).

Table 1. Description of survey sites in the study area.

Sr.	Survey site	Coordinates		Type of survey site	Elevation (ft)
		East	North		
1	Islam Colony	30.3499954	73.39516274	Urban	589
2	Kani Pur	30.40291184	73.51485369	Agri-Rural	652
3	Farid Kot	30.37803027	73.54669148	Rural	665
4	Bunga Niaz Khan	30.18991728	73.45135166	Rural	612
5	Arif Abad	30.33394439	73.34321385	Rural	561
6	Malik Bahawal	30.28630302	73.43802034	Agri-Rural Forest	605
7	Chak 25 SP	30.43691107	73.40485532	Agri-Rural Forest	592
8	Noor Pur	30.4935406	73.24532649	Agri-Rural Forest	552
9	Green Town	30.3615754	73.37732928	Urban	570
10	Bonga Hayat	30.49568629	73.52083014	Agri-Rural	633

Table 2. The various Diversity indices used in the study and their formulae and outcome values.

Sr	Index	Formula	Value
1	Shannon Wiener Diversity Index	$H' = -\sum[(p_i) * \log(p_i)]$	3.41853844
2	Species Evenness Index	$E = H'/\ln S$	0.453317773
3	Margalef's Index	$IMargalef = (S - 1)/\ln N$	5.30422906
4	Simpson's Dominance Index	$D_{simpson} = \frac{\sum n(n-1)}{N(N-p)}$	0.039808635
5	Simpson's Diversity Index	$I_{simpson} = 1 - D_{simpson}$	0.960191365

Table 3. Detailed description of the avifauna observed in Tehsil Pakpattan.

Sr.	Common name	Scientific name	Order	Family	Description	IUCN Status	Feeding habits	N
1	Asian Green bee-eater	<i>Merops orientalis</i> (Latham, 1801)	Coraciiformes	Meropidae	Resident	Least Concern	Insectivores	100
2	Zitting Cisticola	<i>Sylvia juncidis</i> (Rafinesque, 1810)	Passeriformes	Cisticolidae	Summer breeder	Least Concern	Insectivores	20
3	Common myna	<i>Acridotheres tristis</i> (Linnaeus, 1766)	Passeriformes	Sturnidae	Resident	Least Concern	Omnivores	70
4	House crow	<i>Corvus splendens</i> (Vieillot, 1817)	Passeriformes	Corvidae	Resident	Least Concern	Scavenger	150
5	Indian roller	<i>Coracias benghalensis</i> (Linnaeus, 1758)	Coraciiformes	Coraciidae	Resident	Least Concern	Carnivores	10
6	Cattle egret	<i>Bubulcus ibis</i> (Linnaeus, 1758)	Pelecaniformes	Ardeidae	Resident	Least Concern	Insectivores	160
7	Red-vented bulbul	<i>Pycnonotus cafer</i> (Linnaeus, 1766)	Passeriformes	Pycnonotidae	Resident	Least Concern	Omnivores	70
8	Rufous treepie	<i>Dendrocitta vagabunda</i> (Latham, 1790)	Passeriformes	Corvidae	Resident	Least Concern	Omnivores	25
9	Black drongo	<i>Dicrurus macrocerus</i> (Vieillot, 1817)	Passeriformes	Dicruridae	Resident	Least Concern	Insectivores	27
10	Barn swallow	<i>Hirundo rustica</i> (Linnaeus, 1758)	Passeriformes	Hirundinidae	Summer breeder	Least Concern	Insectivores	50
11	White-throated kingfisher	<i>Halcyon smyrnensis</i> (Linnaeus, 1758)	Coraciiformes	Alcedinidae	Resident	Least Concern	Piscivores	16
12	Red-wattled lapwing	<i>Vanellus indicus</i> (Boddaert, 1783)	Charadriiformes	Charadriidae	Resident	Least Concern	Insectivores	75
13	Greater Coucal	<i>Centropus sinensis</i> (Stephens, 1815)	Cuculiformes	Cuculidae	Resident	Least Concern	Insectivores	23
14	House sparrow	<i>Passer domesticus</i> (Linnaeus, 1758)	Passeriformes	Passeridae	Resident	Least Concern	Omnivores	90
15	Eurasian Hoopoe	<i>Upupa epops</i> (Linnaeus, 1758)	Bucerotiformes	Upupidae	Resident	Least Concern	Insectivores	36
16	Coppersmith barbet	<i>Megalaima hamecephala</i> (P. L. S. Müller, 1776)	Piciformes	Megalaimidae	Summer breeder	Least Concern	Frugivores	20
17	Asian Koel	<i>Eudynamis scolopacea</i> (Linnaeus, 1758)	Cuculiformes	Cuculidae	Resident	Least Concern	Omnivores	30
18	Common Tailorbird	<i>Orthotomus sutorius</i> (Pennant, 1769)	Passeriformes	Cisticolidae	Resident	Least Concern	Insectivores	45
19	Black-rumped Flameback	<i>Dinopium benghalense</i> (Linnaeus, 1758)	Piciformes	Picidae	Resident	Least Concern	Insectivores	21
20	Jungle babbler	<i>Turdoides striata</i> (Dumont, 1823)	Passeriformes	Leiothrichidae	Resident	Least Concern	Insectivores	64
21	Brown Rock Chat	<i>Oenanthe fusca</i> (Blyth, 1851)	Passeriformes	Muscicapidae	Resident	Least Concern	Insectivores	98
22	Oriental Magpie-Robin	<i>Copsychus saularis</i> (Linnaeus, 1758)	Passeriformes	Muscicapidae	Resident	Least Concern	Carnivores	56
23	Baya Weaver	<i>Ploceus philippinus</i> (Linnaeus, 1766)	Passeriformes	Ploceidae	Resident	Least Concern	Omnivores	42
24	Rock Pigeon	<i>Columba livia</i> (J. F. Gmelin, 1789)	Columbiformes	Columbidae	Resident	Least Concern	Omnivores	100
25	Painted Stork	<i>Mycteria leucocephala</i> (Pennant, 1769)	Ciconiiformes	Ciconiidae	Resident	Near Threatened	Piscivores	7
26	Spotted Owlet	<i>Athene brama</i> (Temminck, 1821)	Strigiformes	Strigidae	Summer breeder	Least Concern	Carnivores	26
27	White Wagtail	<i>Motacilla alba</i> (Linnaeus, 1758)	Passeriformes	Motacillidae	Summer breeder	Least Concern	Insectivores	60
28	Black-winged Stilt	<i>Himantopus himantopus</i> (Linnaeus, 1758)	Charadriiformes	Recurvirostridae	Resident	Least Concern	Omnivores	20
29	Black Kite	<i>Milvus migrans</i> (Boddaert, 1783)	Accipitriformes	Accipitridae	Resident	Least Concern	Scavenger	38
30	Purple Sunbird	<i>Cinnyris asiaticus</i> (Latham, 1790)	Passeriformes	Nectariniidae	Summer breeder	Least Concern	Nectarivores	12
31	Common Starling	<i>Sturnus vulgaris</i> (Linnaeus, 1758)	Passeriformes	Sturnidae	Winter	Least Concern	Omnivores	19

Sr.	Common name	Scientific name	Order	Family	Description	IUCN Status	Feeding habits	N
32	Indian Robin	1758) <i>Copsychus fulicatus</i> (Linnaeus, 1766)	Passeriformes	Muscicapidae	Resident	Least Concern	Carnivores	65
33	Laughing Dove	<i>Spilopelia senegalensis</i> (Linnaeus, 1766)	Columbiformes	Columbidae	Resident	Least Concern	Granivores	60
34	Gray Francolin	<i>Ortygornis pondicerianus</i> (J. F. Gmelin, 1789)	Galliformes	Phasianidae	Resident	Least Concern	Insectivores	10
35	Wire-tailed Swallow	<i>Hirundo smithii</i> (Leach & K. D. Koenig, 1818)	Passeriformes	Hirundinidae	Summer breeder	Least Concern	Insectivores	80
36	Indian Golden Oriole	<i>Oriolus kundo</i> (Sykes, 1832)	Passeriformes	Oriolidae	Summer breeder	Least Concern	Frugivores	15
37	Red throated bee-eater	<i>Merops bulocki</i> (Vieillot, 1817)	Coraciiformes	Meropidae	Resident	Least Concern	Insectivores	30
38	Yellow-eyed pigeon	<i>Columba eversmanni</i> (Bonaparte, 1856)	Columbiformes	Columbidae	Resident	Vulnerable	Granivores	5
39	Black-tailed Godwit	<i>Limosa limosa</i> (Linnaeus, 1758)	Charadriiformes	Scolopacidae	Resident	Near Threatened	Carnivores	12
40	River tern	<i>Sterna aurantia</i> (J. E. Gray, 1831)	Charadriiformes	Laridae	Resident	Vulnerable	Carnivores	10
41	Common Quail	<i>Coturnix coturnix</i> (Linnaeus, 1758)	Galliformes	Phasianidae	Summer breeder	Least Concern	Insectivores	17

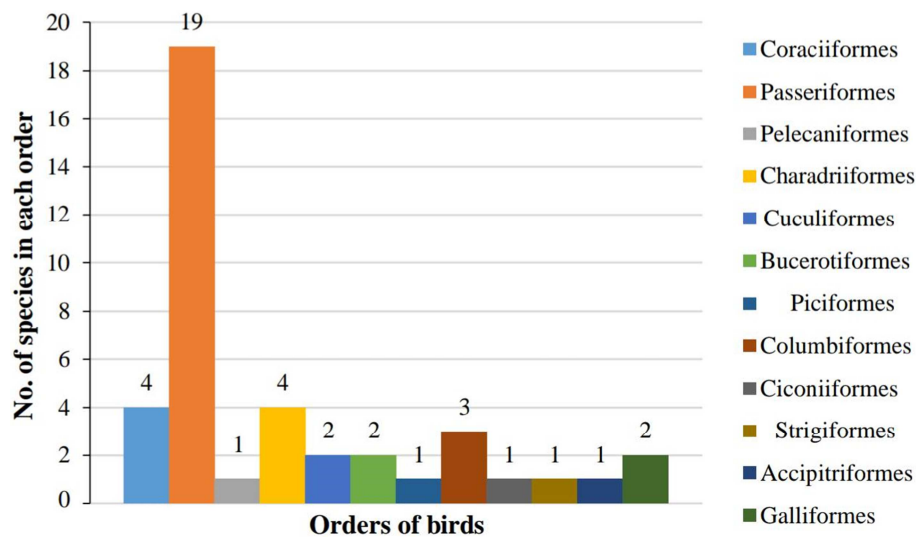


Figure 1. Species diversity among various orders exhibiting bird species in each order.

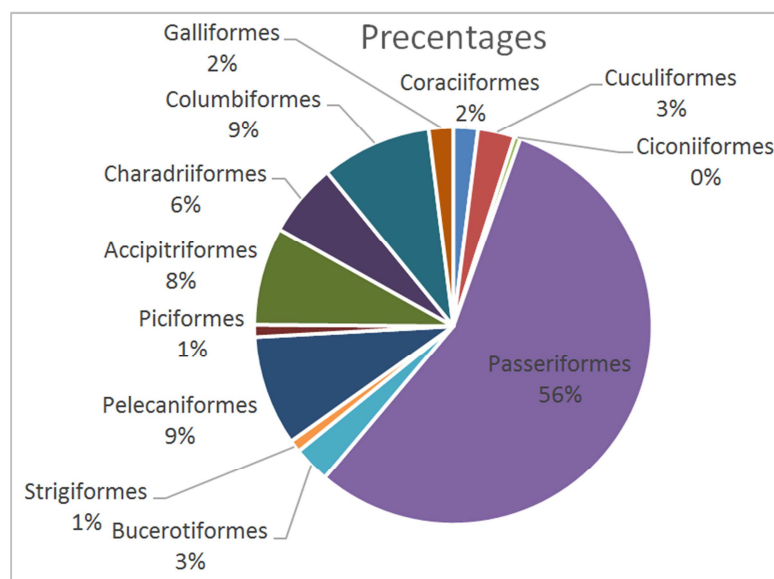


Figure 2. Percentages of individual birds of different orders.

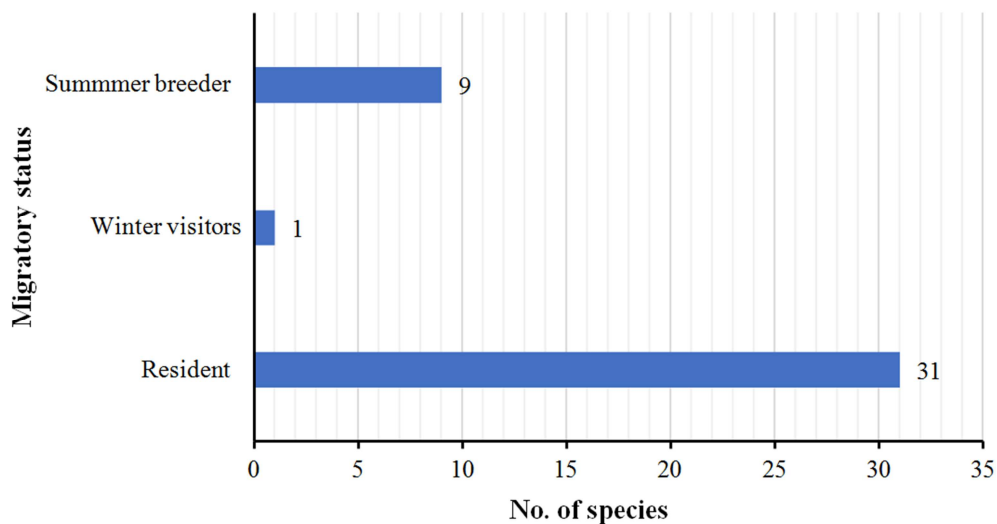


Figure 3. Migratory status of the ornithofauna indicating the abundance of summer breeders, winter visitors, and resident species.

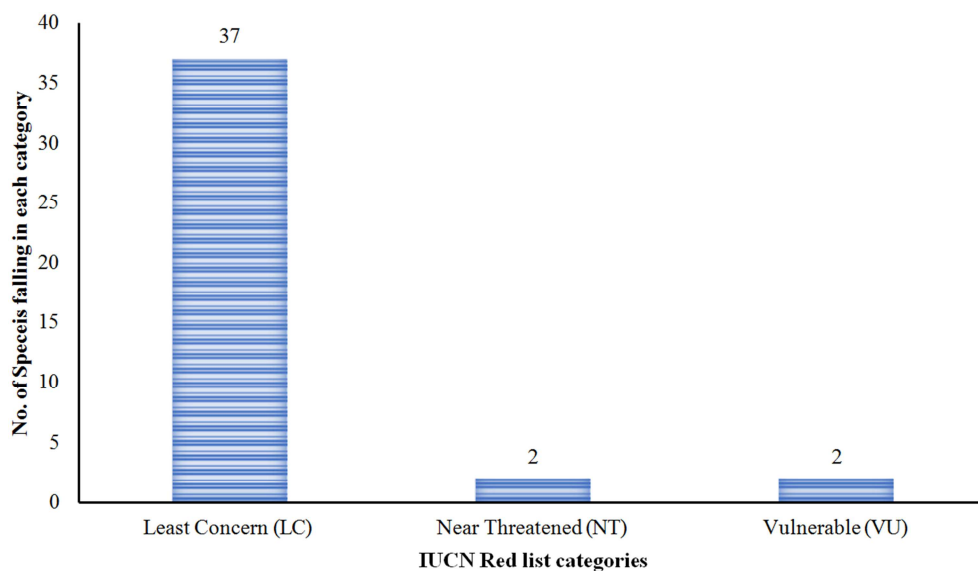


Figure 4. Distribution of the avifauna according to their International Union for International Oncology (IUCN) Red List status.

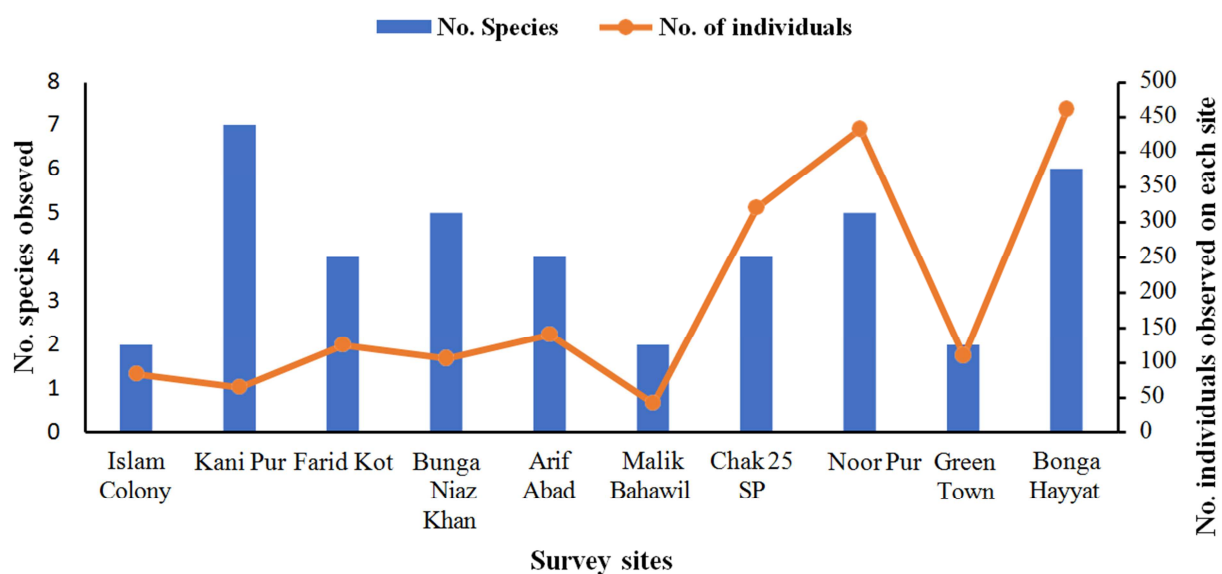


Figure 5. Relative number of species and individuals observed at each survey site.

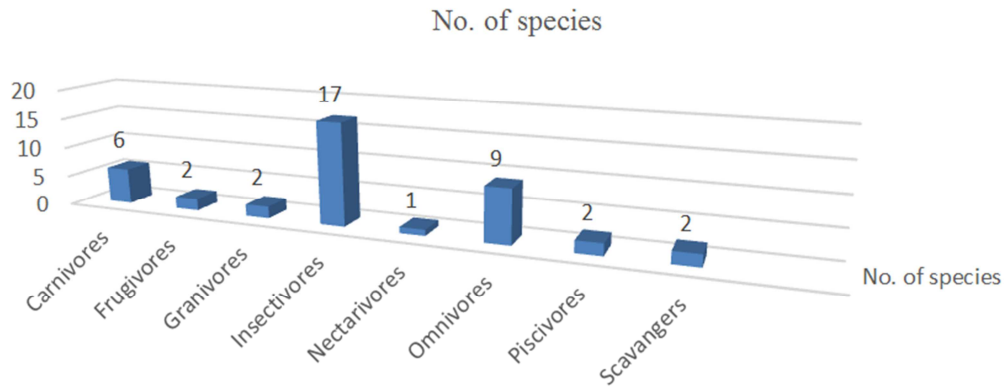


Figure 6. Feeding habits of different bird species.

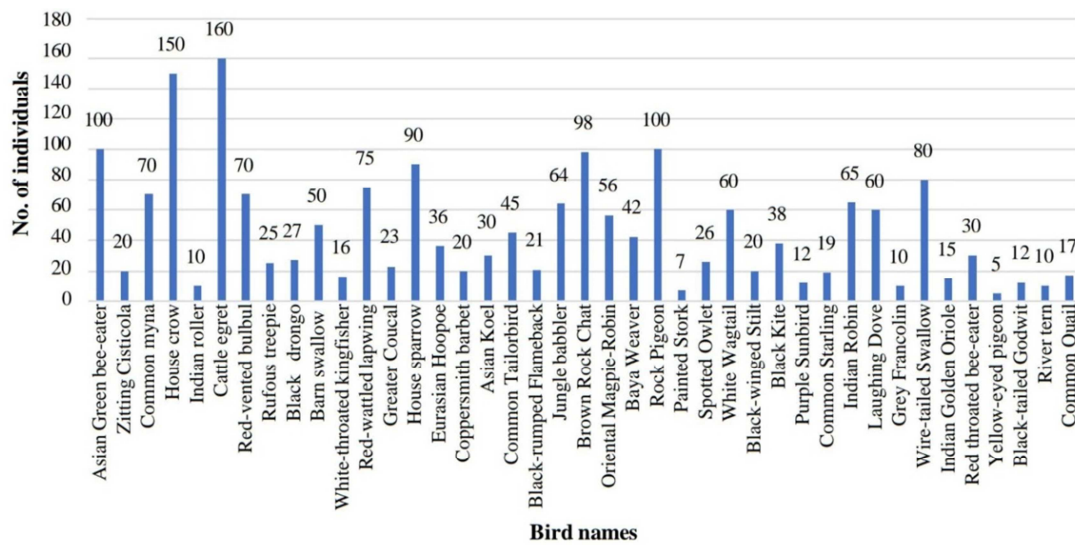


Figure 7. Species wise distribution of individuals.

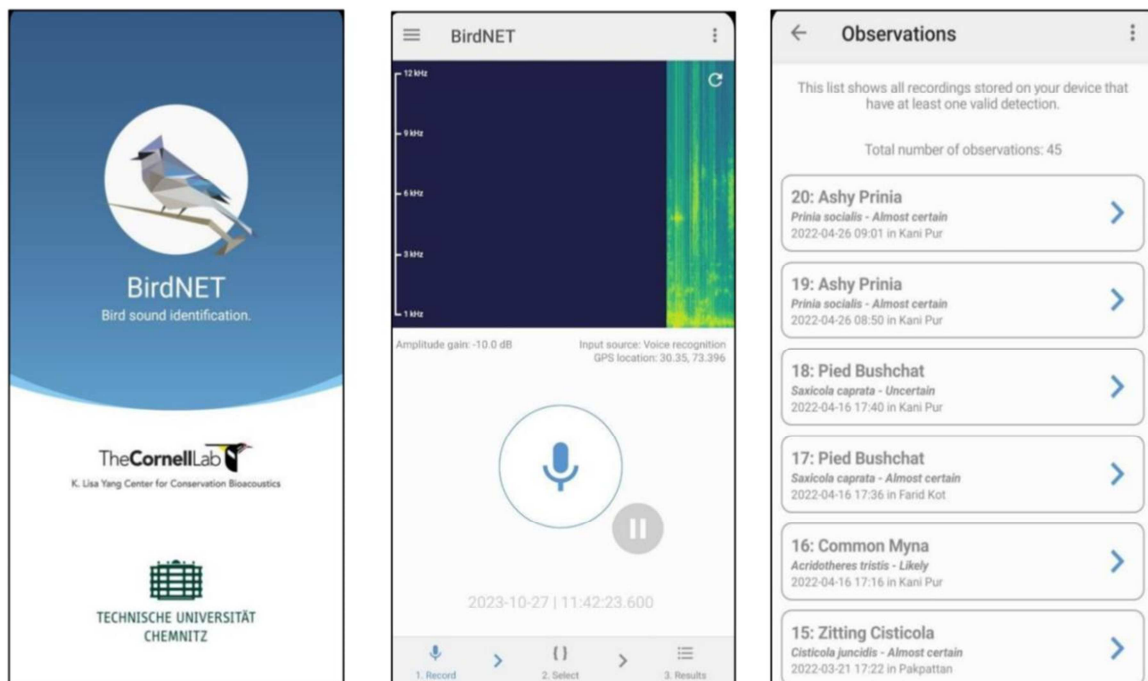


Figure 8. Interference of BirdNET mobile application for sound capture for the identification of birds.

4. Discussion

Pakistan has high avifaunal diversity. Birds are regarded as valuable environmental indicators and help us recognize preeminent zones for conservation. Protection efforts are aided by metrics such as those of the current species distribution, historical distribution evidence, and degree of threat to the species [9]. Birds are crucial for the continuance of ecological cycles, especially in the trophic hierarchies of food chains [10]. The current study was designed to obtain insight into the species diversity, IUCN Red List status, feeding types, and migratory behavior of the ornithofaunal populations of Tehsil Pakpattan, Punjab, Pakistan. No survey has been conducted for the appraisal of bird diversity in this region. A total of 1884 birds were observed to belong to 41 species, 30 families, and 12 orders of Class Aves. A significant proportion (55.15%) of the bird population belonged to the order Passeriformes, making it the most diverse group among all the other groups; these findings are consistent with previous findings from the adjacent areas of the study zone as well as from other areas of the country [1, 11, 12]. For the quantitative analysis of diversity, various diversity indices were applied, including the Shannon–Wiener Diversity Index ($R' = 3.41853$), the species evenness index, Simpson's dominance index ($I_{\text{simpson}} = 0.039808$), Simpson's dominance index ($D_{\text{simpson}} = 0.03980$), and Margalef's index ($I_{\text{Margalef}} = 5.30422$), all of which strongly suggested the presence of a rich avifaunal population in Tehsil Pakpattan. The majority of survey sites are situated in agri-farming and countryside settings, which is why predominantly bird species are insectivores and omnivores relying on grains and other herbaceous and carnivorous feed sources. The nutritional habits of the bird species suggested that the bird population predominantly feeds on small insects and other arthropods, viz. Insectivores. The observed population was dominated by resident avifauna, as 75.60% ($n = 31$) of the birds were residents, 21.95% ($n = 9$) were summer breeders, and 2.43% ($n = 1$) were winter visitors. As the study site included a region with low industrial and urbanization activity, the results regarding the threat level status indicated that the majority of the bird population (90.24%, $N = 37$) belonged to the least concerning (LC) category, 2 (4.87%) species were classified in the near threatened (NT) category, and 2 (4.87%) were classified in the vulnerable (VU) category of the Red List of the International Union of Conservation of Nature (IUCN). The findings of our study also confirmed that the conservation status of the avifauna of Tehsil Pakpattan was satisfactory and that there was no sign of environmental pressure driving population decline. Moreover, the highest numbers of individual birds and species were observed for $N = 460$ birds and $N = 7$ birds at Bonga Hayat and Kanipur, respectively. The site where the lowest number of birds was observed was Bhaiwal ($n = 2$), while the lowest number of species sighted was $N = 2$ at Islam Colony, Malik Bhaiwal, and Green Town. The lowest species diversity and bird abundance in these

areas strongly suggested that anthropogenic activities in urban areas are collectively affecting avifauna due to land use, environmental pollution, and habitat loss [13, 18]. Moreover, the availability of plenty of dietary resources, habitat suitability, a lower degree of urbanization, and natural habitat exploitation in the other parts of the study area provide a secure and flourishing habitat for bird populations and result in a rich ornithofaunal glimpse in the study area [7].

5. Conclusion

The study concluded that the area of tehsil Pakpattan has rich avifaunal diversity. A large number of ($n = 41$) species is an unambiguous sign of a healthy and least exploited habitat. The urban vicinities in the study area had the lowest proportion of birds, indicating a trend toward no ecofriendly anthropogenic activities in the urban setting, causing the dwindling of avifauna in the region. Overall, the study suggested that the study area is a healthy, less exploited, and stable habitat for the flourishing of bird populations. Furthermore, efforts should be made to increase awareness of messes through well-organized strategies through effective channels such as social media, mass media, and publicity campaigns for the dispersal of information in rural areas regarding the protection and conservation of avifauna to mitigate the loss of avian diversity in defiance of upcoming environmental challenges in the future.

ORCID

0009-0007-4943-4108

Declarations

Data Availability

All the data described in this research paper in tables and figures because it is a real time data.

Author Contribution

Total research carried by the single author Muhammad Amir Sial, in this paper there is no another author is present.

Ethical Responsibilities of Authors

Author has read, understood, and have complied as applicable with the statement on "Ethical responsibilities of Author" as found in the Instructions for Authors.

Acknowledgments

The author is delighted to acknowledge the Muhammad Zohaib Kamboh and Muhammad Danish Latif, Department of Wildlife and Ecology, University of Veterinary and Animal Sciences, Lahore, Pakistan, for their continuous support during this study.

Conflicts of Interest

The authors declare no conflicts of interest.

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