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Diversity and Abundance of Avian Fauna in Cultivated and Riverine Habitats of Bahawalnagar, Pakistan

Javed Iqbal[1], Sajid Hussain*[1], Huma Azam[1], Nimra[1], Shanza Karamat[1], Hafiz Toheed[1] and Fareeha Nawaz[1]

[1]Department of Zoology, GC University Faisalabad, Punjab, Pakistan
*Correspondence: sajid612gb@gmail.com

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ABSTRACT

The avian fauna of Punjab, Pakistan's District Bahawalnagar was examined between October 2022 and May 2023. District Bahawalnagar, which lies close to the Sutlej River, provides an excellent habitat for a variety of bird species. This study is the first survey of bird species carried out in Bahawalnagar. The landscapes of Bahawalnagar were separated into two groups: the riverine area and the agricultural region. Potential bird habitats were found in both the riverine and cultivated sectors. The birds were viewed using a binocular telescope with the naked eye. For odd time periods, the survey was carried out using the point count method from a fixed location inside a specified 50-meter radius. 10515 individual birds of 74 species, spanning 32 families of 12 orders, were identified during the current study. Additionally, 25 plant species were found in the study region. Winter observations included 49 bird species, spring observations included 70, and summer observations included 60. Common Myna *(Acridotheres tristis)*, House Crow (*Corvus splendens)* and House Sparrow (*Passer domesticus)* were the most prevalent species. According to statistical analysis, the spring season's evenness and Shannon-Wiener values were 0.6477 and 1.195, respectively. Species diversity was much higher in the spring than in other seasons. The order Passeriformes was the most prevalent in all food kinds and species diversity. These results indicate that agricultural and riverine habitats support diverse avian fauna. These approaches help support habitat diversity and food availability.

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INTRODUCTION

Birds are the commonest species of vertebrates over the world with almost 10,400 species and making a great indicator of ecosystems (Barrowclough et al. 2016). Pakistan provides a platform of great climatic and vegetation regions that in means many bird's species. To prevent from a cold winter season, large number of birds is migrating from Europe and Central Asia to Pakistan in winter (Stephens et al. 2016). Along with a bird, man-made landscape modifications typically result in a decrease in the natural environment and a subsequent loss of biological diversity. Birds are an important part of the global biodiversity and are essential to the upkeep of a healthy ecosystem. With their behavior, exquisite colors, and melodies, birds are thought to be human. Riparian regions also consist of a dispersal pathway and provide the enough cover for migratory birds; hence they also support a richness species of bird's diversity (Fraixedas et al. 2020). Vultures and the pied crow (*Corvus albus)* are venomous birds that consume and decompose disease-carrying insects. In addition to controlling illness, birds are crucial for pollination and seed dissemination. Bird diversity and abundance are greatly enhanced by agro ecosystems. Small rodents that permanently harm crops are managed by birds (Chain-Guadarrama et al. 2019).

The world's fifth most populous nation is Pakistan. Bird diversity is thus seriously threatened by overpopulation brought on by habitat loss, deforestation, altered desert ecosystems, industrialization, urbanization, and agricultural practices. Birds that rely on the forest have been primarily harmed by its degradation, and when a forest fragment is too small or too degraded to guide prospective populations, reasons of species extinction have been hypothesized (Umar et al. 2018). Determining avian diversity through regional studies is crucial to species protection. Birds are excellent environmental indicators that aid in the analysis of high-quality conservation sites. Pakistan's birds are seriously threatened by urbanization, cattle grazing, pollution,

eutrophication, intensified agriculture, and illicit hunting. These dangers are contributing to the extinction of species (Saleem et al. 2025). Any bio-indicator that favors biodiversity status can be used to assess the site's environmental issues using birds. Birds perform a range of ecological functions in their native habitats. For instance, they are bioindicators of ecological health (Iqbal et al. 2021). Birds are important pollinators, consumers, plant seed distributors, and bug predators. Although they don't help with pollination, birds do help manage insect populations. Every species occupies a distinct ecological niche (Abrahamczyk, 2019).

To gain items like down and feathers, these birds help manage the many omnivorous and carnivorous populations that exist around the world. Bird diversity is negatively impacted by human activities, which can lead to changes that may eventually lead to the extinction of local or perhaps global avian species (Matuoka et al. 2020). Because of their reproductive capacity and behavioral habits, birds are the best indicators of environmental changes. They have been used as bio monitors to assess the environment and the long-term effects of habitat fragmentation. They have proven to be excellent biological markers of particular habitats (Quintero & Jetz, 2018). The ecological elements that influence the stability and persistence of bird populations must be considered in conservation efforts since vegetation is crucial to avian habitat. A significant decline in biodiversity is one of the immediate consequences of urbanization (Carrasco et al. 2018). River flows are a great way to measure river quality and catchment on a variety of sizes. Human activities have significantly increased the usefulness of watercourses for agriculture, electricity generation, flood control, transportation, and water supply (de Montaigu & Goulson, 2023).

The use of pesticides, fertilizers, shorter crop rotations, machine-driven farming, and making agricultural fields less suitable for a wide variety of organisms all contribute to the intensification that takes place at the field level (Moreau et al. 2022). Numerous ecosystems can be found in the region, including the river, woodlands, desert, and both farmed and uncultivated land. The wild plant *Tamarix dioica*, also referred to as tamarisk, formerly covered a sizable amount of the area and was utilized as fuel wood. Although Bahawalnagar City and its surroundings are situated along the Sutlej River, contain a range of habitats, and are an important wintering site for many migrating birds, a literature search turned up no current studies or data on the diversity of birds in the area or winter migrants (Van Doren & Horton, 2018). However, there are unofficial allegations of unlawful hunting along the river of migratory ducks. Locals claim that although there used to be a wide variety of animals in the area, the ecosystem has become unstable and there are now fewer species than there once were due to illegal hunting and habitat destruction. Many different kinds of birds can find vital habitat in the river's aquatic habitats (Aebischer, 2019). While some aquatic birds spend most of their lives in the water and only come ashore to nest and feed, others split their time between aquatic and terrestrial habitats. However, no studies on the avian fauna were conducted in Bahawalnagar and the surrounding areas. Numerous bird species that require documentation for their protection have been represented by the study location. The most often produced crops in the study area are rice, corn, wheat, and sugar cane (Basto et al. 2019). A variety of useful guides were examined to identify the different types of birds. This research aims to create baseline data on the richness of the species and relative abundance of the Sutlej River's bird fauna.

MATERIALS AND METHODS

Study area

The Sutlej River runs along the northern boundary of the Bahawalnagar district (29.6892° N, 72.9933° E), which is bounded to the east and south by Indian Territory and to the west by the Bahawalpur district. It is situated 163 meters (516.41 feet) above sea level and is located on the expanding flat plains of Southern Punjab. District Bahawalnagar has a total size of 8,878 km². It is the 54th largest city in Pakistan by population, according to the 2017 census. According to Pakistan's 2017 census, Bahawalnagar had 2,981,919 residents. Bahawalnagar supports a range of habitats. Two studies sites—Site 1 in the riverine region and Site 2 in the cultivated area—were built in the riverine and cultivated areas, which served as the two primary research areas (Fig. 1).

Fig. 1: Map of District Bahawalnagar indicating the study sites of the riverine and agriculture sites field Survey

Field Surveys

The period of the field observation was October 2022–May 2023. Three distinct seasons—winter, spring, and summer-were used to gather data. The point count method was used to gather data from a certain location for a predetermined amount of time. This approach was effective for studying the species in a wide variety of environments. The point count sampling approach was used to record birds at several points within a predetermined radius (Morelli et al. 2022). Five plots for each location in each season were placed 300 meters apart to create 105-point count stations spread across six habitats. A global positioning system (GPS) device was used to create plots with a 50-meter radius. For every kind of micro landscape, five plots were randomly chosen inside a five-kilometer-by-five-kilometer grid cell (Gasc et al. 2015). Every plot was observed for twenty minutes. Every plot was visited twice during the day, with equal intervals of two hours at daybreak and dusk. The bird diversity (total/physical count) along the river was determined using the linear count survey method (0.4 km in length and 0.2 km in breadth). The birds were photographed with a camera (Canon EOS 5D), binoculars, and naked eyes. A number of helpful bird species identification aids were examined (Sullivan et al. 2017).

Statistical Analysis

To analyze avian diversity across different habitats or districts, the following ecological indices were applied:

1. Relative Abundance (Pi)

Relative abundance was used to determine the proportion of individual bird species relative to the total bird population in each site:

Relative Abundance (Pi) =N/n

Where:

- *n* = Number of individuals of a specific bird species in a site
- *N* = Total number of individuals of all bird species in that site

2. Shannon-Wiener Diversity Index (H′)

This index was used to quantify species diversity by considering both the richness and evenness of the species present:

$H' = -\sum(Pi \cdot \ln Pi)$

Where:

- *H′* = Shannon-Wiener diversity index
- *Pi* = Proportion of each species relative to the total number of individuals
- *ln Pi* = Natural logarithm of *Pi*

3. Species Richness (S) and Evenness Index (J′)

Species richness refers to the total number of different bird species recorded in a given area:

S=Total number of species

Evenness (J′) was calculated to assess how evenly individuals are distributed among the species:

$J' = H'/Hmax = H'/INS$

Where:

- *J′* = Evenness index
- *H′* = Shannon-Wiener index
- *Hmax* = Maximum diversity possible = ln(*S*)

4. Simpson's Diversity Index (D)

This index was used to measure the probability that two individuals randomly selected from a sample belong to different species:

$D = N - 1\sum(n-1)/N - 1$

Where:

- *n* = Number of individuals of a specific bird species
- *N* = Total number of individuals of all species

Vegetation Assessment

At bird counting stations, the quadrant technique (10m 10m) was used to sample the plant variables present in these ecosystems. This approach is one of the most popular and well-respected ways to survey vegetation in different settings (Besnard et al. 2015) . To ascertain the vegetation structure within the consistency of the point count stations, a total of 21 quadrant plots were gathered. Plant pressure was assessed using field-collected plant samples, according to (Agra et al. 2015). The dried plant samples were prepared, oven-dried for a week, and then stored on herbarium sheets. Plants from the Botany Department of Government College Faisalabad were identified.

RESULTS

In Bahawalnagar, 74 bird species from 32 families and 12 orders have been identified throughout the study period. There were 32 species and 13 families in the main order, Passeriformes. Forty different plant species were observed. Common mulberries (*Morus alba),* shisham (*Dalbergia sisso),* eucalyptus trees (*Eucalyptus globulus*), Bermuda grass (*Cynodon dactylon*), neem trees (*Azadirachta indica*), populus/cottonwood *(Populus tremula*), and sukhchain/Indian beach trees (*Pongamia pinnata)* were abundant. These plants were used by birds for roosting, nesting, and feeding. Certain plants offer birds additional safety. Over the course of the study, there was a notable diversity of bird species in the Bahawalnagar area (70 spring, 25 winter, and 25 summer species) Fig 3. The avian diversity index for the area was 2.25. Along with their own unique species, each of the two research sites also featured a few common species that are found all over the world. Except for five species, every species observed during the investigation is of the least concern. IUCN Red Lists indicate that these five species are threatened (Table 1).

Table 1: IUCN conservation status of avian species recorded in Bahawalnagar

Sr.	Species name	IUCN Status	Residential status
1	Spotted green shank	Endangered	E
2	Sandpiper	Critical Endangered	CR
3	Red Wattled Lapwing	Vulnerable	VU
4	Piping Plover	Near Threatened	NT
5	Pied Kingfisher	Vulnerable	VU

Study Site 1: The riverine area

Study Site 1 covered around 20 km² of the Satluj River. Along the riverbanks here are native plants including River Tamarind (*Leucaena leucocephala),* Common Mulberry (*Morus alba*), Common Wheat (*Triticum*

aestivum), Berseem Clover (Trifolium alexandrinum), Shisham (*Dalbergia sissoo*), and Wild Sugarcane (*Saccharum spontaneum*). The river also features several sandy islands throughout its course. This location is home to a broad range of bird species throughout the year, with the maximum avian richness occurring in the winter. A total of 5,606 individual birds, representing 53 distinct species, were recorded throughout the surveys, demonstrating the region's significant species diversity. February and March of 2022 had the greatest number of people. The findings showed that the recorded avifauna belonged to nine orders and 26 families (Fig. 1). With 11 families and 19 species, the order Passeriformes was the most prevalent among them. With five families and fifteen species, the Charadriiformes order was the second most represented. The order Coraciiformes is the third most represented, with three families and four species. The most common species at Study Site 1 was the House Crow (Corvus splendens), which belongs to the Passeriformes order and had 1,213 individuals documented, or a relative abundance (RA) of 5.35%.

The Great Blue Heron (*Ardea herodias*), a member of the order Pelecaniformes, was the least frequent species, with only two individuals observed (RA 0.0088%). The Black-winged Stilt (*Himantopus himantopus*, RA 1.9722%), Common Myna (*Acridotheres tristis*, RA 2.2855%), and House Crow (RA 5.352%) were the most common species at Study Site 2. Other types of terrain also showed seasonal variations in bird abundance. Seasonal variations in bird counts were seen in the riverine zones, with 953 individuals recorded in the winter, 3,241 in the spring, and 1,022 in the summer. The study site has a high degree of bird diversity, according to the diversity measures. Table 2 shows that the Simpson Diversity Index (D) was 0.0865, the Evenness (J') value was 0.7407, and the Shannon-Wiener Diversity Index (H') was 1.2772. The first-time documentation of three bird species in District Bahawalnagar—the Glossy Ibis (*Plegadis falcinellus),* the Short-tailed Pipit (*Anthus brachyurus*), and the Red-naped Ibis (*Pseudibis papillosa*)-was a noteworthy highlight of this study. These species, which are mostly known to exist in Indian Territory and the Pakistani province of Sindh, have never been documented in the area. Their known distribution range has been significantly expanded by their presence in Bahawalnagar.

Study Site 2: The cultivated area

In addition to orange and guava orchards, the area is home to a wide range of agricultural crops, such as vegetables, maize, rice, wheat, and sugarcane. At this location, 4,909 individual birds were counted, representing 45 species richness. Ten orders and twenty-six families were used to categorize the avifaunal data. With 13 families and 23 species, the Passeriformes order was the most prevalent. The order Coraciiformes, which had three families and three species, came next. With two families and two species apiece, the orders Charadriiformes and Bucerotiformes were tied for third place. The most common species at this site was the House Crow (*Corvus splendens),* a species of the Passeriformes order, with 1,273 individuals recorded. The Black-crowned Night Heron (*Nycticorax nycticorax*), a species of the Pelecaniformes order, was the least common, with only one bird observed. In 2023, the highest number of people was in February and March. There was a noticeable seasonal variation in bird abundance, with 861 birds recorded in the winter, 2,311 in the spring, and 972 in the summer. House Crow (RA 5.617%), Common Myna (*Acridotheres tristis*, RA 4.4917%), and House Sparrow (*Passer domesticus*, RA 4.0019%) were the most prevalent species at Site 2 (Table 2). With a Simpson Diversity Index (D) of 0.1529, an Evenness (J') of 0.5884, and a Shannon-Wiener Index (H') of 0.9728, the diversity indices showed a reasonably high degree of avian variety.

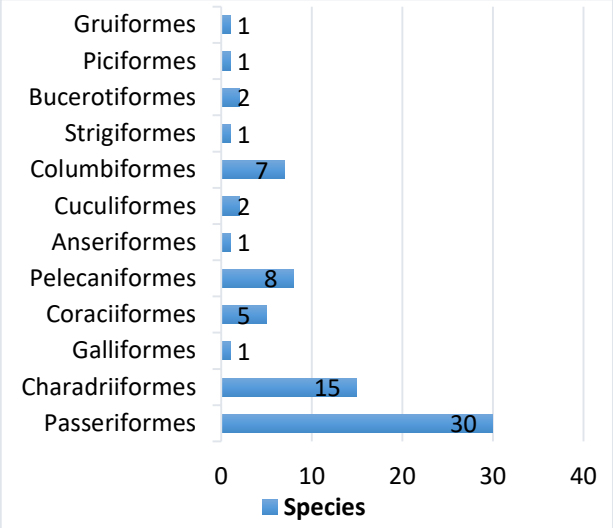

Fig. 2: Different orders of avian fauna demonstrating number of species.

3. The entire study area:

Bird surveys covering three different seasons—winter (October, November, December, and January), spring (February and March), and summer (April and up to May 18)—were carried out between October 2022 and May 2023 to evaluate seasonal variance. The survey period was two months for the spring and summer seasons, and four months for the winter season. To provide thorough coverage, every study location was visited at random during each season (Fig. 2). Seasonal temperature variations were evident in the climate data collected during the research period. The lowest average temperature in June was 27°C (82°F), while the highest average temperature was 41°C (105°F). On the other hand, January's average temperature was as low as 4°C (39°F) and as high as 20°C (68°F). In all seasons, 74 different bird species were observed during the study period. Over the winter, 49 species were seen, with an Evenness (J') of 0.6961 and a Shannon-Wiener Diversity Index (H') of 1.1766. The corresponding diversity values were H' = 1.195 and J' = 0.6477 when the number of species observed increased to 70 in the spring. Of the 60 species discovered during the summer, the highest diversity was observed with H' = 1.3022 and J' = 0.7323 (Table 3). Across all survey sites, the most common and frequently sighted species were the House Sparrow (Passer domesticus), Black-winged Stilt (*Himantopus himantopus*), Common Myna *(Acridotheres tristis*), and House Crow (*Corvus splendens*).

Table 2: Checklist of birds recorded in Agriculture area and around Sutlej River

Order	Family	Scientific Name	Common Name	Site 1	Site 2	RA
Passeriformes	Covidae	*Corvus splendens*	House Crow	1213	1273	10.969
		Pica hudsonia	Black billed magpie	0	14	0.0618
		Acridothe res tristis	Common Myna	518	1018	6.7772
	Pycnonot idae	*Pycnonot us cafer*	Red vented bulbul	3	201	0.9
	Laniidae	*Lanius vittatus*	Bay backed shrike	0	53	0.2338
		Lanues schach	Long tailed shrike	0	13	0.0026
	Passeridae	*Passer domesticus*	House Sparrow	102	907	4.4519
	Motacillidae	*Anthus brachyurus*	Short tailed Pipit	0	7	0.0014
		Anthus rubescens	Buff bellied pipit	29	0	0.1279
		Motacilla flava	Western yellow wagtail	102	11	0.4985
		Anthus similis	Long billed Pipit	6	0	0.0265
		Motacilla citreola	Citrine Wagtail	109	16	0.5515
		Motacilla maderasp atensis	White browed wagtail	17	0	0.0750
		Anthus Novaeseel andiae	Australasin Pipit	6	0	0.0265
		Motacilla alba	White wagtail	387	7	1.7075
	Leiothrichidae	*Argya striata*	Jungle babbler	0	61	0.2691
	Muscicapidae	*Copsychus saularis*	Oriental Magpie robin	291	7	1.3149
		Oenanthe fuscaf	Brown rock Chat	11	42	0.2338
	Passerellidae	*Melozone fusca*	Canyon towhee	0	33	0.1456
		Peucaea cassinii	Cassins Sparrow	9	0	0.0397
	Hirundinidae	*Riparia riparia*	Bank swallow	123	0	0.5427
	Cisticolidae	*Prinia gracilis*	Graceful prinia	6	12	0.0265
		Prinia buchanani	Rufous fronted prinia	0	31	0.1368
		Prinia subflava	Tawny flanked Prinia	0	11	0.0485
	Alaudidae	*Alauda arvensis*	Eurasian skylark	0	13	0.0573
		Spizocorys conirostris	Pink billed lark	0	19	0.0838
		Eremophila alpestris	Shore lark	13	0	0.0573
		Galerida cristata	Crested lark	39	41	0.353
	Acrocephalidae	*Iduna rama*	Sykes's warbler	0	11	0.0485
	Dicruridae	*Dicrurus macrocercus*	Black drongo	31	313	1.5178
Charadriiformes	Scolopacidae	*Tringa ochropus*	Green Sandpiper	50	0	0.2206
		Calidris pusilla	wader	40	0	0.1765
		Numenius arquata	Common curlew	11	0	0.0485
		Tringa guttifer	Spotted greenshank	19	0	0.0838
		Tringa glareola	Wood Sandpiper	9	0	0.0397
		Tringa semipalmata	Willet	9	0	0.0397
		Calidris alpina	Sandpiper	53	0	0.2338
		Tringa nebularia	Common greenshank	441	0	1.9458
	Charadriidae	*Charadrius vociferus*	Killdeer	54	0	0.2383
		Vanellus indicus	Red Wattled Lapwing	285	123	1.8002
		Charadrius melodus	Piping Plover	33	0	0.1456
		Charadrius melodus	Piping Plover	58	0	0.2559
	Recurvirostridae	*Himantopus himantopus*	Black Winged Stilt	447	12	2.0251
	Glareolidae	*Glareola pratincola*	Collared pratincole	76	0	0.3353
	Laridae	*Sterna Hirundo*	Common tern	357	0	1.5751
Galliformes	Phasianidae	*Coturnix coturnix*	Common Quail	24	13	0.1632
Coraciiformes	Alcedinidae	*Ceryle rudis*	Pied Kingfisher	120	0	0.5295
		Halcyon smyrnensis	White throated kingfisher	12	14	0.1147
	Coraciidae	*Coracias benghalensis*	Indian Roller	3	54	0.2515
		Coracias benghalensis	Indian Roller	29	24	0.2338
	Meropidae	*Merops persicus*	Blue cheeked bee eater	6	70	0.3353
Pelecaniformes	Threskior nithidae	*Pseudibis papillosa*	Red naped ibis	14	0	0.0618
		Plegadis falcinellus	Glossy ibis	11	0	0.0485
	Ardeidae	*Nycticorax nycticorax*	Black crowned night hiron	7	1	0.0353
		Ardea intermedia	Intermediate Egret	16	0	0.0706
		Bubulcus ibis	Cattle egret	44	105	0.6574
		Ardea herodias	Great blue hiron	2	0	0.0088
		Egretta garzetta	Little Egret	104	7	0.4898
		Ardea alba	Great Egret	210	139	1.5398
Anseriformes		*Anser indicus*	Bar headed Goose	11	0	0.0485
Cuculiformes	Cuculidae	*Eudynamys scolopaceus*	Asian koel	0	17	0.0750
		Centropus sinensi	Greater coucal	0	29	0.1279
Columbiformes	Columbidae	*Streptopelia decaocta*	Eurasian collared dove	0	38	0.1677
		Strepopelia Tranquebarica	Red collared Dove	16	25	0.1809
		Columba Livia domestica	Feral pigeon	14	0	0.0618
		Columba livia	Rock pigeon	0	22	0.0970
		Spilopelia chinensis	columbinae	0	15	0.0662
		Columbinae *livia domestica*	columbinae	0	21	0.0926

		Spilopelia senegalensis	Laughing dove	0	27	0.1191
Strigiformes	Strigidae	*Athene noctua*	Little owl	0	3	0.0132
Bucerotiformes	Bucerotidae	*Ocyceros birostris*	Indian grey horn bill	0	23	0.1015
	Upupidae	*Upupa epops*	Hoopoe	3	6	0.0397
Piciformes	Picidae	*Dinopium benghalense*	Black rumped flame-back	0	7	0.0309
Gruiformes	Rallidae	*Amaurornis phoenicurus*	White breasted waterhen	3	0	0.0132
Total				5606	4909	46.2255

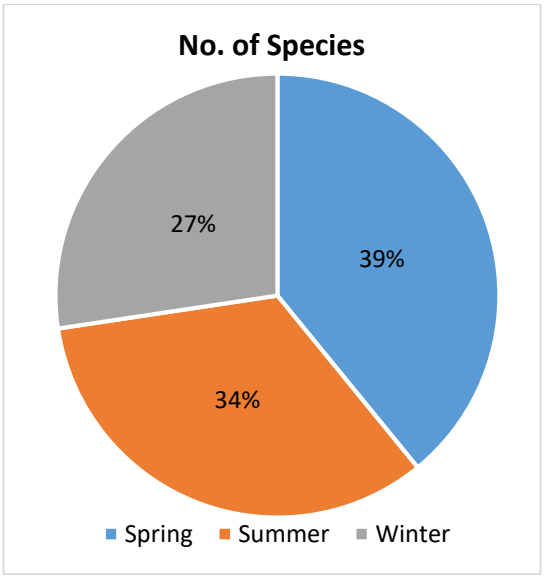

Fig. 3: Seasonal distribution of bird fauna.

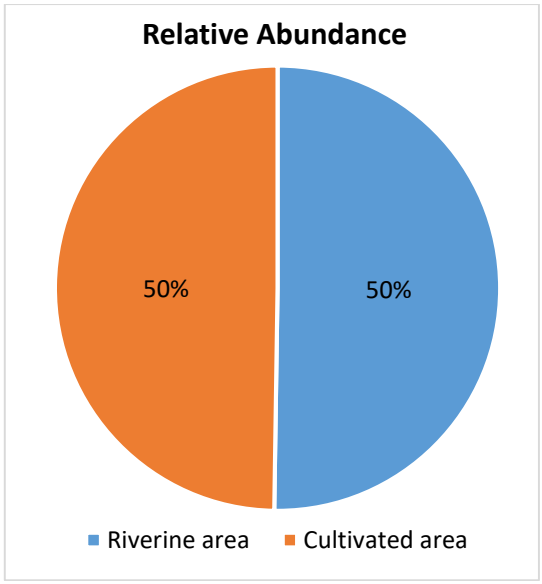

Fig. 4: Relative abundance of bird fauna of different sites.

Table 3: Diversity of avian fauna in Bahawalnagar

Diversity measure	Riverine area	Cultivated area	Total study area
Species richness	53	45	74
Shannon -Wiener (H')	1.2772	0.9728	2.25
Simpson diversity (D)	0.0865	0.1529	0.2394
Evenness (J')	0.7407	0.0865	1.3291

DISCUSSION

The diversity of birds in Punjab, Pakistan's District Bahawalnagar is described in detail for the first time in this study. This region had not previously been the focus of ornithological surveys, despite the ecological importance of the Sutlej River. The separation of the region into agricultural and riverine landscapes allowed for a methodical evaluation of the habitat-specific bird diversity. The vast number of species (74) and individuals (10,515) recorded indicates the availability and suitability of these habitats for supporting a diverse bird community. The order Passeriformes was shown to be the most dominating in all seasons, which is consistent with other studies that highlight the order's wide adaptability and diversity in a range of habitats. Due to their synanthropic tendencies and ability to thrive in ecosystems that people have altered, the most common species were House Crow, Common Myna, and House Sparrow. There was a clear seasonal fluctuation in species richness and diversity, with the maximum diversity indices occurring in the spring (Shannon-Wiener H' = 1.195; Evenness J' = 0.6477).

According to comparable observations in agro-riverine environments, this may be explained by migratory influx, reproductive activity, and an abundance of food resources during this season. The point count method's usefulness in avifaunal research was further supported by the fact that it was successful in sampling a range of habitats and producing accurate population estimates when applied within a defined 50-meter radius. Additionally, the discovery of uncommon species that had not been previously documented in this district, like *Plegadis falcinellus*, *Anthus brachyurus*, and *Pseudibis papillosa*, emphasizes the significance of ongoing observation and the promise of Bahawalnagar as a major location for bird conservation. However, the study also emphasizes the dangers that humans pose to the local avifauna, namely habitat loss, pollution, and hunting. These findings align with global concerns regarding the loss of biodiversity in riparian and agricultural habitats. Conservation efforts should focus on habitat preservation, increasing public awareness, and enforcing regulations in order to preserve the biological integrity of this region.

Conclusion

The study recorded 10,515 individual birds from 74 species, representing 32 families and 12 orders, along with 25 plant species. Bird observations were conducted both with binocular telescopes and the naked eye, using point count methods during odd time periods. Spring showed the highest species diversity and evenness, with Shannon-Wiener and evenness values of 1.195 and 0.6477, respectively. The most observed birds were Common Myna, House Crow, and House Sparrow. Passeriformes emerged as the dominant order across all types of habitats and seasons. The results indicate that cultivated land and riverine habitats are diverse and species-rich bird community. These findings suggest that agricultural landscapes and riverine habitats can sustain diverse bird fauna.

DECLARATION

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Data Availability: There is no supplementary data of this study

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Authors Contribution: JI, SH planned and conducted the study; HA, N, SK helped in experimentation and paper write up; HT, FN proof read and approved manuscript.

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