



Diversity and Abundance of Birds at Guddu Barrage, Pakistan

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SUMMARY

The rivers of Pakistan have many dams and barrages with limited public access, which provides more protection to the birds. Guddu Barrage is one of the most important wetlands for migratory and resident bird species on the Indus River in the trans-boundary region of the Punjab, Sindh, and Balochistan provinces. Generally, the area is neglected by researchers; therefore, the present study is designed to record the diversity and relative abundance of resident as well as migratory birds at Guddu Barrage and its surroundings. A total of 15,174 birds from 83 species belonging to 16 orders and 36 families were recorded at Guddu Barrage from July 2021 to August 2022. The Shannon-Wiener diversity index was calculated as $H' = 3.62$. Threatened species included the Egyptian Vulture (EN), Common Poacher (VU), River Tern (VU), Spotted Eagle (VU), and Ferruginous Duck (NT). The highest relative abundance was recorded for the House Crow, Bank Myna, River Tern, and Jungle Babbler, while the Sindh Jungle Sparrow, Common Crane, Little Ringed Plover, and Egyptian Vulture were observed with the lowest relative abundance. Important migratory birds included cranes, ducks, pintails, sandpipers, teals, gulls, and terns. Among prey birds, the Marsh Harrier, Long-legged Buzzard, Black-winged Kite, Brahminy Kite, and Black Kite were observed. This study provides baseline data about bird diversity at Guddu Barrage that will be helpful for further studies and conservation of species in the future.

Keywords: Indus River, Guddu, Dams, Barrage

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INTRODUCTION

Birds are one of the most important components of biodiversity, with huge ecological, economic, and aesthetic value (Girmay et al., 2020). Birds are found everywhere on all continents and islands and occupy a large variety of habitats, including coasts and beaches, forests, plateaus, plains, and mountains (Nguembock et al., 2017). In agriculture, birds provide their services by eating pests that can destroy the entire yield of a crop. Thus, birds act as biological pest control agents, and the presence of nest boxes for insectivorous birds near agricultural lands decreases predation by pests (Garcia et al., 2021). Some predatory birds are scavengers, which help recycle nutrients by eliminating the dead bodies of animals and keeping the environment clean (Nisa et al., 2021).

Birds are a valuable part of an ecosystem and act as biological indicators of its status (Hossain and Baki, 2015). Many birds, such as partridges and pheasants, are a source of food for humans and wild animals and help to maintain biodiversity (Pekas et al., 2020). Birds that feed on fruits and nectar and fly long distances to obtain food are prime examples of pollinators (Karenina and Giljov, 2022). In this way, birds contribute to the revival of many plant populations through their ability to pollinate and control pest diseases (Whelan et al., 2010).

Pakistan has International Migratory Route No. 4, also named the Green Route and Indus Flyway, which extends from the Karakoram to the Indus delta and holds more than 225 wetlands (Abbas et al., 2011). Every year, more than 400 migratory bird species, including cranes, ducks, pintails, spoonbills, teals, waders, and pelicans, cover a distance of about 4,500 km during September-November from Siberia to reach Pakistan and return to Siberia during February-March (Umar et al., 2018). Birds are also reared as pets for the conservation of their species and to synthesize medicines and natural products from birds, which are used by humans for food, beautifying clothes, and making medicines and tools (Fieder et al., 2020; Rahman et al., 2022).

Despite limited research on bird diversity and population trends at major wetlands in Pakistan, birds are vital indicators of ecosystem health. This study represents the first examination of the avifauna at Guddu Barrage, an important water-body and migratory stopover. It aims to provide baseline data for conservation and management planning by documenting the richness and relative abundance of resident and migratory bird species, analyzing their seasonal patterns, and identifying key habitats and factors that influence bird distribution.

MATERIALS AND METHODS

STUDY SITE

Guddu Barrage (28°25'07"N 69°42'48"E) was built in 1962 on the Indus River to control water flow during floods and to provide water for agricultural lands (Figure 1). Guddu Barrage is an important wetland in Pakistan due to its location at the confluence of three provinces: Sindh, Punjab, and Balochistan, near Kashmore town in Sindh. The length of the barrage is 1.35 km, with 64 bays, each of which has a width of 60 feet. Guddu Barrage supplies irrigation water to 12,000 km² of agricultural land in the Kashmore, Jacobabad, Larkana, and Sukkur districts of Sindh, as well as the Naseerabad and Jafarabad districts of Balochistan. The surrounding area of the barrage consists of villages, farmlands, and agricultural fields.

DATA COLLECTION

The diversity and abundance of birds were observed from 05:00 to 10:00 am and 04:00 to 07:00 pm. The direct observation method was used to observe the bird species at Guddu Barrage, its surrounding riverbanks, and adjacent agricultural fields. The bird species and their numbers were recorded on a monthly basis along walking transects of variable lengths. The observations were made using Olympus 10 X 50 DPS I binoculars, and photographs of the birds were taken with a Nikon D5300/70-300mm digital camera. The photographs were captured carefully so that the plumage color of the birds was visible and the bird species could be identified. The species of birds were identified using field guides (Grimmett et al., 2008; Mirza and Wasiq, 2007).

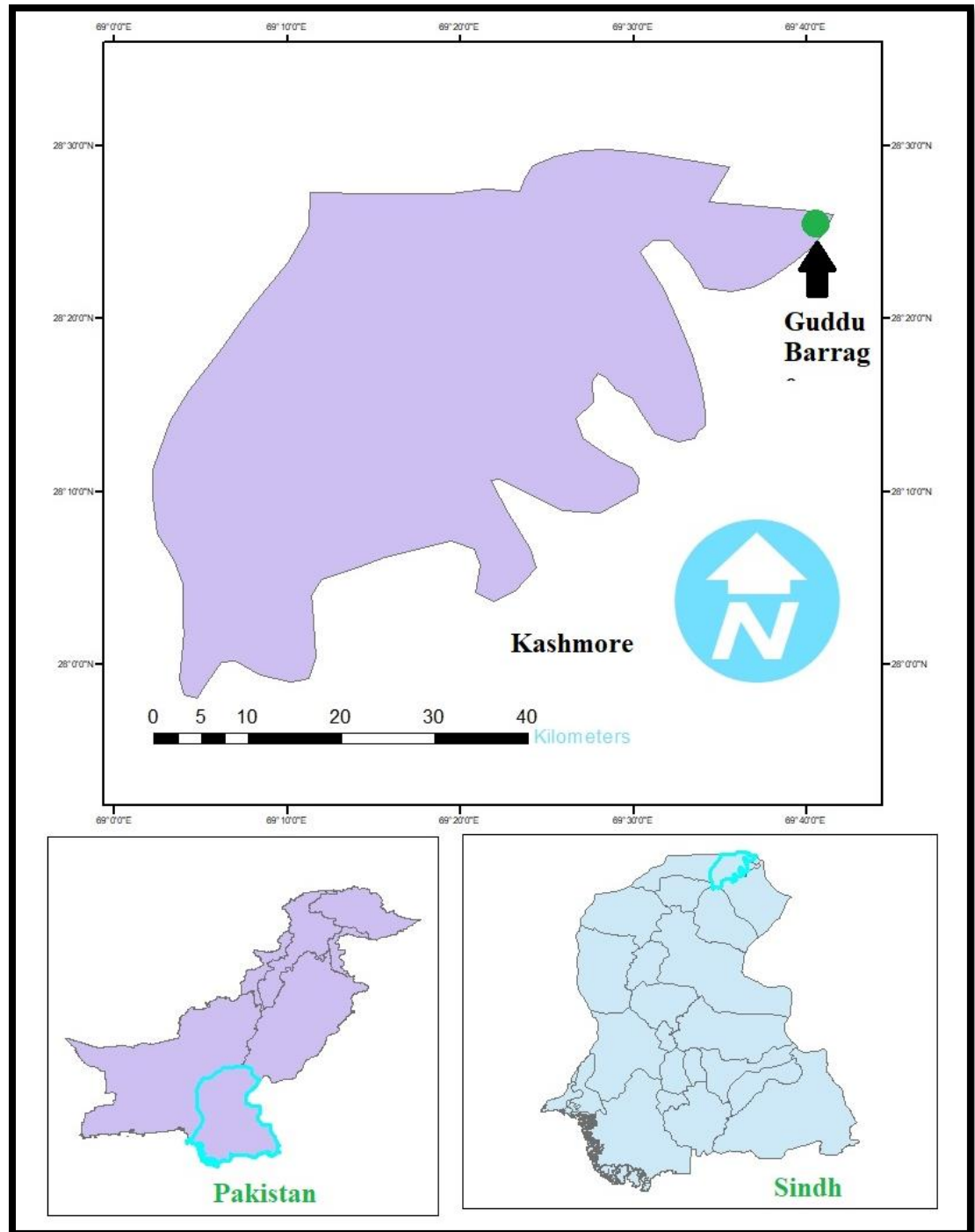


Figure 1: Map of the study area.

ANALYSIS OF DATA

Spreadsheets in MS Excel were used to arrange the collected data in the form of tables and to create graphs. The data were analyzed and compared to measure the diversity and relative abundance of species. The Shannon-Wiener Diversity Index was calculated to evaluate species richness and diversity using the following equation:

$$H' = - [\sum P_i \ln P_i]$$

Where H' is the Shannon-Wiener diversity index, P_i is the proportion of a species relative to the total number of species, and lnP_i is the natural logarithm of this proportion.

RESULTS

This study was conducted at Guddu Barrage and its surroundings from August 2021 to July 2022 to assess the diversity and abundance of bird species. During this period, a total of 15,174 birds from 83 species belonging to 36 families and 16 orders were recorded (Table 1). The Shannon-Wiener diversity index was H'=3.62, indicating that the area is rich in bird diversity. The data collected during the study (Table 1) showed significant variation in relative abundance, with the highest being that of the House Crow (0.0977), Bank Myna (0.0877), River Tern (0.0548), and Jungle Babbler (0.0246), and the lowest observed in the Sindh Jungle Sparrow (0.0038), Common Crane (0.0014), Little Ringed Plover (0.0004), and Egyptian Vulture (0.0002) (Figure 2).

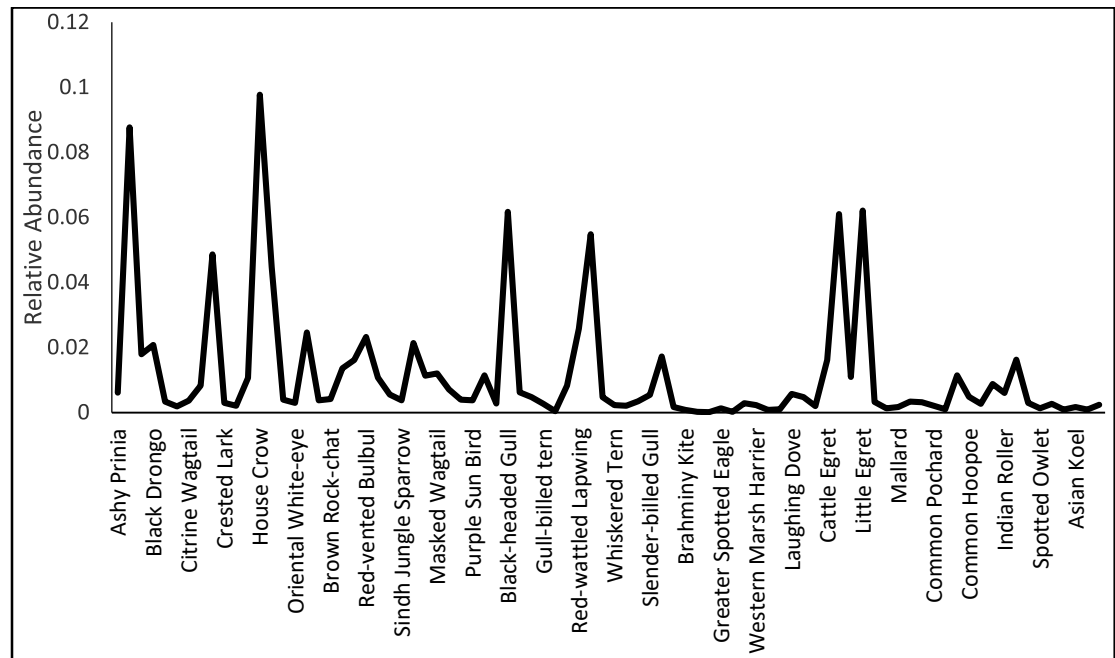


Figure 2: Variation in Relative abundance of major bird species at Guddu Barrage and its surroundings.

During the study, the bird species observed at Guddu Barrage belonged to 16 orders and 36 families. The dominant order was Passeriformes (31 species from 15 families), followed by Charadriiformes (13 species from 4 families) and Accipitriformes (8 species from 1 family) (Figure 3). The dominant families of birds observed at Guddu Barrage were Accipitridae (8 species), Laridae (7 species), and Muscicapidae and Anatidae (6 species each) (Figure 4).

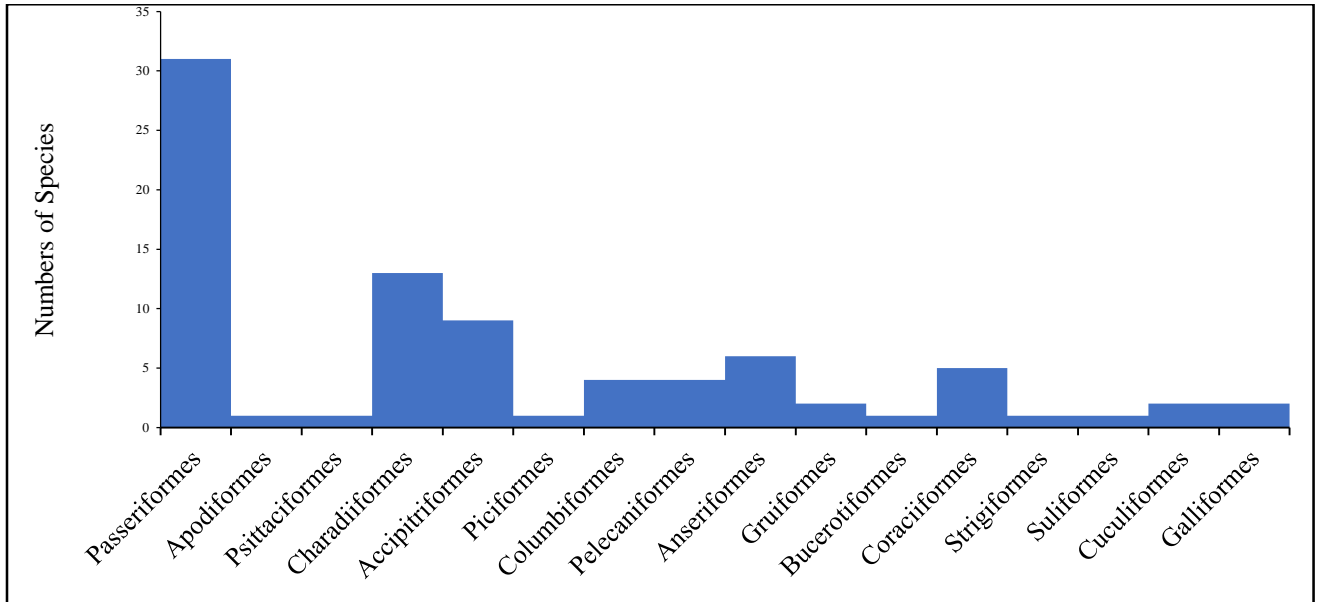


Figure 3: Orders of Bird recorded at Guddu Barrage.

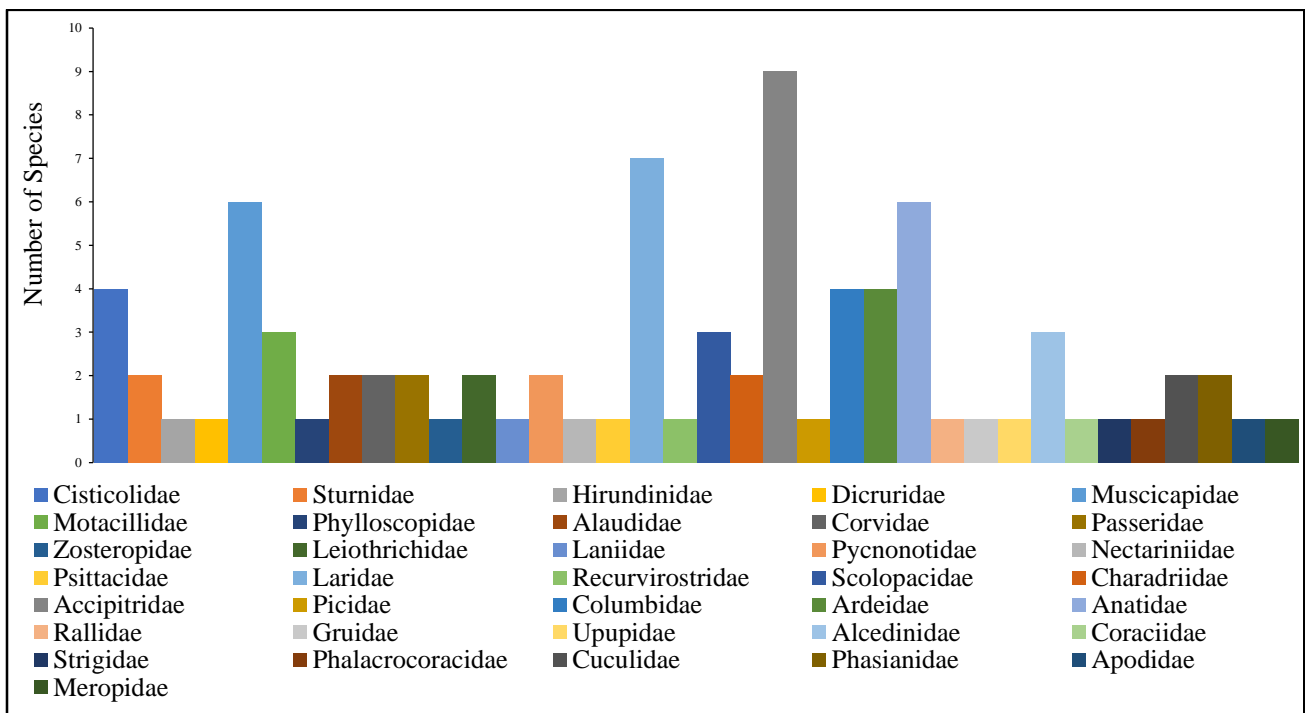


Figure 4: Families of Birds recorded at Guddu Barrage.

The birds were observed and recorded at three sites: the main barrage length, river banks, and catchment areas around Guddu Barrage. A total of 4,556 birds belonging to 69 species were observed at the main barrage length; 3,987 birds belonging to 72 species were observed at the river banks; and 6,631 birds from 83 species were observed in the catchment areas of Guddu Barrage during August 2021 and July 2022 (Figure 5).

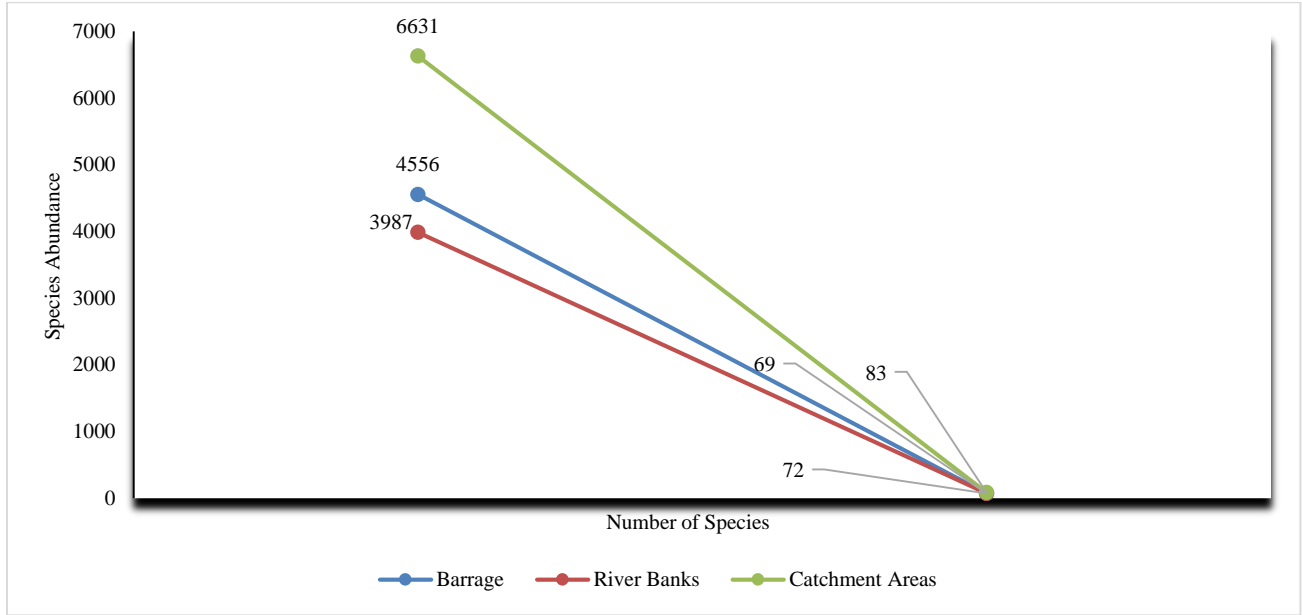


Figure 5: Comparison of Diversity and Abundance of Birds at main barrage length, riverbanks and catchment areas.

OCCURRENCE STATUS OF BIRDS

The occurrence status of the birds recorded during the study at Guddu Barrage was determined to be 52 resident species, 25 winter visitors, 4 summer visitors, and 2 passage migrants (Figure 6). From August 2021 to July 2022, a total of 3,933 (26%) birds belonging to 31 species were observed as migratory bird species that visit the Guddu Barrage at different times of the year. This showed that 74% of the birds observed during this study are residents of Guddu Barrage and its surroundings, with a total of 11,241 birds belonging to 52 species.

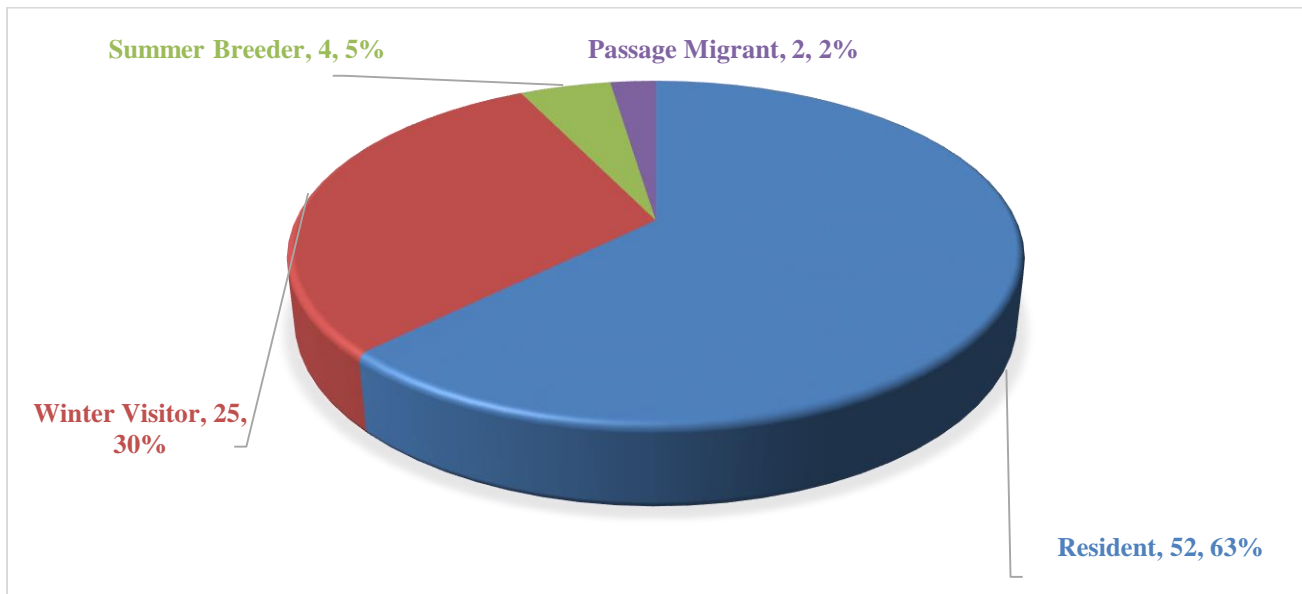


Figure 6: Occurrence Status of Birds at Guddu Barrage.

CONSERVATION STATUS OF BIRDS

Guddu Barrage has been determined to be rich in diversity and abundance of bird species. During this study 83 species of birds were recorded out of which one species (Egyptian Vulture) is Endangered, one species (Ferruginous Duck) Near Threatened and three species (Common Pochard, Greater Spotted Eagle and River Tern) are Vulnerable (Figure 7).

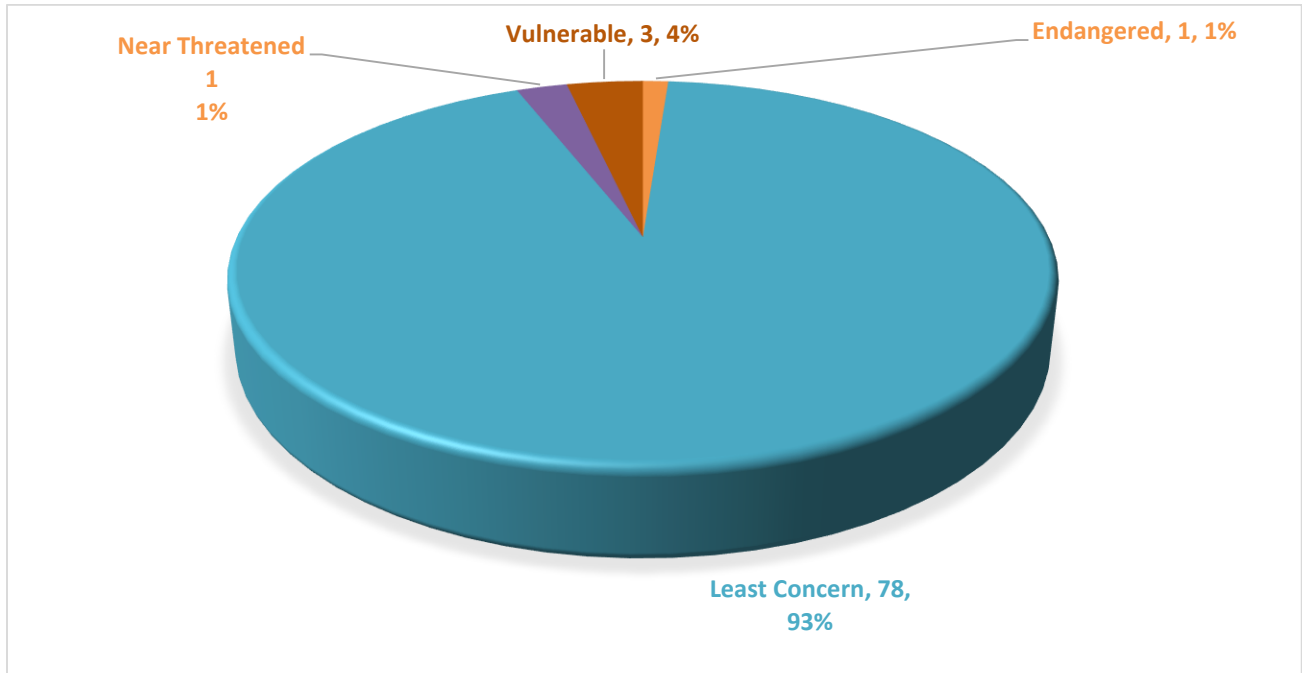


Figure 7: Conservation status of Birds at Guddu Barrage.

DISCUSSION

Eighty-three species of birds were identified in the study area, with a total of 15,174 bird records and a Shannon-Wiener diversity index $H' = 3.62$. Passeriformes is recorded as the most diverse order of birds, including 31 species present in the study area, while Accipitridae is the most diverse family of birds, including 8 species. During the one-year study (2021-2022), the birds were recorded as residents (52 species), winter visitors (25 species), summer visitors (4 species), and passage migrants (2 species). Out of the 83 species recorded at Guddu Barrage, 78 species are of Least Concern, but 5 species of birds in this area necessarily require strategies to conserve their populations, including the Egyptian Vulture (Endangered), and Ferruginous Duck (Near Threatened), as well as River Tern, Greater Spotted Eagle, and Common Pochard (Vulnerable).

Guddu Barrage and its surroundings are rich in flora and fauna, and many bird nests were observed during the study. The bird species with the highest relative abundance recorded during this study include House Crow (0.0977), Bank Myna (0.0877), Little Egret (0.0621), Black-headed Gull (0.0617), River Tern (0.0548), Common Myna (0.0486), House Sparrow (0.0448), Red-wattled Lapwing (0.0258), Jungle Babbler (0.0246), and Red-vented Bulbul (0.0233).

During surveys and questioning of the local people, it was reported that in the last five years, most of the bird species did not visit the barrage due to increased disturbance and hunting. However, after the Covid-19 lockdown, the people of the area were confined to their homes, and hunting decreased, allowing many species to start arriving at the barrage.

During a study in 2018, 131 bird species belonging to 14 orders were recorded at Langh Lake (Mosvi et al., 2019). At Taunsa Barrage, 150 species of birds belonging to 19 orders and 53 families were recorded, with a Shannon-Wiener diversity index value $H' = 4.08$. Out of these 150 bird species, 19 species were identified as riparian birds (Haider et al., 2022). Due to habitat destruction, unawareness, and poverty of local communities, populations of 14 species of birds declined at Taunsa Barrage Wildlife Sanctuary (Bibi et al., 2013).

At Keti-Bander Port on the Indus River, 4,280 birds of 49 species were recorded, with a Shannon-Wiener diversity index $H' = 3.23$. Out of these 49 species, the most abundant species were Little Egret ($P_i = 0.15$), Cattle Egret ($P_i = 0.09$), Greater Flamingo ($P_i = 0.09$), Greater Egret ($P_i = 0.08$), Common Coot ($P_i = 0.06$), Black-headed Gull ($P_i = 0.02$), and Little Grebe ($P_i = 0.02$) (Ali et al., 2016). A total of 9,699 birds of 89 species belonging to 15 orders were recorded at Trimmu Barrage, including 52 residents, 20 migratory, 4 migratory breeders, and 4 rare species of birds (Mahboob, 2009).

Large numbers of individuals of about 347 species of birds were recorded by Roberts (1991 and 1992) that visit the Mangla Dam, which is an important breeding and wintering site. However, the birds are hunted in such large numbers that the populations of bird species have declined, and only 141 bird species were recorded during the surveys of 2011 (Ali et al., 2011). During 2011-2014, 57,892 birds of 188 species belonging to 57 families and 17 orders were observed at Mangla Dam. The bird population decreased due to water pollution, unsustainable fisheries practices, and trapping (Khan and Ali, 2014).

CONCLUSION

Most of the bird diversity and abundance were observed in the catchment areas of the Guddu Barrage due to disturbances from continuous traffic, the movements of fishermen's boats, and boats of people working for the rehabilitation of Guddu Barrage under DESCON Engineering Company. The main threats to birds are hunting, air pollution from the smoke of passing traffic, trapping, poaching, the use of chemicals and synthetic drugs, and the movements of boats in the river. Hunting of the birds is another cause of the decrease in bird diversity along the main barrage length, and their abundance decreases to very small numbers during the winter season when hunters are most active in shooting water birds. Migratory bird species, especially cranes and ducks, were observed to be hunted and captured during immigration and emigration when birds travel in groups. Although birds are captured and hunted in large numbers, vast diversity and abundance of birds were observed at Guddu Barrage. These bird species can be conserved by declaring the barrage and its surrounding areas as bird sanctuaries or protected areas.

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Table 1: Diversity and Relative Abundance of Birds at Guddu Barrage and its surroundings.

Sr.	Order	Family	English Name <i>Scientific Name</i>	R. A.	Status	Habitat
1	Passeriformes	Cisticolidae	Ashy Prinia <i>Prinia socialis</i>	0.0061	LC	R
2			Plain Prinia <i>Prinia inornata</i>	0.0162	LC	R
3			Sindh Yellow-bellied Wren Warbler <i>Prinia flaviventris</i>	0.0071	LC	R
4			Streaked Fantail Warbler <i>Cisticola juncidis</i>	0.004	LC	R
5		Sturnidae	Bank Myna <i>Acridotheres sginginianus</i>	0.0877	LC	R
6			Common Myna <i>Acridotheres tristis</i>	0.0486	LC	R
7		Hirundinidae	Barn Swallow <i>Hirundo rustica</i>	0.0179	LC	W
8		Dicruridae	Black Drongo <i>Dicurus macrocercus</i>	0.0208	LC	R
9		Muscicapidae	Black Redstart <i>Phoenicurus ochruros</i>	0.0034	LC	W
10			Blue-throat <i>Luscinia svecica</i>	0.0019	LC	W
11			Indian Robin <i>Copsychus fulicatus</i>	0.004	LC	R
12			Brown Rock-chat <i>Oenanthe fusca</i>	0.0042	LC	R
13			Pied Bush-chat <i>Saxicola caprata</i>	0.0136	LC	R
14			Rufous-tailed Scrub Robin <i>Cercotrichas galactotes</i>	0.0108	LC	P
15		Motacillidae	Citrine Wagtail <i>Motacilla citreola</i>	0.0037	LC	W
16			Siberian Pied Wagtail <i>Motacilla alba dukhunensis</i>	0.0113	LC	R
17			Masked Wagtail <i>Motacilla alba personata</i>	0.012	LC	R
18		Phylloscopidae	Brown Chiffchaff <i>Phylloscopus collybita</i>	0.0083	LC	W
19		Alaudidae	Crested Lark <i>Galerida cristata</i>	0.003	LC	R
20			Small Skylark <i>Alauda gulgula</i>	0.0021	LC	W
21		Leithrichidae	Common Babbler <i>Argya caudata</i>	0.0107	LC	R
22			Jungle Babbler <i>Argya striata</i>	0.0246	LC	R
23		Corvidae	House Crow <i>Corvus splendens</i>	0.0977	LC	R
24			Indian Treepie <i>Dendrocitta vagabunda</i>	0.0055	LC	W
25		Passeridae	House Sparrow <i>Passer domesticus</i>	0.0448	LC	R

26			Sindh Jungle Sparrow <i>Passer phyrronotus</i>	0.0038	LC	R	
27		Zosteropidae	Oriental White-eye <i>Zosterops palpebrosus</i>	0.003	LC	R	
28		Laniidae	Long-tailed Shrike <i>Lanius schach</i>	0.0038	LC	R	
29		Pycnonotidae	Red-vented Bulbul <i>Pycnonotus cafer</i>	0.0233	LC	R	
30			White-cheeked Bulbul <i>Pycnonotus leucotis</i>	0.0214	LC	R	
31		Nectariniidae	Purple Sun Bird <i>Cinnyris asiaticus</i>	0.0038	LC	R	
32	Apodiformes	Apodidae	Little Swift <i>Apus affinis</i>	0.0114	LC	P	
33	Psittaciformes	Psittacidae	Rose-ringed Parakeet <i>Psittacula krameri</i>	0.0028	LC	R	
34	Charadriiformes	Laridae	Black-headed Gull <i>Chroicocephalus ridibundus</i>	0.0617	LC	W	
35			Gull-billed tern <i>Gelocheidon nilotica</i>	0.0027	LC	W	
36			River Tern <i>Sterna aurantia</i>	0.0548	VU	W	
37			Whiskered Tern <i>Chlidonias hybrida</i>	0.0023	LC	P	
38			Little Tern <i>Sternula albifrons</i>	0.0021	LC	R	
39			Caspian Tern <i>Hydroprogne caspia</i>	0.0035	LC	W	
40			Slender-billed Gull <i>Chroicocephalus genei</i>	0.0054	LC	W	
41			Recurvirostridae	Black-winged Stilt <i>Himantopus himantopus</i>	0.0062	LC	R
42			Scolopacidae	Green Sandpiper <i>Tringa ochropus</i>	0.0048	LC	W
43				Common Sandpiper <i>Actitis hypoleucos</i>	0.0083	LC	W
44	Wood Sandpiper <i>Tringa glareola</i>	0.0048		LC	W		
45	Charadriidae	Little Ringed Plover <i>Charadrius dubius</i>	0.0004	LC	W		
46		Red-wattled Lapwing <i>Vanellus indicus</i>	0.0258	LC	R		
47	Accipitriformes	Accipitridae	Black Kite <i>Milvus migrans</i>	0.0173	LC	R	
48			Black-winged Kite <i>Elanus caeruleus</i>	0.0017	LC	R	
49			Brahminy Kite <i>Haliastur indus</i>	0.0008	LC	P	
50			Egyptian Vulture <i>Neophron percnopterus</i>	0.0002	EN	R	
51			Eurasian Griffon Vulture <i>Gyps fulvus</i>	0.0001	LC	R	
52			Greater Spotted Eagle <i>Clanga clanga</i>	0.0013	VU	W	

53			Long-legged Buzzard <i>Buteo rufinus</i>	0.0029	LC	W
54			Western Marsh Harrier <i>Circus aeruginosus</i>	0.0023	LC	W
55	Piciformes	Picidae	Golden-backed Woodpecker <i>Dinopium benghalense</i>	0.0008	LC	R
56	Columbiformes	Columbidae	Blue Rock Pigeon <i>Columba livia</i>	0.001	LC	R
57			Laughing Dove <i>Spilopelia senegalensis</i>	0.0057	LC	R
58			Spotted Dove <i>Spilopelia chinensis</i>	0.0048	LC	R
59			Yellow-footed Green Pigeon <i>Treron phoenicopterus</i>	0.002	LC	R
60	Pelecaniformes	Ardeidae	Cattle Egret <i>Bubulcus ibis</i>	0.0162	LC	R
61			Indian Pond Heron <i>Ardeola grayii</i>	0.061	LC	R
62			Intermediate Egret <i>Ardea intermedia</i>	0.011	LC	R
63			Little Egret <i>Egretta garzetta</i>	0.0621	LC	R
64	Anseriformes	Anatidae	Common Teal <i>Anas crecca</i>	0.0033	LC	W
65			Ferruginous Duck <i>Aythya nyroca</i>	0.0013	NT	W
66			Mallard <i>Anas platyrhynchos</i>	0.0017	LC	W
67			Northern Pintail <i>Anas acuta</i>	0.0034	LC	W
68			Gadwall <i>Mareca strepera</i>	0.0032	LC	W
69			Common Pochard <i>Aythya ferina</i>	0.0021	VU	W
70	Gruiformes	Rallidae	White-breasted Water-hen <i>Amaurornis phoenicurus</i>	0.001	LC	R
71		Gruidae	Common Crane <i>Grus grus</i>	0.0114	LC	W
72	Bucerotiformes	Upupidae	Common Hoopoe <i>Upupa epops</i>	0.0049	LC	R
73	Coraciiformes	Alcedinidae	Common Kingfisher <i>Alcedo atthis</i>	0.0027	LC	R
74			Pied Kingfisher <i>Ceryle rudis</i>	0.0163	LC	R
75			White-breasted Kingfisher <i>Halcyon smyrnensis</i>	0.003	LC	R
76		Meropidae	Green Bee-eater <i>Merops orientalis</i>	0.0088	LC	S
77		Coraciidae	Indian Roller <i>Coracias benghalensis</i>	0.006	LC	R
78	Strigiformes	Strigidae	Spotted Owlet <i>Athene brama</i>	0.0013	LC	R
79	Suliformes	Phalacrocoracidae	Little Cormorant <i>Microcarbo niger</i>	0.0027	LC	R

80	Cuculiformes	Cuculidae	Greater Coucal <i>Centropus sinensis</i>	0.0009	LC	R
81			Asian Koel <i>Eudynamys scolopaceus</i>	0.0017	LC	S
82	Galliformes	Phasianidae	Black Partridge <i>Francolinus francolinus</i>	0.0009	LC	R
83			Grey Partridge <i>Francolinus pondicerianus</i>	0.0024	LC	R

Note: RA: Relative Abundance, R: Resident, W: Winter, S: Summer, P: Passage Migrant