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AVIFAUNA IN AN URBAN LANDSCAPE OF A LOWER GANGES DISTRICT OF BANGLADESH: COMMUNITY STRUCTURE, SEASONALITY, HABITAT PREFERENCE AND CONSERVATION ISSUES

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Abstract

A yearlong scientific study was conducted using direct field observation technique from November 2020 to October 2021 to investigate community structure, habitat preference, and conservation concerns of birds in the urban setting of Faridpur Sadar Upazila. A total of 168 species under 18 orders and 56 families were recorded and 6,551 individual of birds were counted. The order Passeriformes had the highest species richness (71 species, 42.26%) and abundance (n=3,831, 58.48%). Among the bird species, 48 species (29.58%) were migratory and the rest were resident. During the winter season, the highest number of bird species (156 species, 92.85%) and individuals (n= 2,960, 45.18%) were observed. The overall comparison of species richness and abundance for three seasons were significant. Pair-wise one-way ANOVA for species richness and abundance of birds shows significant differences between winter-rainy and summer-winter seasons.The diversity index showed the highest value in winter season. Analysis of similarity (ANOSIM) test showed a significant difference in birds communities among three-season. Among the 10 types of microhabitats surveyed, trees were the most used by the bird species (103 species, 61.31%) The highest 69 species (41.07%) were very common according to the observation status. The most abundant bird was *Pycnonotus cafer* with the highest relative abundance (5.15%). Bird hunting, trade, and habitat loss were the major threats for the survival of bird community in this area. Therefore, immediate initiatives are needed to implement for the conservation of bird and their habitats.

Introduction

The avifauna, which includes 9026 species of birds worldwide, is a well-known and important group of wildlife that contribute significantly to the ecology, economy and cultural sector(1). They serve as a bio-indicator for assessing levels of pollution in the environment and play an important role for ecologicalservices(2). They are also pollinators, nutrient recyclers and agents of plant gene flow through seed dissemination(2-4). Scavenger birds, such as the Pied Crow (*Corvus albus*), serve to reduce

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garbage levels and control the population of dangerous insects and other pests[2-3,5]. Insectivorous birds and raptors also control disease vectors like mosquitos and rodents[5]. These ecosystem services are important for other animal communities for the continuity of current and future generations[2,3].

Due to the increasing trend of urbanization, more than 55% of the world's human population lives in cities, and this number is predicted to climb to more than 68% by 2050[8-10]. The fast urbanization process, which is steadily affecting the structure of urban landscape and ecology, that has become a serious threat to biodiversity through local species loss due to habitat conversion and biotic homogeneity[11-15]. In the urban area, birds are one of the most common wildlife fauna. Due to rapid urbanization and urban expansion process, many bird population are facing threats and already have declined[5, 16-18]. Though urban habitats offer a wide range of benefits like increased accessibility of food[19], and relief from predators[20], which support a higher level of species diversity and abundance compared to rural or surrounding habitats[20-21].

Bangladesh is a small South Asian country with diverse wildlife resources due to its geographical location[1,7]. The number of bird species in our country is 690[1] which are facing numerous threats such as habitat loss, indiscriminate killing, rapid industrialisation, use of herbicide, pesticide, insecticide fertilizer, hunting, poisoning and trapping[11,23,24]. These threats are also accelerating their population decline in the country. For instance, huge number of migratory bird population are trapped and killed in haor, baor, beel and char areas of Bangladesh[25,26].

Faridpur is a district situated in the south western-region and the urban area of this district is situated on the bank of the river Padma. There are some scientific publications on birds in some urban areas of Banglaesh[5,6,27,28]. But no study has been done in the urban area of Faridpur Sadar upazilasas well as a few research works on wildlife in lower ganges region of Bangladesh is available[5,29,30]. This study provides baseline information on community structure, diversityand seasonal occurrence, habitat utilizations, threats and conservation issues of birds at Faridpur Sadar upazila. Such study may help for the conservation of birds and their habitats.

Materials and Methods

Study area: Faridpur Sadar upazila (23.50°N, 89.83°E) is situated on the bank of the Padma riverin the south-western region of Bangladesh. It was declared as municipality in 1869 which is one of the oldest municipalities of Bangladesh with 22.65 km^2 area. This study was conducted in 10 sites in urban landscape of the study area(Fig. 1).

We surveyed different types of habitats across the 10 sites (Table 1). Surveyed habitats were categorized as arboreal, terrestrial and aquatic and 10 micro-habitats such as (1) floating plant, (2) bushy area, (3) fallow land, (4) waste disposal site, (5) mudflat, (6) grassland, (7) tree, (8) urban settlement, (9) waterbody, and (10) agricultural land.

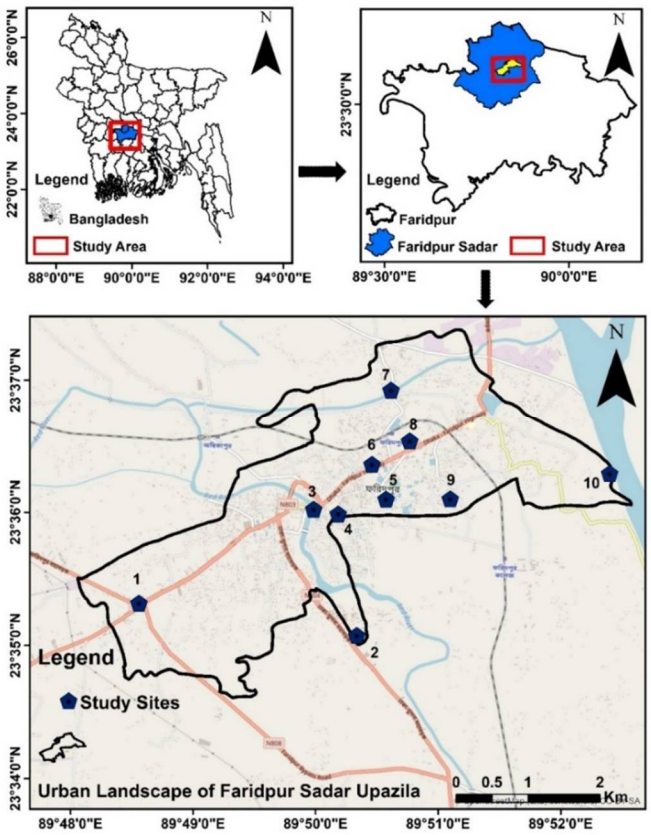

Fig. 1. Map of the study area of Faridpur Sadar upazila, Bangladesh [Note: 1- Rajbarimor area, 2- River Research Institute area, 3- Faridpur New Market area, 4- Jhiltuli area, 5- Rajendro college area, 6- Faridpur district jail area, 7- Ambikapur area, 8- Faridpur Baptist Church area, 9- Polytecnic Institute area, 10- Dholarmor area].

*Data collection:*The study was conducted from November 2020 to October 2021 and the study period was divided into three seasons i.e. winter (November to February), summer (March to June) and rainy (July to October). Data was collected through direct field observation for 48 days (4 days in each month and 16 days in each season) throughout the year. We followed opportunistic survey and transect line survey methods for collecting field data. Each transect line was approximately 400 ×200 = 80,000 square meter and we surveyed three transects per site. Each site was surveyed for two times in each season. Observation was conducted early in the morning (from 6:00am to 10:30am) and afternoon (from 3:00pm to 6:30pm). For collecting data of nocturnal birds, night survey was conducted using torch light and head lamp. Photographs of birds were taken using Nikon D500 DSLR Camera with 200-500 mm VR lensand the relevant field guide[1] was used for proper identification of birds. To investigate the trade of the birds, regular field visit in the local market was done.

Table 1. Study sites and the habitats surveyed at the urban landscape of Faridpur sadar upazila, Bangladesh with their GPS coordinates.

Study Sites	Latitude	Longitude	Surveyed habitat type
Rajbarimor area (1)	23.589	89.8088	Urban settlements, cultivated land, fallow land, waste disposal site, road
River Research Institute area (2)	23.5846	89.8387	Urban settlements, homestead forest, ditch, grassland, river
Faridpur New Market area (3)	23.6012	89.8323	Urban settlements, waste disposal site, river, road
Jhiltuliarea (4)	23.6002	89.8356	Urban settlements, homestead forest, road, ditch, ponds
Rajendro College area (5)	23.6027	89.8421	Urban settlements, homestead forest, road, ditch, ponds, cultivated land, fallow land, grassland
Faridpurdistrict jail area (6)	23.607	89.8401	Urban settlements, road, homestead forest, ditch, ponds, cultivated land, fallow land
Ambikapurarea (7)	23.6125	89.8204	Urban settlements, homestead forest, road, ditch, ponds, cultivated land, fallow land, grassland, river, *beel*
Faridpur Baptist Church area (8)	23.61	89.8451	Urban settlements, ditch, ponds, homestead forest, road, fallow land
Polytecnic Institute area (9)	23.5892	89.8615	Urban settlements, homestead forest, road, ditch, ponds, cultivated land, fallow land, grassland
Dholarmorarea (10)	23.616	89.8674	River, river bank, road, homestead forest, cultivated land, fallow land, urban settlements, grassland

Data analysis: At each location, the number of species and their individual numbers were recorded and used for further calculation. One-way ANOVA wasused to assess difference in species richness and abundance in different micro-habitats and seasons.

The Shannon-Wiener index[31]and Simpson's index [32] of diversity were used to create the diversity indices. By dividing the diversity indices by the natural log of species richness, evenness was calculated. The relative abundance (RA) of different bird species was computed by-

$$RA = \frac{\text{Number of individuals of a particular species}}{\text{Total individuals of all species}} \times 100$$

Following Whittaker (1965)[33], a rank abundance plot was created to better explain dominance patterns. The Bray-Curtis index (1957)[34] approach was used to create a habitat similarity plot or cluster analysis for microhabitats. To estimate the observation status of bird, Khan (2015) was followed as very common (VC) 80-100%, common (C) 50-79%, fairly common (FC) 20-49% and few (F) 10-19% which was calculated based on total sighting per survey attempt. Spreadsheets (MS Excel), R (R Core Team 2020) and PAST software were used to conduct statistical analysis.

Results and Discussion

Species composition: A total of 168 species of birds were observed from the study area which is 24.34% of total birds species of Bangladesh[1] (Appendix 1). The present record of bird species richness in the urban site is higher than any other urban areas of Bangladesh[5,7,27,36]. This result also reflects that the study area covered a diverse types of habitats that might be the reason for the attraction of bird species in such a habitat. Observed birds are belonged to 18 orders and 56 families. The highest number of bird species was under the order Passeriformes (71 species, 42.26% of total species) followed by Charadriiformes (21 species, 12.50%), Accipitriformes (14 species, 8.33%), Pelecaniformes (9 species, 5.35%), Cuculiformes (8 species, 4.76%) and Coraciiformes (8 species, 4.76%). Non-passerine bird species (97 species, 58.74%) number is higher than passerine (71 species, 42.26%) birds in the study area. Of the total species, 120 species (71.42%) were resident birds and the rest 48 (29.58%) species was migratory. *Clamator jacobinus, Cuculus micropterus* and *Merops philippinus* were summer migrant, and *Cuculus canorus*was a passage migrant among the migratory bird species where the rest were winter migratory bird species. This result indicates study area provides ideal habitat for both resident and migratory birds. A total of 6,551 individuals of bird was counted during the study period from the study area. Among them, the highest number (n=3,831, 58.48%) of individuals was recorded from the order Passeriformes. Species accumulation curve increased gradually with the increasing number of field visits and after a certain time, the curve growth was slow and close to equilibrium (Fig. 2). This indicates that, there is possibility to identify more species from the study area if more survey efforts were given.

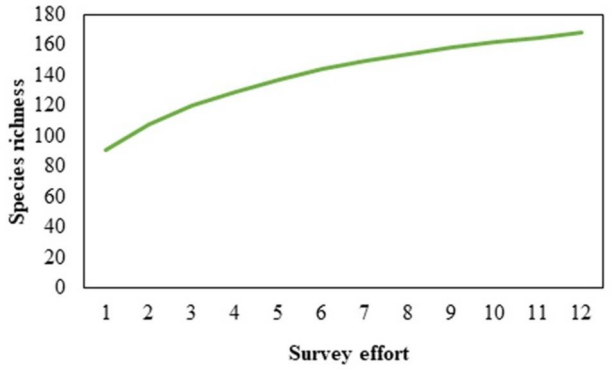

Fig. 2. Species accumulation curve of avifauna in the study area.

Seasonal and monthly variation: The highest number of bird species (156 species, 92.85% of total) were observed from the study area with the highest number of individuals (n= 2,960, 45.18%) during the winter season (Table 2). Among them, 59

species of birds were observed particularly in winter season, where as 77 species of birds observed throughout the year (Fig. 3).

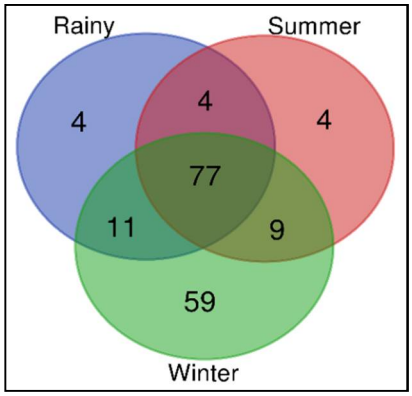

Fig. 3. Venn diagram showing the number of shared and unique species among three seasons.

We found 44 migratory bird species in this season which influenced the the diversity index value (H= 4.417, D_s= 0.981) to be maximum (Table 2). Many species of birds get opportunities to use different habitats (i.e. sand bars, *beels*, river bank) and acquire foodsin the winter season[21]. In January, the highest number of bird species (125 species, 74.04% of total) were observed and diversity indices how the highest diversity for the same month. In July and August, the lowest number of birds (75 species, 44.64%) were observed. Evenness was the highest in the month of June (E=0.721). The highest number of bird individuals (n=784, 11.97%) were observed in the month of December (Table 2). Among 12 month, monthly variation differed significantly in species richness (χ^2= 34.856, df = 11, p =0.002) and abundance (χ^2= 477.6, df = 11, p=0.001).

Analysis of similarity (ANOSIM) test showed significant difference in bird communities among three seasons (R = 0.34, p= 0.002). This test also illustrate significant difference in winter season over the summer and rainy season in non-metric multi-dimensional plot (NMDs) with a stress level of 0.071 (<0.2) (Fig. 4) for the presence of different groups of migratory birds in winter season.

The overall comparison of richness and abundance for three seasons were significantly different (for abundance: F= 5.470, df= 2, p= 0.0045) (for richness: F= 11.330, df= 2, p= 0.001). Pair-wise one-way ANOVA for species richness and abundance of birds shows significant values between winter-rainy and summer-winter season (Table 3). Presence of migratory birds species in winter season made this significant difference.

Habitat preferences, utilization and indices: Among the 10 types of microhabitats, tree was mostly used by the bird species (103 Species, 61.31%) in the study area. Among three types of macro-habitats, the highest number of bird individuals (n= 3,983, 60.80%)

preferred arboreal habitat and the diversity indices (H= 3.882, D_s= 0.9671) also showed the highest value for this macrohabitat (Table 4). The native plant species diversity is high in the urban area of Faridpur Sadar upazila specially in residential, official areas, homestead forests areaswhich supported more species to get shelter, food, roosting and nesting[7, 24,27,29]. Among the observed birds, 52 species used terrestrial habitats and 46 species used aquatic habitat as their macro-habitat (Table 4).

Table 2. Species richness, abundance and diversity indices in different seasons and months

	Category	S	S%	A	A%	D_s	H	E
Season	Rainy	96	57.14	1759	26.85	0.973	4.028	0.585
	Summer	94	55.95	1832	27.97	0.974	4.053	**0.612**
	Winter	**156**	**92.86**	**2960**	**45.18**	**0.981**	**4.417**	0.531
Month	November- 2020	113	67.26	715	10.91	0.979	4.281	0.639
	December- 2020	107	63.69	**784**	**11.97**	0.977	4.200	0.623
	January- 2021	**125**	**74.40**	766	11.69	**0.983**	**4.450**	0.684
	February- 2021	102	60.71	695	10.61	0.978	4.244	0.682
	March- 2021	87	51.79	602	9.19	0.972	4.02	0.640
	April- 2021	81	48.21	416	6.35	0.974	4.037	0.699
	May- 2021	79	47.02	398	6.08	0.971	3.971	0.671
	June- 2021	79	47.02	416	6.35	0.974	4.042	**0.720**
	July- 2021	75	44.64	433	6.61	0.974	4	0.728
	August- 2021	75	44.64	431	6.58	0.971	3.917	0.669
	September- 2021	80	47.62	466	7.11	0.970	3.948	0.648
	October- 2021	81	48.21	429	6.55	0.975	4.049	0.707

S = Species richness, A = Abundance, D_s = Simpson's Index, H = Shannon-Weiner Index, E = Evenness.

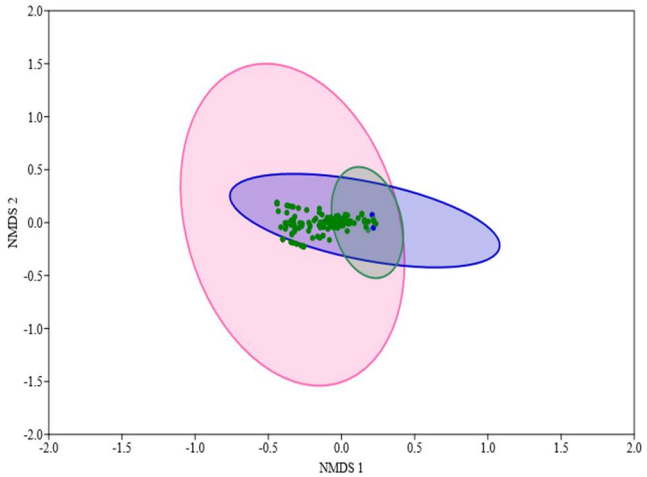

Fig. 4. Non-metric multi-dimensional plot (based on the Bray-Curtis similarity index) showing separation of bird communities among three seasons (circle and dots in pink indicates the winter season; blue indicates summer and green indicates rainy season).

Table 3. Pair-wise tukey HSD results for species richness and abundance in three seasons.

Treatment pairs	Abundance			Richness		
	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD inferfence	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD inferfence
R vs S	0.253	0.899	insignificant	0.708	0.858	insignificant
R vs W	4.172	0.009	** p<0.01	6.152	0.001	** p<0.01
S vs W	3.918	0.016	* p<0.05	5.443	0.001	** p<0.01

R=Rainy, S= Summer, W=Winter.

Table 4. Species richness, abundance and diversity indices in different habitats.

	Category	S	S%	A	A%	D_s	H	E
Macro - habitat	Aquatic	46	27.38	1255	19.16	0.934	3.13	0.497
	Arboreal	**103**	**61.31**	**3983**	**60.80**	**0.967**	**3.882**	0.470
	Terrestrial	52	30.95	1313	20.04	0.952	3.37	**0.559**
Micro-habitat	Agricultural land	6	3.57	88	1.34	0.797	1.669	0.884
	Bushy area	7	4.17	184	2.81	0.746	1.555	0.676
	Fallow land	5	2.98	63	0.96	0.773	1.539	**0.932**
	Floating plant	12	7.14	198	3.02	0.862	2.136	0.705
	Grassland	35	20.83	515	7.86	0.918	2.966	0.554
	Mudflat	21	12.50	297	4.53	0.913	2.676	0.692
	Water body	20	11.90	760	11.60	0.884	2.393	0.547
	Tree	**103**	**61.31**	**3983**	**60.80**	**0.967**	**3.882**	0.470
	Urban substrate	17	10.12	246	3.76	0.881	2.413	**0.656**
	Waste disposal site	6	3.57	217	3.31	0.625	1.199	0.552

S = Species richness, A = Abundance, D_s = Simpson's Index, H = Shannon-Weiner Index, E = Evenness.

Among the microhabitats, species rarefaction curve showed the highest richness and abundance for the tree and most of the species associate this habitat were detected where only few species are left to discover from this habitat. The Chao-1 species estimator value for tree habitat is 105.3 which also indicates that most of the species from tree habitat were found in the study (Fig. 5). In urban areas, presence of tree is higher than any others types of microhabitat, thus species richness and abundance was higher on trees[7,27].

Bray-Curtis similarity index was performed for determining the similarity among 10 types of microhabitats. Two large clusters were formed in this index. Birds formed small clusters among them in the following pairs: urban settlement-waste disposal site; fallow land-grass land; bush-agricultural land; floating plant-water body. Both habitat in each pair share maximum the similar species between them. The cluster of floating plant and water body formed another cluster with mudflat habitat. The cluster of urban

settlement-waste disposal site made another cluster with tree whereas the cluster of fallow land-grass land; bush-agricultural land formed another cluster. Ultimately, they made another 2nd large cluster and shows more distance between the species of the 1st large cluster (Fig. 6).

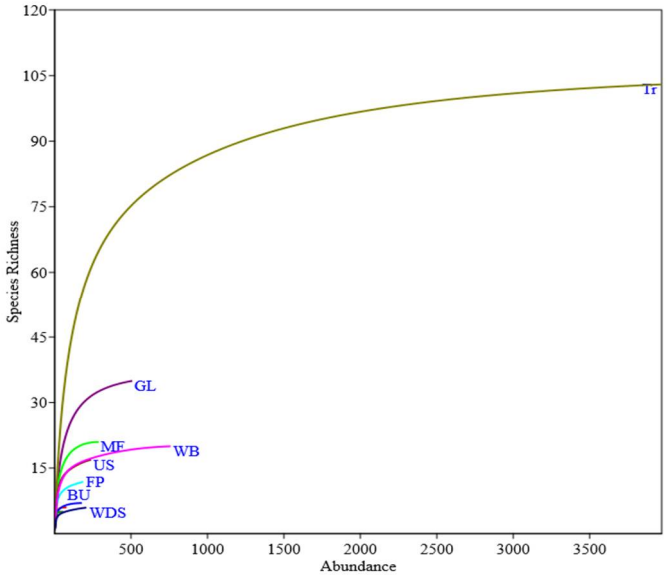

Fig. 5. Rarefaction curves based on the expected number of bird species in different microhabitat.

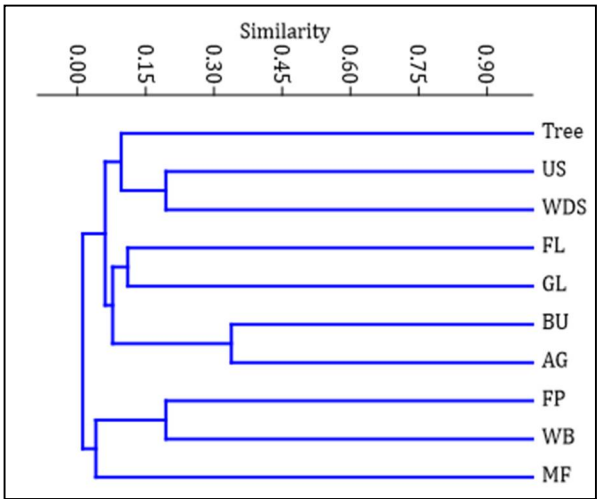

Fig. 6. Similarity profile test among microhabitats using Bray-Curtis index. (BU- Bushy area, FL- Fallow land, WDS- Waste disposal site, MF- Mudflat, GL- Grassland, US- Urban settlement, WB- Water body, AG- Agricultural land, FP- Floating plant).

The overall comparison of richness and abundance for ten microhabitats showed significant variation (for richness: F= 65.144, df=9, p=0.001; for abundance: F=24.874, df=9, p= 0.0001). Bird species richness and abundance was the highest for tree among all micro-habitats and the pair-wise test for habitats was significant for the pairs with tree and all others microhabitat both in species richness and abundance (Table 5). The second highest species richness was observed in the grassland micro-habitat and pairwise variation showed significant value between grassland-agricultural land, grassland-fallow land and grassland-waste disposal site microhabitatin the case of abundance (Table 5).

Table 5. Tukey HSD results for species richness and abundance in ten microhabitats

Treatments pair	Abundance			Richness		
	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD inferfence	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD inferfence
A vs E	1.793	0.9	Ins	4.871	0.021	* p<0.05
A vs G	16.356	0.001	** p<0.01	26.425	0.001	** p<0.01
B vs G	15.952	0.001	** p<0.01	26.019	0.001	** p<0.01
C vs E	1.898	0.9	Ins	4.871	0.021	* p<0.05
C vs G	16.460	0.001	** p<0.01	26.425	0.001	** p<0.01
D vs G	15.894	0.001	** p<0.01	25.329	0.001	** p<0.01
E vs G	14.563	0.001	** p<0.01	21.554	0.001	** p<0.01
E vs J	1.251	0.9	Ins	4.627	0.036	* p<0.05
F vs G	15.478	0.001	** p<0.01	24.882	0.001	** p<0.01
G vs H	15.692	0.001	** p<0.01	25.451	0.001	** p<0.01
G vs I	13.533	0.001	** p<0.01	22.690	0.001	** p<0.01
G vs J	15.814	0.001	** p<0.01	26.181	0.001	** p<0.01

A= Agricultural land, B= Bushy area, C= Fallow land, D= Floating plant, E= Grassland, F= Mudflat, G= Tree, H= Urban settelment, I= Water body and J= Waste disposal Site; Ins= Insignificent.

Relative abundance, observation status and rank abundance curve: According to observation status of the recorded 168 species of bird, 69 (41.07%) bird were very common, 7 (4.16%) were common, 37 (22.02%) were uncommon and 55 (32.73%) were few. Among the bird species the most abundant bird was *Pycnonotus cafér* (Red-vented Bulbul), with the highest relative abundance (6.1%) (Appendix 1). The maximum individuals was counted for Red-vented Bulbul (*Pycnonotus cafer*, 401 individuals), followed by Common Myna (*Acridotheres tristis*, 347 individuals), Asian Pied Starling (*Sturnus contra,* 329 individuals), Jungle Bubbler (*Turdoides striata*, 240 individuals) and Jungle Myna (*Acridotheres fuscus,* 236 individuals). The ten most abundant species constituted for 37.52% of total individuals whereas 100 least abundant species held only 2.15%. This signifies highly uneven distribution of species in the community, which is

explained in the rank abundance plot (Fig. 7). Among the 10 most abundant species, 5 species are mainly scavenger, which indicates that they got more foods in urban area. The most abundant bird species *Pycnonotus cafer* feeds mainly on fruits, grain, nectar, insects [1] and get more opportunity for feeding numerous items because of the presence of diverse number of plant species providing enough food, shelter and nesting facilities for them[7].

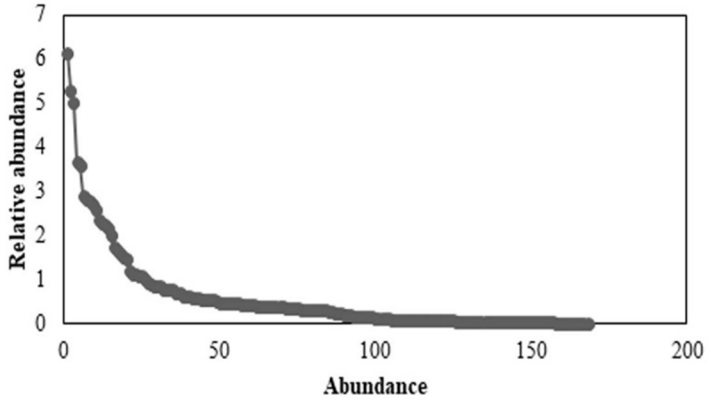

Fig. 7. Rank abundance plot for species recorded from the study site. The y-axis shows the relative abundance and the x-axis ranks the species in order of their abundance from the highest to the lowest.

Threatened status, threats and conservation issue: IUCN Bangladesh (2015)[23] threatened status showed that out of 168 species, 161species are categorized as Least Concern and the rest 7 species are threatened categories, i.e. *Clanga hastate* categorized as Endangered; *Threskiornis melanocephalus*, *Clanga clanga* categorized as Vulnerable; *Ichthyophaga ichthyaetus* and *Vanellus duvauceli* categorized as Near Threatened; *Circus cyaneus* categorized as Data Deficientand, *Emberiza melanocephala* was Not Assessed. A vulture species (*Gyps himalayensis*) was rescued by local people which was came accidentally in this area (personal communication with the rescuer).

During the field visits, some threats like urbanization, deforestation in urban area, crowd around river bank, hunting of wild bird species (*Bubulcus ibis, Nettapus coromandelianus, Centropus bengalensis, Dendrocygna javanica, Ardeola grayii*) were observed. Some wild bird species (*Lonchura atricapilla, Lonchura striata, Lonchura malabarica, Lonchura punctulata, Spilopelia chinensis, Streptopelia decaocto, Psittacula cyanocephala, Psittacula krameri, Psittacul aeupatria*) are regularly traded in the local market which is investigated during field trip. Each pair of *Lonchura spp.* sold in market at 4-5 USD and each individual of *Psittacula spp.* is sold at 7-8 USD. Hunter use traps and nets for capturing birds and in some cases, they collect eggs from bird nest and incubate by domesticated fowl. Local people have little knowledge about the Wildlife (Conservation and Security) Act, 2012.

Urbanization and deforestation is becoming a major problem in the study area. A number of construction work was observed where habitat of birds were destroyed in the study area. The area of homestead garden is declining as well as the native plant species. At present pollution (specially water and sound pollution becoming a great problem in the study area).

Conclusion

This research provides the current scenario of avifauna in urban area of Faridpur Sadar upazila. Though species richness is very high in the study area but due to habitat loss, effects of urbanization, illegal bird hunting, pollution, trade of native bird species birds are facing threats which is the cause of decline of avifauna. This study also suggest that habitat of birds in the urban area like native plant species, water-bodies should be protected. Concentration to conservation of migratory bird species during winter season is essential. Relevant authorities including urban planners need to concentrate on planning the city eco-friendly through planting native trees, managing the settlement processes, maintaining the waste disposal areas and awarning people about the necessity of conserving wild animal and habitats. Proper management system is essential in this movement. Awareness creation among people specially school going children is essential for conservation of bird. Regular monitoring in the field level and local market by Wildlife Crime Control Unit under the Department of Forestry is necessary.

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Appendix 1. List of Avifauna in the urban area of Faridpur Sadar Upazila from November 2020-October 2022

Scientific Name	RA	Se	MH	IBD	OS
Malacocincla abbotti	0.06	S	T	LC	C
Psittacula eupatria	0.08	S,W	T	LC	UC
Dicrurus leucophaeus	0.08	W	T	LC	UC
Artamus fuscus	0.85	Y	T	LC	VC
Merops orientalis	0.58	Y	T	LC	VC
Anastomus oscitans	0.95	Y	T	LC	VC
Cypsiurus balasiensis	1.01	Y	T	LC	VC
Sturnus contra	5.02	Y	T,WDS, GL	LC	VC
Acridotheres ginginianus	0.89	Y	T, US	LC	VC
Hirundo rustica	1.5	Y	T, FP	LC	UC
Turnixsus citator	0.03	R	GL	LC	F
Ploceus philippinus	1.59	Y	T	LC	VC
Dicrurus macrocercus	0.32	Y	T, US, WDS	LC	VC
Milvus migrans	0.72	Y	T, US, WDS	LC	VC
Ploceus benghalensis	0.05	W	GL	LC	F
Nycticorax nycticorax	1.13	Y	T	LC	VC
Emberiza melanocephala	0.03	W	T	NA	F
Coracina melanoptera	0.06	W	T	LC	UC
Larus ridibundus	0.03	W	PW	LC	F
Threskiornis melanocephalus	0.05	W	PW	VU	F
Oriolus xanthornus	0.55	Y	T	LC	VC
Hypothymis azurea	0.49	Y	T	LC	VC
Oriolus chinensis	0.03	W	T	LC	F
Dinopium benghalense	0.79	Y	T	LC	VC
Coracina melaschistos	0.11	W	T	LC	F
Elanus caeruleus	0.24	Y	T	LC	VC
Merops philippinus	0.47	S	AG, US	LC	UC
Luscinia svecica	0.06	W	GL	LC	F
Psilopogon asiaticus	0.41	Y	T	LC	VC
Cyornis rubeculoides	0.03	W	T	LC	F
Acrocephalus dumetorum	0.02	W	GL	LC	F
Haliastur indus	0.32	Y	T	LC	VC
Dicrurus aeneus	0.08	W	WDS T	LC	F
Metopidius indicus	0.32	Y	FP	LC	VC
Ninox scutulata	0.44	Y	T	LC	VC
Ketupa zeylonensis	0.05	R,W	T	LC	F
Lanius cristatus	0.11	W	GL, T	LC	UC
Larus brunnicephalus	0.14	W	PW	LC	UC
Bubulcus ibis	2.9	Y	GL,SW	LC	VC
Nisaetus cirrhatus	0.06	R,W	T	LC	F
Lonchura atricapilla	0.2	R,W	GL	LC	UC
Merops leschenaulti	0.11	R,W	T	LC	UC
Sturnus malabaricus	1.48	Y	T	LC	VC
Ixobrychus cinnamomeus	0.49	Y	FP, SW	LC	UC

(Contd.)

Scientific Name	RA	Se	MH	IBD	OS
Motacilla citreola	0.37	W	MF	LC	UC
Acrocephalus stentoreus	0.03	W	GL	LC	F
Otus lettia	0.08	S,W	T	LC	F
Tyto alba	0.15	W	US	LC	UC
Cuculus canorus	0.02	S	T	LC	F
Hierococcyx varius	0.37	Y	T	LC	VC
Upupa epops	0.53	Y	GL, FL, AG	LC	VC
Aegithin atiphia	0.38	Y	T	LC	VC
Falco tinnunculus	0.18	Y	GL, AG, US	LC	C
Alcedo atthis	0.72	Y	T	LC	VC
Acridotheres tristis	5.3	Y	T, BU	LC	VC
Actitis hypoleucos	0.09	W	MF	LC	F
Gallinago gallinago	0.03	W	MF	LC	F
Saxicola torquatus	0.24	W	GL	LC	UC
Orthotomus sutorius	1.1	Y	T	LC	VC
Anas crecca	0.05	W	PW	LC	F
Tephrodornis pondicerianus	0.4	W	T	LC	UC
Psilopogon haemacephala	0.49	Y	T	LC	VC
Nettapus coromandelianus	0.58	R,W	PW	LC	UC
Spilornis cheela	0.11	Y	T	LC	UC
Phylloscopus fuscatus	0.06	W	BU	LC	UC
Circus spilonotus	0.02	W	GL	LC	F
Spilopelia chinensis	1.08	Y	US, GL,FL, T	LC	VC
Streptopelia decaocto	0.08	R,W	FL	LC	F
Oriolus oriolus	0.12	S,W	T	LC	UC
Zoothera dauma	0.14	W	BU	LC	F
Jynx torquilla	0.05	W	GL	LC	F
Dendrocopos macei	0.64	Y	T	LC	VC
Mareca strepera	0.27	W	PW	LC	F
Spatula querquedula	0.03	W	PW	LC	F
Prinia gracilis	0.44	Y	GL, T	LC	VC
Phalacrocorax carbo	0.46	W	PW	LC	UC
Podiceps cristatus	0.02	W	PW	LC	F
Ardea alba	0.38	Y	SW, MF	LC	VC
Centropus sinensis	0.37	Y	T, FP	LC	VC
Clanga clanga	0.02	W	T	VU	F
Tringa ochropus	0.05	W	MF	LC	F
Pluvialis squatarola	0.15	W	MF	LC	F
Motacilla cinerea	0.38	W	MF	LC	F
Lanius tephronotus	0.05	W	T	LC	F
Prinia hodgsonii	0.1	R	GL	LC	F
Chalcophaps indica	0.03	S	T	LC	F
Ichthyophaga ichthyaetus	0.01	W	T	NT	F
Vanellus cinereus	0.5	W	MF	LC	UC
Circus cyaneus	0.01	W	FP	DD	F
Corvus splendens	2.7	Y	US, T	LC	VC

(Contd.)

Scientific Name	RA	Se	MH	IBD	OS
Passer domesticus	2.8	S	T, US	LC	VC
Apus nipalensis	2.2	Y	T	LC	VC
Cuculus micropterus	0.1	Y	T	LC	UC
Terpsiphone paradisi	0.5	Y	T	LC	C
Ardeola grayii	2.6	Y	T, FP, PW, SW, MF	LC	VC
Coracias benghalensis	0.4	Y	GL, T, US	LC	VC
Clanga hastata	0.03	W	T	EN	F
Ardea intermedia	0.4	Y	SW, PW	LC	VC
Clamator jacobinus	0.1	S,R	T	LC	UC
Turdoides striata	3.7	Y	T, BU	LC	VC
Corvus levaillantii	2.8	Y	T, WDS, US	LC	VC
Acridotheres fuscus	3.6	Y	T, BU, AG, US	LC	VC
Charadrius alexandrinus	0.1	W	MF	LC	F
Tephrodornis gularis	0.1	R	T	LC	F
Centropus bengalensis	0.1	R,W	T	LC	UC
Dicrurus remifer	0.01	W	T	LC	F
Charadrius mongolus	0.1	W	MF	LC	F
Dendrocygna javanica	2.4	Y	PW, FP	LC	VC
Psilopogon lineatus	0.5	Y	T	LC	VC
Microcarbo niger	2.2	Y	PW, T	LC	VC
Egretta garzetta	2	Y	SW, FP	LC	VC
Tachybaptu sruficollis	0.3	Y	PW	LC	C
Charadrius dubius	0.4	S,W	MF	LC	UC
Calidris minuta	0.1	W	MF	LC	UC
Lanius schach	0.3	Y	T, GL	LC	VC
Zoothera citrina	0.3	Y	BU	LC	VC
Pernis ptilorhynchus	0.1	S,W	T	LC	UC
Copsychus saularis	1.7	Y	GL, T, US	LC	VC
Zosterops palpebrosus	0.4	Y	T	LC	VC
Pandionhaliaetus	0.01	W	T	LC	F
Pluvialis fulva	0.03	W	MF	LC	F
Anthus rufulus	0.8	Y	GL, T	LC	VC
Acrocephalu sagricola	0.1	W	T	LC	F
Dicaeum erythrorhynchos	0.2	Y	T	LC	C
Hydrophasianus chirurgus	0.1	W	FP	LC	F
Circus melanoleucos	0.01	W	GL	LC	F
Ceryle rudis	0.3	Y	T	LC	VC
Gallinago stenura	0.1	W	MF	LC	F
Prinia inornata	0.6	Y	T, GL	LC	VC
Cacomantis merulinus	0.2	S,R	T	LC	UC
Psittacula cyanocephala	0.03	W	T	LC	F
Nectarina asiatica	0.9	Y	T	LC	VC
Nectarinia zeylonica	0.6	S	T	LC	VC
Streptopelia tranquebarica	0.2	R,W	T	LC	UC
Falco chicquera	0.01	R	T	LC	F
Pycnonotus cafer	6.1	Y	T	LC	VC

(Contd.)

Scientific Name	RA	Se	MH	IBD	OS
Vanellu sindicus	1.2	Y	GL, AG, FL	LC	VC
Vanellus duvauceli	0.1	W	MF	NT	F
Columba livia	0.6	Y	GL, US, FL, T	LC	VC
Psittacula krameri	2.3	Y	T	LC	VC
Dendrocitta vagabunda	0.4	Y	T	LC	VC
Micropternu sbrachyurus	0.1	S,R	T	LC	F
Mirafra assamica	0.2	Y	GL, T	LC	UC
Lonchura punctulata	0.6	Y	GL, T, US	LC	VC
Accipiter badius	0.1	R,W	T	LC	F
Pericrocotu scinnamomeus	1.8	Y	T	LC	VC
Athene brama	0.5	Y	T	LC	VC
Pelargopsis capensis	0.4	Y	T	LC	VC
Turdoidese arlei	0.1	W	GL	LC	F
Megalurus palustris	0.2	W	GL, T	LC	UC
Ficedula albicilla	0.2	R,W	T	LC	UC
Calidris temminckii	0.2	W	MF	LC	F
Acrocephalu saedon	0.1	W	BU, GL	LC	UC
Lonchura malacca	0.1	W	GL	LC	F
Eudynamys scolopaceus	0.4	Y	T	LC	VC
Chlidonias hybrida	0.03	W	PW	LC	F
Motacilla alba	0.8	W	MF	LC	UC
Halcyon smyrnensis	0.8	Y	T	LC	VC
Amaurornis phoenicurus	0.3	Y	T, FP	LC	VC
Motacilla madaraspatensis	0.4	R,W	MF	LC	C
Lonchura striata	0.9	Y	GL, T	LC	VC
Saxicola leucurus	0.1	W	GL	LC	UC
Lonchura malabarica	1.1	Y	T, GL	LC	VC
Tringa glareola	0.1	W	MF	LC	UC
Ixobrychus sinensis	0.3	Y	SW, FP	LC	C
Treron phoenicopterus	0.3	S,W	T	LC	UC
Motacilla flava	0.4	W	MF	LC	UC
Cisticola juncidis	0.6	Y	GL	LC	VC

RA- Relative Abundance; OS- Observation Status; VC- Very Common; C-Common, UC- Uncommon, Few- F; IBD- IUCN BD status 2015, LC- Least Concern, EN- Endangered, VU- Vulnerable, NT- Near Threatened, NA- Not Assessed; BU- Bushy Area, FL- Fallow Land, WDS- Waste disposal Site, MF- Mudflat, GL- Grassland, Tr- Tree, US- Urban Settlement, PW- Permanent Water body, SW- Swallow Waterbody, AG- Agricultural Land, FP- Floating Plant; Se- Season W-Winter, S- Summer and R- Rainy, Y - Year round.

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