

Population Dynamics of Avian Diversity in the District Okara, Pakistan

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Abstract: Pakistan has a varied bird fauna, with over 790 species recorded and their distribution in three zoogeographical zones (Oriental, Palearctic, and Ethiopian), which is exceptional in the world. The data on avian diversity and abundance in the district Okara, Punjab was carried out from January 2022 to January 2023. Data were collected by direct, indirect, and flocks count methods on four transect points used in the study by visiting the field and by interviewing the local people and hunters about the current and past status of the avian fauna of the area. Okara district contains a major wetland for both local and international migratory birds, including falcons, gulls, plovers, snipes, waders, and long-distance migrating birds. A total of 201 avian species of 19 orders and 54 families were recorded. These included 54 winter migrant species, 23 summer migrants, 13 passage migrants, 1 year-round visitor, and 110 resident species. The spotting of seven globally threatened species and three vulnerable also highlights the importance of this area for avian species. A total of 80 species were recorded in the Passeriformes order. The Shannon-Weiner diversity index showed that Transect Point 1 ($H' = 4.906$) had the largest diversity of birds, followed by Transect Points 2, 3, and 4, i.e., 4.778, 4.672, and 4.679. Species evenness has varied among transects based on diversity, with values of 0.7266 (TP 1), 0.6719 (TP 2), 0.7082 (TP 3), and 0.7226 (TP 4). The Simpson index (1-D) for Transect Points 1, 2, 3, and 4 was 0.991, 0.9872, 0.9883, and 0.9888, indicating that Transect Points 1 and 2 had the maximum bird species diversity. The findings revealed that the Okara district is home to a large number of resident migratory and endangered bird species. As a result, it is critical to conserving its habitat as well as bird variety by overcoming serious challenges.

Keywords: Avian, Population, Diversity, Indices

1. Introduction

Birds are among the most fascinating living creatures on the earth. Because of their naturally stunning feathers, enchanting melodies, and creative behavior, birds have always attracted humans [1]. Any of the more than 10,906 extant species that are unique in possessing feathers are considered birds (class Aves) [2]. Birds are particularly sensitive to environmental conditions and are utilized as bio indicators, so due to their great mobility, birds respond very quickly to changes in their surroundings [3]. However, as a result of some harsh climatic conditions and many

anthropogenic activities, bird diversity has been diminishing worldwide in recent years [4]. According to Birdlife International (2015), 1375 bird species are endangered with extinction worldwide, with 84 species from the Indian subcontinent [4].

Pakistan has a varied bird fauna, with over 790 species recorded and their distribution in three zoogeographical zones (Oriental, Palearctic, and Ethiopian areas) is exceptional in the world [5]. Thousands of birds migrate from various countries to Pakistan. There are seven fly zones in the globe, with one (Indus flyway) in Pakistan [6]. The Indus flyway offers food and refuge for millions of migratory

and resident birds [7]. Okara is a district of Pakistan that is served by two rivers (Ravi river and Sutlej) and various canals are also found in this district [8]. This area is well-known for its rich plains, serene surroundings, and verdant fields of crops including potatoes, tomatoes, sugarcane, wheat, rice, and maize [9]. Orchards for oranges and mangoes are prevalent. District Okara is a treasure trove for those who are interested in history, religion, and spirituality [10].

For a wide variety of birds, these habitats offer crucial wintering, staging, and breeding grounds [11]. The variety and quantity of birds are influenced by environmental factors such as food availability, water quality, wintering areas, and breeding grounds [12]. District Okara's land is an ideal environment for a variety of animals and plants, including birds, mammals, amphibians, fish, reptiles, and plants [13]. The diversity and number of species are both important aspects of strengthening the environment. Evolutionary, historical, and environmental factors all contribute to patterns of bird diversity and composition [14]. The assessment of bird communities has become an important tool in biodiversity conservation and in determining conservation actions for high-human-pressure areas [14]. Monitoring the abundance of bird species, on the other hand, gives essential information that is frequently utilized in bird conservation and the management of vulnerable and endangered species [15]. Furthermore, seasonal bird monitoring is critical for detecting variable bird migration in specific habitats [16].

The district Okara gives useful information on biodiversity and economic values. This data may be used to build regulations and conservation plans [17]. Birds are great environmental indicators, assisting us in locating significant locations and providing a helpful measure of how effectively the country's ecosystems give advantages to humans [18]. Thus, ornithological study and monitoring of district Okara biodiversity are critical ecological instruments that give vital information for sustainable ecosystems and climate change globally [19]. Okara district is an industrial area so waste from industries pollutes the environment which affects the avian diversity [20]. It is very important to protect the fauna of the Okara district of Pakistan, otherwise, the environment may deteriorate due to the negligence of the authorities of the Okara district [21]. A major source of the degradation of the natural environment for bird species is the transition from rural to urban areas [22]. Lack of vegetation and tree cutting allow pollution levels to increase, which affects the bird's diversity and other living creatures [23]. Due to habitat destruction and human activity, bird diversity has been declining. This study was arranged to examine the species variety and the number of wild birds in the Okara district, Pakistan [24]. No researcher has before investigated the avifauna of the district Okara. So the main focus of the study was to identify current bird diversity, major threats, and

threatened bird species [25]. This information on the species composition, variety, and richness of native and migratory birds is scarce. As a result, the current study is an attempt to investigate the current state and variety of the bird fauna in this area [26].

2. Materials and Methods

2.1. Study Area

In Pakistan's Punjab province, the district Okara has located between 30°48'4.968" North latitude and 73°26'54.0024" East longitude, at an elevation of 105 m. (344ft). The area of district Okara, Pakistan is 4,377 km sq (1,690 sq mi). The weather in Okara is often mild and dry. The coldest months are December through February when moderate rains and low temperatures can reach 3 °C (37 °F). May through July are the warmest months, with highs of up to 45 °C (113 °F). Before 1982, it was a part of Sahiwal District until becoming a distinct district. This district's name, "Okara," really derives from the word "Okan" (a lush green tree with needle-like leaves). The phrase Okanwala (Country of Okan), which eventually became Okara, was born from the tree Okan. Boundaries of the Okara District are shared with Bahawalnagar to the south, Pakpattan to the south-west, Sahiwal to the west, the Okara of Faisalabad and Nankana Sahib to the north, Kasur to the near-east and far-east, and Fazilka to the south-east (India). The Indian-Pakistani border's Radcliffe Line passes through the Okara District. The Sutlej River lies to the east, and the River Ravi is 100 kilometers to the west. With a total size of 6671 acres and high biodiversity, the Pipli Pahar forest is the most significant region in the Okara district.

2.2. Methods

The data on avian diversity was carried out from January 2022 to January 2023. Various field techniques were used at Four transect points throughout the survey [27]. These techniques may be generally divided into two groups: 1) direct field observations and 2) indirect observations based on information from the locals. Point transect sampling was used to count and identify all birds heard and seen, as well as in flight [28]. Four transect points were set to explore the diversity and abundance of birds (see Table 1). These transects' locations were chosen to include all types of habitats in this area (see the figure 1). The data collection was done from 6:30 am to 10:00 am (morning) and 5:00 pm to 7:30 pm (evening) from May–September and between 8:30 am to 11:00 am (morning) and 3:00 pm to 5:00 pm (evening) in October–April. Some survey was not conducted during poor weather or the rainy season [29].

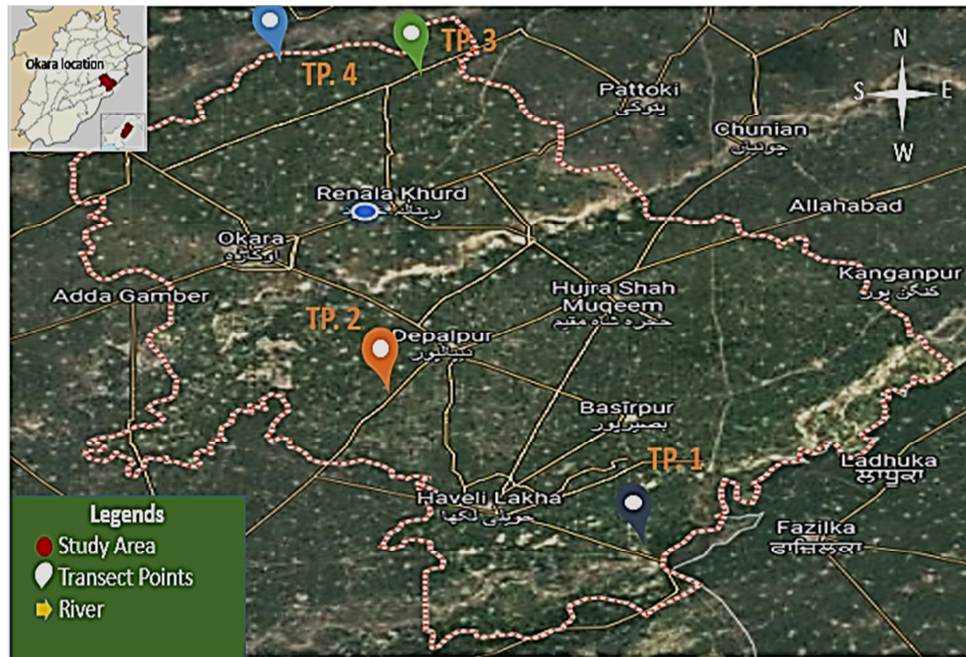


Figure 1. Map showing location of district Okara, site and selected study sites for analyzing avian species.

Table 1. Details of transects selected to check the avian fauna of the district Okara site.

Transect Name	Coordinates	Description
TP.1	30.37896 N 73.86423 E	Head sulemanki, indo pak belt line, Sutlej river.
TP.2	31.07209 N 73.44568 E	Jndraka wetland area, River ravi, cultivated area.
TP.3	30.63783 N 73.48055 E	Pipli pahar, forest area, Cultivated areas, vegetables, land.
TP.4	31.05906 N 73.62029 E	Chuchak, cultivated area.

2.3. Direct Count Method

This is the most diverse method used to measure species diversity and abundance. All the surveys were done on foot. Binoculars of Nikon, 30 × 100 were used to watch the birds [30]. The coordinates of transects and the location of species were recorded using a GPS map. The bird's photos were captured using a camera Nikon D3400 (70- 300 mm lens). Field guides were used to recognize the birds. With the use of field guides, the condition of resident, migratory, terrestrial, and aquatic birds was evaluated.

2.4. Flocks Count Method

The abundance was calculated using this method when the birds were gathered in big flocks. A block of birds within a flock was counted or evaluated by using this technique [31]. Depending on the flock size, there were 15, 20, 25, 30, 50, or 100 birds in the flock.

2.5. Statistical Analysis

PAST version 2.17C software was used to assess diversity indices from all of the acquired fieldwork data of birds (Shannon, Simpson, Margalef, Dominance, and Evenness).

From January 2022 to January 2023, the maximum population was counted each month and transect.

3. Results

3.1. Bird Monitoring Frequency

From January 2022 to January 2023, 113 surveys were completed to track the diversity and abundance of birds along four transects. The maximum number of surveys (14) was carried out in July, and the least number (6) in December. The four research sites were chosen to assess bird abundance; the highest number of surveys (56) were conducted at Transect Points 1 and 2, while the lowest number (31) was at Transect Point 4. The research sites were checked under the weekly plan. Because of the weather, certain surveys under the fieldwork plan were not carried out.

3.2. Bird Species Composition

From January 2022 to January 2023, 201 bird species from 54 families and 19 orders were identified. The most diverse Order is the Passeriformes (show in figure 3), which include 80 species across 26 families. followed by Charadriiformes, which include 29 species across 7 families, Accipitriformes (20 species across 1 family), Anseriformes (18 species across 1 family), Pelecaniformes (14 species across 2 families), Coraciiformes (8 species across 3 families), Piciformes (2 species across 1 family), Suliformes (2 species from single-family), Columbiformes (6 species from 1 family), Cuculiformes (4 species from 1 family), Strigiformes (3 species from 1 family), Gruiformes (2 species from 1 family), Galliformes (3 species from 1 family), Psittaciformes, Pterocliiformes, Falcaniformes and Ciconiiformes (one species from single-family), Apodiformes (4 species from 1

family), Bucerotiformes (2 species from two families).

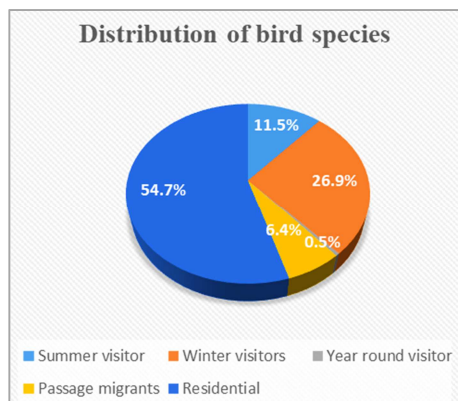


Figure 2. Percentage composition of species occurring according to seasonal distribution status.

The largest number of species are found in the families Accipitridae, Anatidae, Scolopacidae, Ardeidae, and Muscicapidae (20, 18, 15, 10, 10). Family Upupidae,

Psittaculidae, Bucerotidae, Nectariniidae, Rostratulidae, Jacanidae, Pteroclididae, have a low number of species. The species with the highest population during the study period included the house sparrow (*Passer domesticus*), common myna (*Acridotheres tristis*), common starling (*Sturnus vulgaris*), black-winged stilt (*Himantopus himantopus*), cattle egret (*Bubulcus ibis*), black kite (*Milvus migrans*), and Indian roller (*Coracias benghalensis*). Throughout the research period, a few species were only documented once in a single month, and a few uncommon (rare in number) species were also recorded. During the study, the following species were only seen once: the rosy starling (*Pastor roseus*), painted stork (*Mycteria leucocephala*), red-whiskered bulbul (*Pycnonotus jocosus*), glossy ibis (*Plegadis falcinellus*), short-toed snake eagle (*Circus gallicus*), and eastern imperial eagle (*Aquila heliaca*). Out of the total avian species, 54.7% species were residents, 6.4% were passage migrants, 26.8% winter visitors, 11.4% summer visitor and 0.4% year round visitors (see the figure no. 2).

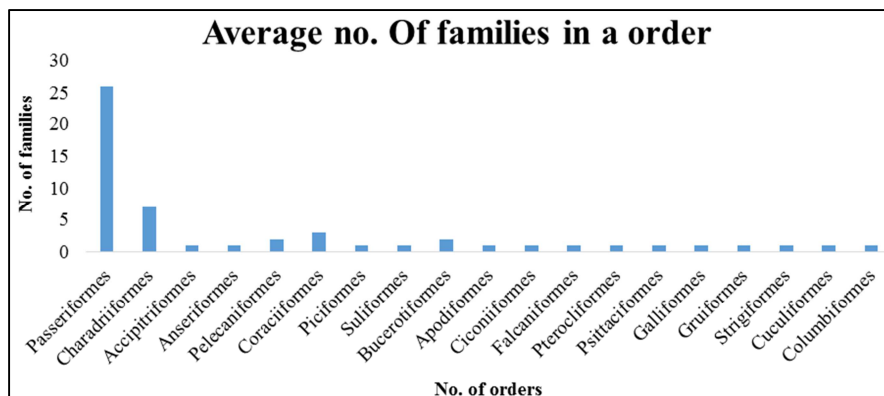


Figure 3. Passeriformes order shows the maximum number of families as compared to others.

3.3. Avian Diversity

Monthly average of avian population showing the maximum values at Transect Points 1 and 2 (see the figure 4) other than 3 and 4. The Shannon-Weiner diversity index showed that Transect Point 1 ($H' = 4.906$) had the largest diversity of birds, followed by Transect Points 2, 3, and 1,

i.e., 4.778, 4.672, and 4.679. Species evenness has varied among transects based on diversity, with values of 0.7266 (TP 1), 0.6719 (TP 2), 0.7082 (TP 3), and 0.7226, (TP 4). The Simpson index (1-D) for Transect Points 1, 2, 3, and 4 was 0.991, 0.9872, 0.9883, and 0.9888, indicating that Transect Points 1 and 2 had the maximum bird species diversity (see the table 2).

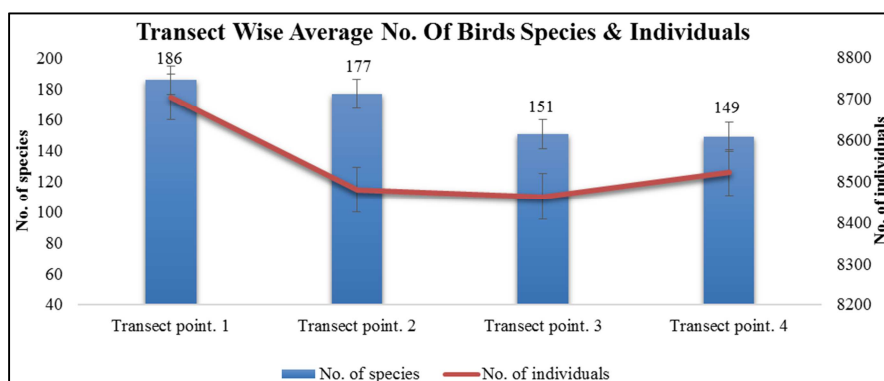


Figure 4. Monthly average of avian population showing the maximum values at Transect Points 1 and 2 observed from January 2022 to January 2023.

Table 2. Transect-wise diversity indices of avian species from January 2022 to January 2023.

Diversity indices	Transect point 1	Transect point 2	Transect point 3	Transect point 4	Total
No. of species	186	177	151	149	201
Individuals	8703	8479	8463	8521	34166
Dominance_D	0.009034	0.01278	0.0117	0.01123	0.009579
Simpson_1-D	0.991	0.9872	0.9883	0.9888	0.9904
Shannon_H	4.906	4.778	4.672	4.679	4.897
Evenness_e^H/	0.7266	0.6719	0.7082	0.7226	0.6659
Brillouin	4.851	4.724	4.625	4.633	4.878
Menhinick	1.994	1.922	1.641	1.614	1.087
Margalef	20.39	19.46	16.59	16.35	19.16
Equitability_J	0.9389	0.9232	0.9312	0.9351	0.9233
Fisher_alpha	33.42	31.64	26.1	25.65	28.33
Berger-Parker	0.02643	0.06274	0.03155	0.03427	0.03026
Chao-1	187.7	178.5	154.3	152.8	201

3.4. Globally Threatened Species

Throughout the study area, 201 bird species were observed, including 191 Least Concern and 3 Vulnerable species, as well as 7 near threatened species (Table 3). According to the IUCN Red List 2021-3, seven species are considered near threatened (NT): Red-necked falcon (*Falco chicquera*), Painted stork (*Mycteria leucocephala*), Black-tailed godwit (*Limosa limosa*), Eurasian curlew (*Numenius arquata*), Indian river tern (*Sterna aurantia*), European roller (*Coracias garrulus*), Ferruginous pochard or white-eyed pochard (*Aythya nyroca*). Vulnerable species were the Yellow-eyed pigeon (*Columba eversmanni*), White-breasted bush chat (*Saxicola insignis*), and Eastern imperial eagle (*Aquila heliaca*).

Table 3. List of globally threatened species recorded from January 2022 to January 2023.

Sr. #	Common name	Scientific name	IUCN status
1	Red-necked falcon	<i>Falco chicquera</i>	NT
2	Painted stork	<i>Mycteria leucocephala</i>	NT
3	Black-tailed godwit	<i>Limosa limosa</i>	NT
4	Eurasian curlew	<i>Numenius arquata</i>	NT
5	Indian river tern	<i>Sterna aurantia</i>	NT
6	European roller	<i>Coracias garrulus</i>	NT
7	white-eyed pochard	<i>Aythya nyroca</i>	NT
8	Yellow-eyed pigeon	<i>Columba eversmanni</i>	VU
9	White browed bushchat	<i>Saxicola insignis</i>	VU
10	Eastern imperial eagle	<i>Aquila heliaca</i>	VU

4. Discussion

The purpose of this research was to track the variety and number of birds in the district Okara, Pakistan. The major determinants of variance in the bird population may be somewhat more related to food availability, feeding, and habitats than any other threat [32]. According to the results of our study, the richness and dispersion of the local bird fauna depend significantly on the availability of food and habitat. The vegetation of the study area was rich and the study area had a rich avian fauna due to dense vegetation. A total of 201 bird species from 54 families and 19 orders were identified as part of the current study. They comprised 1 year-round

visitor, 1 year-round resident, 54 winter migratory species, 23 summer migrant species, 13 passage migrants, and 110 resident species. The research area's biodiversity monitoring offers useful data on species diversity, wetland conditions, and economic significance. Wetland conservation plans and policies may be created using this data [33].

The birds are actively hunted and caught in Pakistan, where they are native, which may be causing local populations to decline, but the condition of the species as a whole is thought to remain stable [34]. There are seven fly zones worldwide, and Pakistan is home to one of them (the Indus fly zone). The birds travel via the Hindu Kush, the Sulaiman Mountains, and Karakorum before landing in Pakistan near the Indus River. In the host nation, migrating birds such as falcons, cranes, swans, ducks, flamingos, waders, and geese are significant. Hence, the migratory birds that were observed in our research region were Mallard, Gadwall, Eurasian widgeon, Eurasian teal or common teal, Northern pintail, Northern shoveler, Indian spot-billed duck, Garganey, Indian whistling duck or lesser whistling teal, Greylag goose, Bar-headed goose, Red-crested pochard, Common pochard, Ferruginous pochard or white-eyed pochard, Common shelduck, Ruddy shelduck, Tufted duck, Cotton pygmy goose, Chestnut-bellied sandgrouse or common sandgrouse which were primary winter visitor. Common winter visitors to the district Okara, Pakistan are the Common Sandpiper, Common Greenshank, Wood Sandpiper, Green Sandpiper, and Marsh Sandpiper. Common redstarts were the regular and regional migrants. Red turtle dove, Common reed warbler, Eurasian golden oriole, Common redstart, Richard's pipit, Rock sparrow, Common house martin, Siberian stonechat, Asian barred owl, Eurasian sparrowhawk, Hen harrier, Grey heron, Common swift, Red-necked falcon were the summer visitor. Resident species in our study were House crow, house sparrow, Jungle babbler, Eurasian tree sparrow, Jungle prinia, Common redstart, White-winged lark, Indian golden oriole, Streaked weaver, Ashy-crowned sparrow-lark, Common wood shrike, Blunt-winged warbler, Yellow-eyed babbler, Afghan babbler, Common babbler, Russet sparrow.

The Grey Francolin (*Francolinus pondicerianus*) is a bird that is frequently connected to the drier areas of the Indus plains. The Grey Francolin was widespread throughout our investigation. The year-round visitor of the study region is

the rosy starling. Great grey shrike, Long-tailed bush warbler, Little bittern, Black-crowned night heron, Black-tailed Isabelline shrike, Common grasshopper warbler, Rufous-breasted accentor, Greater spotted eagle, Black shoulder kite, godwit were the passage migrants in the study area.

Table 4. List of birds of district Okara.

Sr.#	Order name	Family name	Common name	Scientific name	IUCN status
1	Columbiformes	Columbidae	Eurasian collared	<i>Streptopelia decaocto</i>	LC
2			Red turtle dove	<i>Streptopelia tranquebarica</i>	LC
3			Laughing dove	<i>Spilopelia senegalensis</i>	LC
4			Rock dove, rock pigeon	<i>Columba livia</i>	
5			Yellow-eyed pigeon	<i>Columba eversmanni</i>	VU
6	Passeriformes	Muscicapidae	Spotted dove	<i>Spilopelia chinensis</i>	LC
7			Pied bushchat	<i>Saxicola caprata</i>	LC
8			Indian robin	<i>Saxicoloides fulicatus</i>	LC
9			Brown rock chat	<i>Cercomela fusca</i>	LC
10			Common red start	<i>Phoenicurus phoenicurus</i>	LC
11			Oriental magpie-robin	<i>Copsychus saularis</i>	LC
12			Blue throat	<i>Luscinia svecica</i>	LC
13			Siberian stonechat	<i>Saxicola maurus</i>	LC
14			White browed bushchat	<i>Saxicola macrorhynchus</i>	VU
15			White tailed stonechat	<i>Saxicola rubicola</i>	LC
16			Gray bushchat	<i>Saxicola ferreus</i>	LC
17		Rhipiduridae	White-browed fantail	<i>Rhipidura aureola</i>	LC
18		Acrocephalidae	White throated fantail	<i>Rhipidura albicollis</i>	LC
19			Common reed warbler	<i>Acrocephalus scirpaceus</i>	LC
20			Great reed warbler	<i>Acrocephalus arundinaceus</i>	LC
21		Ploceidae	Blunt-winged warbler	<i>Acrocephalus concinens</i>	LC
22			Black-breasted weaver	<i>Ploceus benghalensis</i>	LC
23			Streaked weaver	<i>Ploceus manyar</i>	LC
24		Oriolidae	Baya weaver	<i>Ploceus philippinus</i>	LC
25			Eurasian golden oriole	<i>Oriolus oriolus</i>	LC
26			Indian golden oriole	<i>Oriolus kundoo</i>	LC
27		Leiothrichidae	Afghan babbler	<i>Argya huttoni</i>	LC
28		Passeridae	Common babbler	<i>Turdoides caudate</i>	LC
29			Jungle babbler	<i>Turdoides striata</i>	LC
30			Eurasian tree sparrow	<i>Passer montanus</i>	LC
31			Russet sparrow	<i>Passer rutilans</i>	LC
32			Rock sparrow	<i>Petronia petronia</i>	LC
33			House sparrow	<i>Passer domesticus</i>	LC
34			Sind sparrow	<i>Passer pyrrhonotus</i>	LC
35		Cisticolidae	Jungle prinia	<i>Prinia sylvatica</i>	LC
36			Plain prinia	<i>Prinia inornata</i>	LC
37			Indian tailor	<i>Orthotomus sutorius</i>	LC
38		Parulidae	Fan-tailed warbler	<i>Basileuterus lachrymosus</i>	LC
39		Alaudidae	White winged lark	<i>Alauda leucoptera</i>	LC
40			Ashy-crowned sparrow-lark	<i>Eremopterix griseus</i>	LC
41			Crested lark	<i>Galerida cristata</i>	LC
42			Eurasian skylark	<i>Alauda arvensis</i>	LC
43			Sand lark	<i>Alaudala raytal</i>	LC
44			Indian bushlark	<i>Mirafra erythroptera</i>	LC
45		Motacillidae	Richard'pipit	<i>Anthus richardi</i>	LC
46			Tree pipit	<i>Anthus trivialis</i>	LC
47			Grey wagtail	<i>Motacilla cinerea</i>	LC
48			Pied wagtail (white wagtail)	<i>Motacilla alba</i>	LC
49			White-browed wagtail	<i>Motacilla maderaspatensis</i>	LC
50			Western yellow wagtail	<i>Motacilla flava</i>	LC
51			Black backed wagtail	<i>Motacilla alba lugens</i>	LC
52			Paddyfield pipit	<i>Anthus rufulus</i>	LC
53		Vangidae	Common wood shrike	<i>Tephrodornis pondicerianus</i>	LC
54		Paradoxornithidae	Yellow-eyed babbler	<i>Chrysomma sinense</i>	LC
55	Laniidae		Great grey shrike	<i>Lanius excubitor</i>	LC
56			Long tailed shrike or rufous backed shrike	<i>Lanius schach</i>	LC
57			Bay baked shrike	<i>Lanius vittatus</i>	LC
58			Isabelline shrike	<i>Lanius isabellinus</i>	LC
59			Common grasshopper warbler	<i>Locustella naevia</i>	LC
60		Locustellidae	Long tailed bush warbler	<i>Locustella caudate</i>	LC
61			Bristled grassbird	<i>Schoenicola striatus</i>	LC

Sr.#	Order name	Family name	Common name	Scientific name	IUCN status
62		Estrildidae	Indian silverbill or white-throated munia	<i>Euodice malabarica</i>	LC
63		Hirundinidae	Common house martin	<i>Delichon urbicum</i>	LC
64			Wire-tailed swallow	<i>Hirundo smithii</i>	LC
65			Grey-throated martin or asian plain martin	<i>Riparia chinensis</i>	LC
66			Barn swallow	<i>Hirundo rustica</i>	LC
67			Streak-throated swallow	<i>Petrochelidon fluviicola</i>	LC
68			Sand martin or bank swallow	<i>Riparia riparia</i>	LC
69		Dicruridae	Black drongo	<i>Dicrurus macrocercus</i>	LC
70			Ashy drongo	<i>Dicrurus leucophaeus</i>	LC
71		Corvidae	House crow	<i>Corvus splendens</i>	LC
72			Rufous treepie	<i>Dendrocitta vagabunda</i>	LC
73		Sturnidae	Rosy starling (year visitor passage migrants)	<i>Pastor roseus</i>	LC
74			Common myna	<i>Acridotheres tristis</i>	LC
75			Bank myna	<i>Acridotheres ginginianus</i>	LC
76			Indian pied myna	<i>Gracupica contra</i>	LC
77			European starling (common starling)	<i>Sturnus vulgaris</i>	LC
78		Nectariniidae	Purple sunbird	<i>Cinnyris asiaticus</i>	LC
79		Pycnonotidae	Red-vented bulbul	<i>Pycnonotus cafer</i>	LC
80			Red-whiskered bulbul	<i>Pycnonotus jocosus</i>	LC
81		Prunellidae	Rufous breasted accentor	<i>Prunella strophiaata</i>	LC
82		Emberizidae	White capped bunting	<i>Emberiza stewarti</i>	LC
83		Phylloscopidae	Plain leaf warbler	<i>Phylloscopus neglectus</i>	LC
84			Dusky warbler	<i>Phylloscopus fuscatus</i>	LC
85			Gray-hooded warbler	<i>Phylloscopus xanthoschistos</i>	LC
86		Cettiidae	Gray-sided bush warbler	<i>Cettia brunnifrons</i>	LC
87	Strigiformes	Strigidae	Spotted owl	<i>Athene brama</i>	LC
88			Indian scops-owl	<i>Otus bakkamoena</i>	LC
89			Asian barred owl	<i>Glaucidium cuculoides</i>	LC
90	Cuculiformes	Cuculidae	Lesser coucal	<i>Centropus bengalensis</i>	LC
91			Asian koel	<i>Eudynamis scolopaceus</i>	LC
92			Greater coucal or common crow pheasant	<i>Centropus sinensis</i>	LC
93			Indian cuckoo	<i>Cuculus micropterus</i>	LC
94	Gruiformes	Rallidae	White breasted water hen	<i>Amaurornis phoenicurus</i>	LC
95			Purple swamphen	<i>Porphyrio porphyrio</i>	LC
96	Accipitriiformes	Accipitridae	Oriental honey buzzard	<i>Pernis ptilorhynchus</i>	LC
97			Tawny eagle	<i>Aquila rapax</i>	LC
98			Greater spotted eagle	<i>Clanga clanga</i>	LC
99			Black shoulder kite	<i>Elanus axillaris</i>	LC
100			Eurasian marsh-harrier	<i>Circus aeruginosus</i>	LC
101			Black kite	<i>Milvus migrans</i>	LC
102			White eyed buzzard	<i>Butastur teesa</i>	LC
103			Long legged buzzard	<i>Buteo rufinus</i>	LC
104			Brahminy kite	<i>Haliastur indus</i>	LC
105			Short toed snake eagle	<i>Circaetus gallicus</i>	LC
106			Eurasian sparrowhawk	<i>Accipiter nisus</i>	LC
107			Shikra	<i>Accipiter badius</i>	LC
108			Eastern imperial eagle	<i>Aquila heliaca</i>	LC
109			Booted eagle	<i>Hieraetus pennatus</i>	LC
110			Bonnelli's eagle	<i>Aquila fasciata</i>	LC
111			Northern goshawk	<i>Accipiter gentilis</i>	LC
112			Common buzzard	<i>Buteo buteo</i>	LC
113			Indian spotted eagle	<i>Clanga hastate</i>	LC
114			Pallid harrier	<i>Circus macrourus</i>	LC
115			Hen harrier	<i>Circus cyaneus</i>	LC
116	Pelecaniformes	Ardeidae	Little bittern	<i>Ixobrychus minutus</i>	LC
117			Black bittern	<i>Ixobrychus flavicollis</i>	LC
118			Cinnamon bittern	<i>Ixobrychus cinnamomeus</i>	LC
119			Yellow bittern	<i>Ixobrychus sinensis</i>	LC
120			Little egret	<i>Egretta garzetta</i>	LC
121			Great egret	<i>Ardea alba</i>	LC
122			Purple heron	<i>Ardea purpurea</i>	LC
123			Grey heron	<i>Ardea cinerea</i>	LC
124			Indian pond heron	<i>Ardeola grayii</i>	LC
125			Cattle egret	<i>Bubulcus ibis</i>	LC
126			Striated heron	<i>Butorides striata</i>	LC
127			Black crowned night heron	<i>Nycticorax nycticorax</i>	LC
128			Intermediate egret	<i>Ardea intermedia</i>	LC

Sr.#	Order name	Family name	Common name	Scientific name	IUCN status
129		Threskiornithidae	Glossy ibis	<i>Plegadis falcinellus</i>	LC
130	Apodiformes	Apodidae	Little swift	<i>Apus affinis</i>	LC
131			Common swift	<i>Apus apus</i>	LC
132			House swift	<i>Apus nipalensis</i>	LC
133			Asian palm swift	<i>Cypsiurus balasiensis</i>	LC
134	Suliformes	Phalacrocoracidae	Little cormorant	<i>Microcarbo niger</i>	LC
135			Greater cormorant	<i>Phalacrocorax carbo</i>	LC
136	Falconiformes	Falconidae	Red-necked falcon	<i>Falco chicquera</i>	NT
137	Piciformes	Picidae	Black-rumped flameback	<i>Dinopium benghalense</i>	LC
138			Sind woodpecker	<i>Dendrocopos assimilis</i>	LC
139	Ciconiiformes	Ciconiidae	Painted stork	<i>Mycteria leucocephala</i>	NT
140	Bucerotiformes	Upupidae	Eurasian hoopoe	<i>Upupa epops</i>	LC
141		Bucerotidae	Indian-gray hornbill	<i>Ocyeros birostris</i>	LC
142	Charadriiformes	Rostratulidae	Greater painted snipe	<i>Rostratula benghalensis</i>	LC
143		Jacaniidae	Pheasant tailed jacana	<i>Hydrophasianus chirurgus</i>	LC
144		Glareolidae	red-winged pratincole	<i>Glareola pratincola</i>	LC
145			Small indian pratincole	<i>Glareola lacteal</i>	LC
146		Laridae	Black-headed gull	<i>Chroicocephalus ridibundus</i>	LC
147			Indian river tern	<i>Sterna aurantia</i>	NT
148		Scolopacidae	Temminck's stint	<i>Calidris temminckii</i>	LC
149			Little stint	<i>Calidris minuta</i>	LC
150			Dunlin	<i>Calidris alpine</i>	LC
151			Common snipe	<i>Gallinago gallinago</i>	LC
152			Black tailed godwit	<i>Limosa limosa</i>	NT
153			Whimbrel	<i>Numenius phaeopus</i>	LC
154			Eurasian curlew	<i>Numenius arquata</i>	NT
155			Spotted redshank	<i>Tringa erythropus</i>	LC
156			Common redshank	<i>Tringa tetanus</i>	LC
157			Common sandpiper	<i>Actitis hypoleucos</i>	LC
158			Common greenshank	<i>Tringa nebularia</i>	LC
159			Wood sandpiper	<i>Tringa glareola</i>	LC
160			Green sandpiper	<i>Tringa ochropus</i>	LC
161			Marsh sandpiper	<i>Tringa stagnatilis</i>	LC
162			Ruff	<i>Calidris pugnax</i>	LC
163		Charadriidae	Lesser sand plover	<i>Charadrius mongolus</i>	LC
164			Greater sand plover	<i>Charadrius leschenaultii</i>	LC
165			White tailed lapwing	<i>Vanellus leucurus</i>	LC
166			Red- wattled lapwing	<i>Vanellus indicus</i>	LC
167			Sand plover	<i>Charadrius mongolus</i>	LC
168			Little ringed plover	<i>Charadrius dubius</i>	LC
169		Recurvirostridae	Black winged stilt	<i>Himantopus himantopus</i>	LC
170			Pied avocet	<i>Recurvirostra avosetta</i>	LC
171	Psittaciformes	Psittaculidae	Rose-ringed parakeet	<i>Psittacula krameri</i>	LC
172	Anseriformes	Anatidae	Mallard	<i>Anas platyrhynchos</i>	LC
173			Gadwall	<i>Mareca strepera</i>	LC
174			Eurasian widgeon	<i>Mareca Penelope</i>	LC
175			Eurasian teal or common teal	<i>Anas crecca</i>	LC
176			Northern pintail	<i>Anas acuta</i>	LC
177			Northern shoveler	<i>Spatula clypeata</i>	LC
178			Indian spot-billed duck	<i>Anas poecilorhyncha</i>	LC
179			Garganey	<i>Spatula querquedula</i>	LC
180			Indian whistling duck or lesser whistling teal	<i>Dendrocygna javanica</i>	LC
181			Grelag goose	<i>Anser anser</i>	LC
182			Bar headed goose (migratory)	<i>Anser indicus</i>	LC
183			Red crested pochard	<i>Netta rufina</i>	LC
184			Common pochard	<i>Aythya ferina</i>	LC
185			Ferruginous pochard or white-eyed pochard	<i>Aythya nyroca</i>	NT
186			Common shelduck	<i>Tadorna tadorna</i>	LC
187			Ruddy shelduck	<i>Tadorna ferruginea</i>	LC
188			Tufted duck	<i>Aythya fuligula</i>	LC
189			Cotton pygmy goose	<i>Nettapus coromandelianus</i>	LC
190	Pterocliiformes	Pteroclididae	Chestnut-bellied sandgrouse or common sandgrouse	<i>Pterocles exustus</i>	LC
191	Galliformes	Phasianidae	Common quail	<i>Coturnix coturnix</i>	LC
192			Grey francolin	<i>Ortygornis pondicerianus</i>	LC
193			Black partridge	<i>Melanoperdix niger</i>	LC
194	Coraciiformes	Coraciidae	Indian roller	<i>Coracias benghalensis</i>	LC

Sr.#	Order name	Family name	Common name	Scientific name	IUCN status
195			European roller	<i>Coracias garrulous</i>	NT
196		Meropidae	Green bee eater	<i>Merops orientalis</i>	LC
197			Blue tail bee eater	<i>Merops philippinus</i>	LC
198			Blue-cheeked bee-eater	<i>Merops superciliosus</i>	LC
199		Alcedinidae	White- throated kingfisher	<i>Halcyon smyrnensis</i>	LC
200			Common kingfisher or eurasian kingfisher	<i>Alcedo atthis</i>	LC
201			Pied kingfisher	<i>Ceryle rudis</i>	LC

LC: least concerned; VU: vulnerable; NT: near threatened

5. Conclusion

The data on bird diversity shows the remarkable range of avian species present throughout the research area. A total of 201 bird species from 54 families and 19 orders were identified. Nonetheless, the district Okara site's evaluation of bird population conditions and trends has the highest value for bird conservation. The results of this study show that bird abundance varied across land use categories. It was noticeable that increasing the intensity of land use affected bird diversity. Furthermore, the observation shows that vegetation played a significant effect on bird community diversity and density trends across land use categories. Birds play an important part in ecological balance, and their diversity reflects the variety of environments they inhabit. Yet, many species' survival is challenged by many reasons such as habitat degradation, climate change pollution, and invasive species. As a result, we must take steps to conserve avian fauna by conserving and restoring their habitats, minimizing human-caused risks, managing invasive species, monitoring bird numbers, and educating communities. By following these actions, we can secure the survival of bird species and their variety for future generations.

Appendix



Figure 5. *Haliastur indus*, common name Brahminy kite (Photo by Syed Ali Haider Shah).



Figure 6. *Sturnus vulgaris*, common name Common starling (Photo by Syed Ali Haider Shah).



Figure 7. *Coracias benghalensis*, common name Indian roller (Photo by Muhammad Mubeen Ahmad).



Figure 8. *Phalacrocorax carbo*, common name Great cormorant (Photo by Syed Ali Haider Shah).



Figure 9. *Chroicocephalus ridibundus*, common name Black-headed gull (Photo by Syed Ali Haider Shah).



Figure 10. *Sterna aurantia* (VU), common name Indian river tern (Photo by Syed Ali Haider Shah).

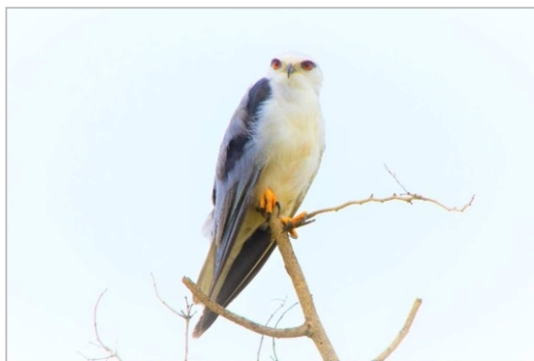


Figure 11. *Elanus caeruleus*, common name Black-winged kite (Photo by Syed Ali Haider Shah).



Figure 12. *Anas platyrhynchos*, common name Mallard (Photo by Syed Ali Haider Shah).

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