International Journal on Emerging Technologies **11**(5): 647-651(2020)

ISSN No. (Print): 0975-8364
ISSN No. (Online): 2249-3255

Seasonal Variations in Diversity and Distribution of Avian Fauna in Trimmu Barrage at District Jhang Punjab, Pakistan

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(Received 19 October 2020, Revised 27 November 2020, Accepted 18 December 2020)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Pakistan is prosperous country in case of biodiversity and contains many areas which are the important habitats for different flora and fauna. Pakistan catches the attention of variety of birds due to diverse ecosystem. Birds are important to maintain the balance of ecosystems by providing various ecological services. Current study assesses the seasonal variation in the population of birds in Trimmu Barrage at Jhang district for the period of one year (May 2018-April 2019). Direct or indirect methods were used to collect the avifaunal data and meetings with locals were done. Binocular and spotting scope was used to enumerate the birds. Field guide (bird of Pakistan) was used as a key for the identification of birds. During this whole period 26 types of species was observed in Trimmu Barrage with a total count of 11,556. The dominant specie in the barrage was common coot and the relative abundance was 63.71. The Shannon-Weiner diversity index was 1.60. The census index was 775.7. Also the richness and evenness indices were 27.9 and 1.13. Water quality parameters (Temperature, DO, Turbidity, pH, Ammonia, Nitrite, Nitrate, Calcium and Magnesium of the barrage were evaluated at monthly basis along with the diversity and distribution of birds of all the sites. The results suggest that the birds are important biotic component of ecosystem; therefore, their population needs to be conserved by protecting their habitat.

Keywords: ecosystem, district Jhang, Trimmu barrage, seasonal variation, water quality parameters.

I. INTRODUCTION

The Pakistan is located in the western part of South Asia almost between 24, 37◦ N and 62, 75◦ E [1]. Pakistan provide habitat to biodiversity. Biodiversity is essential for balance and protection of an ecosystem and also important for understanding central value of all species on earth. Pakistan has variety of ecosystems that attract the concentration of many birds' species [2]. More than 650 species are reported in Pakistan in three zoogeographical zones that are Oriental, Palearctic and Ethiopian region which is very distinctive in the world [3]. Pakistan provide habitat to migratory birds that migrate from Siberia towards Pakistan. Decline in number of birds was due to prohibited hunting, land leasing to the farmers for agriculture, eutrophication of lake, livestock grazing and vegetation exploitation [4]. Trimmu Barrage is situated about 21km from district Jhang and 96 km from Faisalabad. It contains one drain named Bhud and two rivers Jhelum and Chenab. Trimmu Barrage shows characteristics of both fresh water and terrestrial ecosystems. It is an important staging and wintering place for migratory waterfowls particularly Anatidae and staging shelter for waders [5]. The main objective of the current study was to determine the seasonal variations in diversity, distribution and water quality parameters of avian fauna in Trimmu barrage of district Jhang.

II. MATERIALS AND METHODS

Study area Specifications

The study was carried in Trimmu Barrage (TB) at district Jhnag Punjab, Pakistan. Trimmu Barrage is located 21km from district Jhang on Bhakkar road and it is present near Atharan Hazari where the River Jhelum flows into River Chenab. Head pond area is 3, 680, 43 acres of Trimmu Barrage. Three main canals, two from the left bank (Trimmu_Sadhnai link canal and Haveli project canal) and one from the right bank (Rangpur canal) emerged from the pond area of the Barrage. Trimmu Barrage contain both terrestrial and aquatic ecosystem.

Data collection method

Data on ecology and population of aquatic bird's diversity were recorded from the barrage. The study site was observed once in month. A variety of field methods were applied at different stages of the survey. These methods were generally classified into two categories:

1. The direct field observations
2. Indirect observation method (Information from the local community) was used.

Census and Monitoring of Avifauna

The census and monitoring of birds is very important to investigate the complete fitness of an environment and it

is considered as highly commercial method and investigates the complete fitness of environment. Direct count method was used to check the bird's diversity. Bird species was counted three times and an average was recorded during each survey.

Point Count and other methods

In point count method, several random points were selected and species diversity and species abundance was recorded. Binocular and spotting scopes were used to count the accurate number of birds in the field. Photographs were taken with different angles by using boats for species identification. Meetings with local expert people of the community was arranged to get information.

Other methods

— A boat survey was conducted for number of eggs count and bird identification.

— Photographs were taken.

— Species identification was also done through a field guide [6]. Further information was obtained by informal meetings with the locals for taking the information about overall status of wild life of the area and particularly for the birds. Boat and field surveys were used to do the meetings with the community.

Water sampling

For the study of physicochemical parameters, five sampling points were selected within the lake and samples were collected from the same location each time using one litter plastic bottles. Plastic bottles were treated by diluted hydrochloric acid solution (2.5% HCL) for sampling; distilled water was used for washing and dried.

The containers were cleaned about three times with the same water to be sampled in the field. The sample bottle was labeled describing the sampling point, name of water body, time and date.

On spot reading were taken for PH, temperature and electrical conductivity. Further analysis of the sample water has done as per the standard methods [7].

Statistical analysis

The data of bird's diversity was subjected for statistical analysis by using Excel software 2007. For water quality parameters Excel is used for the calculation of mean and standard deviation of the water quality variables.

The different diversity indices were used for calculating the bird's diversity including:

Shannon Weiner Diversity Index

It was calculated by using formula of Shannon and Wiener [8].

H' = - [ΣPI ln PI]

Where H = Diversity Index

PI= relative abundance of the species to the total population.

Species richness.

The number of species was noted [9].

SR = (S – 1)/logn N,

Where S=Total number of species

N= Total number of individuals present in the sample

Species evenness.

It was calculated by using the following formulae [10].

E = H'/ Logn S

Where S =Total number of species

H =Shannon wiener diversity index

III. RESULTS

Avian diversity at Trimmu barrage

The survey study was conducted from May 2018 to April 2019. In this duration a variety of species were observed and recorded on the Trimmu Barrage. During this survey total 26 bird species were observed on the Trimmu Barrage with a total count of 11,556. The most common species was Common Coot (*Fulicaatra*) with a total count of 7240 while bird species with the least count was Crested Lark (*Galeridacritata*). Other species observed were Common Pochard (*Aythyaferina*), Northern shoveler (*Anasclypeata*), Little Grebe (*Tachybaptusruficollis*), Common Teal (*Anascrecca*), Black wing stilt (*Himantopushimantopus*), Gadwall (*Anasstrepera*), Common Myna (*Acredotherestristis*), Barn swallow (*Hirundorustica*)Greater flamingo (*Phoenicopterusruber*), Grey Heron (*Ardeacinerea*) and Indian Roller (*Coraciasbenghalensis*) as shown in Table 1.

Relative abundance

Relative abundance of all the species was calculated. Common Coot has the highest relative abundance of 62.65 while Crested Lark has lowest relative abundance of 0.07. Relative abundance of other species as Common Pochard (9.54), Nothern Shoveler (5.45), Little Grebe (4.28), Common Teal (2.69), Black wing Stilt (2.23), Gadwall (1.67), Common Myna (1.64), Barn Swallow (1.51), Greater Flamingo (1.38), House Crow (1.22), Red wattled lapwing (1.15), Weigon (0.94), White Wagtail (0.74), Northern Pin Tail (0.71), Common Moorhen (0.51), Great crested Grebe (0.29), Little Stint (0.24), White Throated Kingfisher (0.23), Black Kite (0.22), Rock Pigeon (0.17), Common Sandpiper (0.14), Grey Heron (0.12), Pied Bush Chat (0.10) and Purple Heron (0.08) as shown in Table 1.

Census Index.

Census index was also calculated for each species by dividing the total number of individual of one species by the area. The highest diversity index was calculated for Common Coot that was 485.72/Km^2 while the lowest diversity index was calculated for Crested Lark that was 0.54/Km^2. Census index of other species as Common Pochard (73.93), Nothern Shoveler (42.27), Little Grebe (33.31), Common Teal (20.86), Black wing Stint (17.31), Gadwall (12.95), Common Myna (12.75), Barn Swallow (11.74), Greater flamingo (10.73), House Crow (9.46), Red wattledlapwing (8.92), Weigon (7.31), White Wagtail (5.71), Northern Pin Tail (5.50), Common Moorhen (3.96), Great crested Grebe (2.21), Little Stint (1.88), White Throated Kingfisher (1.81), Black Kite (1.68), Rock Pigeon (1.34), Common Sandpiper (1.14) and Grey Heron (0.94) as shown in Table 1.

Table 1: Birds data of Trimmu Barrage (May 2018-April 2019).

Species (Common Name) Scientific Name	Months														Relative Abundance	Census Index
	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total	Average		
Common Coot (***Fulicaatra***)	20	0	0	0	800	100	270	750	900	1200	2800	400	7240	603.33	62.62	485.72
Commom Pochard (***Aythyaferina***)	20	0	0	0	0	10	33	50	166	400	300	123	1102	91.83	9.53	73.93
Northern Shover (***Anasclypeata***)	5	0	0	0	30	0	0	25	80	130	250	110	630	52.50	5.45	42.27
Little Grebe (***Tachybaptusruficollis***)	10	0	0	0	140	40	50	60	67	73	35	20	495	41.25	4.28	33.21
Commom Teal (***Anascrecca***)	0	0	0	0	0	0	0	30	60	105	95	21	311	25.92	2.69	20.86
Black wing stilt (***Himantopushimantopus***)	30	38	25	10	11	14	20	21	20	25	21	23	258	21.50	2.23	17.31
Gadwall (***Anasstrepera***)	0	0	0	0	0	0	0	28	45	60	44	16	193	16.08	1.67	12.95
Common Myna (***Acredotherestristis***)	20	18	16	14	17	10	15	8	14	18	19	21	190	15.83	1.64	12.75
Barn Swollow (***Hirundorustica***)	0	0	0	24	48	23	35	45	0	0	0	0	175	14.58	1.51	11.74
Greater flamingo (***Phoenicopterusruber***)	19	19	21	51	50	0	0	0	0	0	0	0	160	13.33	1.38	10.73
House crow (***Corvussplendens***)	16	18	12	10	11	8	5	7	12	15	15	12	141	11.75	1.22	9.46
Red wattled lapwing (***Vanellusindicus***)	22	15	10	2	0	2	3	5	12	20	21	21	133	11.08	1.15	8.92
Weigon (***Anas Penelope***)	0	0	0	0	0	0	0	15	24	40	20	10	109	9.08	0.94	7.31
White Wagtail (***Motacilla alba***)	6	4	7	4	7	5	7	10	11	9	7	9	86	7.16	0.74	5.77
Nothern Pin Tail (***Anasacuta***)	0	0	0	0	0	0	0	10	20	18	23	11	82	6.83	0.71	5.50
Common Moorhen (***Gallinulachloropus***)	6	0	0	0	4	5	7	9	8	9	11	6	59	4.92	0.51	3.96
Great crested Grebe (**Podicepscristatus**)	0	0	0	0	0	0	0	2	13	10	8	0	33	2.75	0.29	2.21
Little stint (**Calidris minutes**)	0	0	0	4	7	0	0	2	4	6	5	0	28	2.33	0.24	1.88
White throated kingfisher (***Halcyon smyrnensis***)	1	4	2	2	1	2	2	2	1	3	3	4	27	2.25	0.23	1.81
Black kite (***Milvusmigrans***)	4	3	2	4	3	0	1	2	1	2	1	2	25	2.08	0.22	1.68
Rock pigeon (***Columba livia***)	1	2	2	2	2	2	1	1	3	2	1	1	20	1.67	0.17	1.34
Common Sandpiper (***Actitishypoleucos***)	0	1	0	1	1	1	2	1	2	4	3	1	17	1.42	0.15	1.14
Grey Heron (***Ardeacinerea***)	1	0	2	2	1	0	0	1	1	1	2	3	14	1.17	0.12	0.94
Pied bush chat (***Saxicolacaprata***)	0	0	2	0	0	0	0	0	2	4	3	0	11	0.92	0.10	0.74
purple Heron (***Ardeapurpurea***)	1	0	1	0	1	0	0	1	0	2	1	2	9	0.75	0.08	0.60
Crested Lark (***Galeridacritata***)	0	2	2	0	1	0	0	0	1	1	0	1	8	0.67	0.07	0.54

Summary of different diversity indices at the Survey Sites.

Total area of Trimmu Barrage is 1490.574 hectares. The dominant specie in the barrage was common coot and the relative abundance was 63.71. The different diversity indices of the barrage including Shannon-Weiner diversity index, Richness Index, Evenness Index were calculated as shown in the Table 2.

Table 2: Summary of Different Analysis at the Survey Sites.

Analysis	Trimmu Barrage
Total population	11562
Total Number of Species	28
Survey Area (ha)	1490.574
Census Index	775.7
Shannon-Weiner Diversity Index	1.60
Richness Index	27.9
Evenness Index	1.13
Dominant Species	Common Coot
Relative abundance	63.71

At Trimmu Barrage total 26 bird species were observed out of which 15 were resident (58%), 7 winter visitors (27%), 3 summer breeders (11%) and 1 was passage migrant (4%) as shown in Fig. 1.

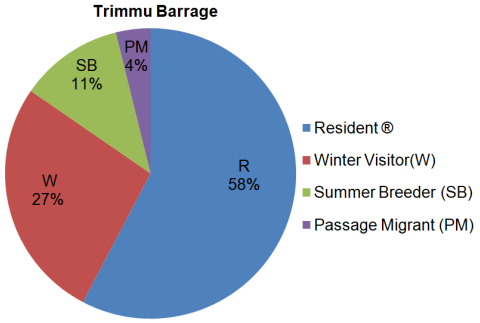

Fig. 1. Pie chart showing distribution of birds at Trimmu Barrage.

Water Quality Parameters of Trimmu barrage

To study water quality parameters, water was collected from May 2018 to April 2019 on monthly basis. The mean values of chemical parameters observed throughout the year are Temperature (24.51±4.95), DO (6.92±1.26), Turbidity (11.15±2.29), pH (7.93±0.95), Ammonia (0.47±0.23), Nitrite (0.03±0.06), Nitrate (0.01±0.03), Calcium (296.33±61.18) and Magnesium (284.58±69.85) as shown in Table 3.

Table 3: Water quality parameters of Trimmu barrage.

S.No.	Parameters	Trimmu Barrage
1.	Temperature	24.51±4.950
2.	DO	6.92±1.26
3.	Turbidity	11.15±2.29
4.	PH	7.93±0.95
5.	Ammonia	0.47±0.23
6.	Nitrites	0.03±0.06
7.	Nitrates	0.01±0.03
8.	Calcium	296.33±61.18
9.	Magnesium	284.58±69.85

IV. DISCUSSION

Asia is rich in biodiversity and contains variety of ecosystems because it is largest on the planet of earth. In Pakistan, there are several important sites that provide shelter, food and other necessary things to the aquatic birds. Every year numerous birds migrate towards the water bodies in Pakistan to spend the winter. Wind also effects the migration in birds. Birds prefer to migrate at dusk when the rate of wind is suitable [11].

During the current survey total 26 bird species were observed on the Trimmu Barrage with a total count of 11,556. Shannon-weiner diversity index was (1.60). Richness Index and Evenness was (27.9) and (1.13) respectively. Seasonal variation in bird diversity and population was also observed and minimum number of birds was observed during July (2018) and maximum population was observed in March (2019). Mehboob and Nisa [5] conducted a survey to check the bird's diversity of Trimmu Barrage and reported 89 bird's species of that belong to 68 genera, 39 families and 15 orders. The most dominant order was Passeriformes while charadriiformes were the sub dominant order. Ali and Ripley [12] reported 89 species from the same area. This showed that there is large decrease in bird's population and diversity in comparisons to other studies. This might be serious threats to bird's diversity in the form of overhunting, poaching and no suitable environment to the birds or many other reasons.

Raza *et al.,* [13] conducted a survey to check the avian diversity at Lahore zoo safari during winter season. A total 2085 birds were noted that belong to 52 species, 30 families and 12 orders. Shannon-weiner diversity index (1.93) was recorded. The observed species wereHouse crow, House sparrow, Common myna, Jungle babbler and Black crowned night heron. Awan *et al.,* [14] noted 49 species, out of these 24 species were resident, 14 species were winter visitors and 11 species were summer visitors. Irfan [15] noted 524 birds during the survey of Changa Manga. Munir (2010) recorded maximum 363 birds in Ravi Siphon. Altaf *et al.,* [16] recorded 2644 birds from head Khanki, Punjab, Pakistan. The reason of decline population in Trimmu barrage compared to other areas is like loss of habitat, diseases, chemical pollution, feeding and rooting areas. There was disturbance due to human degraded quality of foraging, invasion of introduced species and illegal hunting especially during December, January and February when there is huge number of migrant birds are available.

The analysis of surface water was also done to check the physic-chemical parameters of water. The water analysis showed that the water in Trimmu barrage is saline and has a pH range of 8.7-10.2. The analysis of water showed that the values of total dissolved solids (TDS), Chloride, Conductivity and total alkalinity were above the W.H.O maximum permissible amount. The rain fall and dilution of water are the main factors that cause variation in the parameters. Rate of dissolution is affected by temperature and rain fall dilutes the concentration of dissolved chemicals of the water. Due to rain the water from the surrounding area carrying the salts flows into water bodies and increase the salinity. In the summer season due to evaporation of water causes the increase in concentration of salts which results in increase of salinity of water bodies. The color of water was mainly greenish due to presence of algae.

V. CONCLUSION

From the current study a total of 26 bird species were observed on the Trimmu Barrage with a total count of 11,556. The most common species was Common Coot (*Fulicaatra*)while the least count was Crested Lark (*Galeridacritata*). This number could be increase but due to many serious threats to the birds which were observed, like loss of habitat, chemical pollution, human degraded quality of foraging and illegal hunting especially during December, January and February when there is huge number of migrant birds are available. The current study recommends the Government attention to take the serious action and to impose the strict rules against illegal hunting, pollution and habitat loss of both the resident and migratory birds because they are important biotic component of ecosystem.

Conflict of Interest. The authors declared no conflict of interest.

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How to cite this article: Khan, M. H., Alam, M., Fozia, Rehman, A. U., Ihtesham, Y., Hassan, S. I., Ullah, W., Mahmood, M. Z. and Naz, S. (2020). Seasonal Variations in Diversity and Distribution of Avian Fauna in Trimmu Barrage at District Jhang Punjab, Pakistan. *International Journal on Emerging Technologies, 11*(5): 647–651.