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BIRD DIVERSITY, COMPOSITION AND RESPONSE DURING COVID-19 IN AN URBAN LANDSCAPE, JAMALPUR, BANGLADESH

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Abstract

The world has been encountering a COVID-19 pandemic since late 2019. The world's people have also witnessed the free movement of wildlife, even in many urban areas in some countries during the imposed lockdown. We conducted research on the birds in the urban landscape of Jamalpur Sadar upazila from March 2020 to October 2020 during this pandemic situation. A total of 134 species of birds with 4338 individuals were recorded during the study period. The number of resident bird species was the maximum (115 species, 85.82%) compared to migrants. The highest number of birds was observed (120 species, 89.55%) and counted 2278 individual birds 52.51%) in the summer season. It was observed that the highest diversity of birds (89 species, 65.92%) was in March. The tree was the most (94 species, n = 2502) used microhabitat by birds in the study area. Among all birds, *Pycnonotus cafer* was the most abundant bird species with the highest relative abundance (6.11%). Some bird species (e.g. *Metopidius indicus, Anastomus oscitans, Amaurornis phoenicurus, Streptopelia tranquebarica, Lonchura malacca*) were frequently observed in the urban landscape of the study area during the pandemic. Proper management and awareness creation are essential for the conservation of the bird species in this area.

Introduction

Globally the number of the human population is increasing very rapidly, which provides velocity to urbanization. This urbanization process is slowly changing the structure of landscape ecology. As a result, biodiversity is facing different anthropogenic threats[1,2]. Birds are one of the most common wild fauna in the urban area and due to the rapid urbanization-expansion process, it's population is facing threats and has already been declining[3-6]. Some studies suggested that urban habitats offer many advantages to wild animals, such as food accessibility, lower predation rate, etc., thus supporting more species relative to other habitats[7-10]. Situations in urban landscapes like less human disturbance and suitable space for wild animals can gather more species increasing the probability of detection[11]. During the COVID-19 situation, bird diversity and population seems to be increased in the study area.

The COVID-19 created an unexpected pandemic situation worldwide. To inhibit the spreading of the virus, most countries implemented different methods like social distancing, lockdown, and home-office[12]. In that snappy situation, a dramatic effect on the environment was

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observed throughout the world by marked reduction of air[13] and noise pollution[14]. The streets and roads of the urban areas became empty, movements of humans were small, which provide the spaces for the wildlife's unrestricted movement. This resulted in the observation of the unusual movement of wild animals[10]. Humans understood how wildlife is affected by human activities in urban areas, which was mentioned in social, print, and electronic media[11,12].

Bangladesh is a small south-Asian country with diverse wildlife assets due to its geographical location[15-17]. The bird is a very familiar group of wildlife in Bangladesh that provides ecological services in natural and modified ecosystems. Globally, there are 9,026 living species of birds, and of them, 7.64% of species are found in Bangladesh[17]. Avifaunal diversity is one of the most important ecological indicators for estimating the health and quality of ecosystems. Apart from being a part of the food web, birds play vital roles in many crucial natural activities like pollination, seed dispersal, and pest control[18]. They also meet copious threats, remarkably anthropogenic activities that include indiscriminate killing, hunting, poisoning and trapping, habitat loss and its subsequent effect on food, and shelter; thus compelling birds to change their habitats[15,16,19]. Comprehensive and baseline studies are imperative for monitoring and preserving them from critical conditions[19,20]. Besides, it is important to observe birds' composition and diversity in the urban areas of Bangladesh in this pandemic situation methodologically so that it may allow comparing this data with the previously collected data during the normal situation.

We investigated the diversity and composition of birds to the sudden and drastic changes occurring in urban environments resulting from the COVID-19 lockdown in urban sites of the northern Jamalpur district of Bangladesh. No previous studies on birds are available in this study area. This study provides baseline information on diversity, status, abundance, seasonal occurrence, and habitat usage of birds in the pandemic situation that may help compare the data while monitoring birds in the future study area. This information on birds may also help for the conservation and management of birds.

Materials and Methods

Study area: Jamalpur Sadar upazila (24°55'55.4"N 89°56'37.7"E) is situated in the northern region of Bangladesh (Fig. 1). This study was conducted in the urban landscape (55.25 Km^2) of Jamalpur Sadar upazila in ten sites. The study sites have buildings, roads, urban settlements, homestead forests including different native and planted trees, grasslands, agricultural lands, fallow land, canal, river, permanent and temporary water body, ditch, ponds.

Data collection: We collected data through direct field observations from March 2020 to October 2020. The study period falls into two seasons: summer (March-June) and rainy (July-October). We spent 32 days (4 days × 8 months) in total at the field and observation was done in the early morning (6.30 am-10.00 am) and afternoon (04.00 pm-06.00 pm). We employed the transect method[21] for data collection. Sometimes opportunistic surveys were done during the study period. The size of the transect line was 500 × 200 square meters. In total, 10 fixed transects were selected and each transect was surveyed at least 2 times in each season. The habitats were

categorized into 3 macrohabitats (arboreal such as trees, terrestrial such as grounds, and aquatic such as canal, ponds, etc.) and 10 microhabitats are bushy area (enrich with herbs), fallow land (lands without trees or infrastructure), roadside (the area around the road), mudflat (area shallow waterbody), grassland (up to one meter), tree, urban settlement (poles, buildings, towers, etc.), permanent waterbody (water present throughout the year, *e.g.*, river, canal, pond, etc.), temporary waterbody (water found only during the rainy season) and agricultural land (cultivated land, farmland). Microhabitats are classified according to identifying characteristics of each habitat in the study area under 3 basic macro habitats.

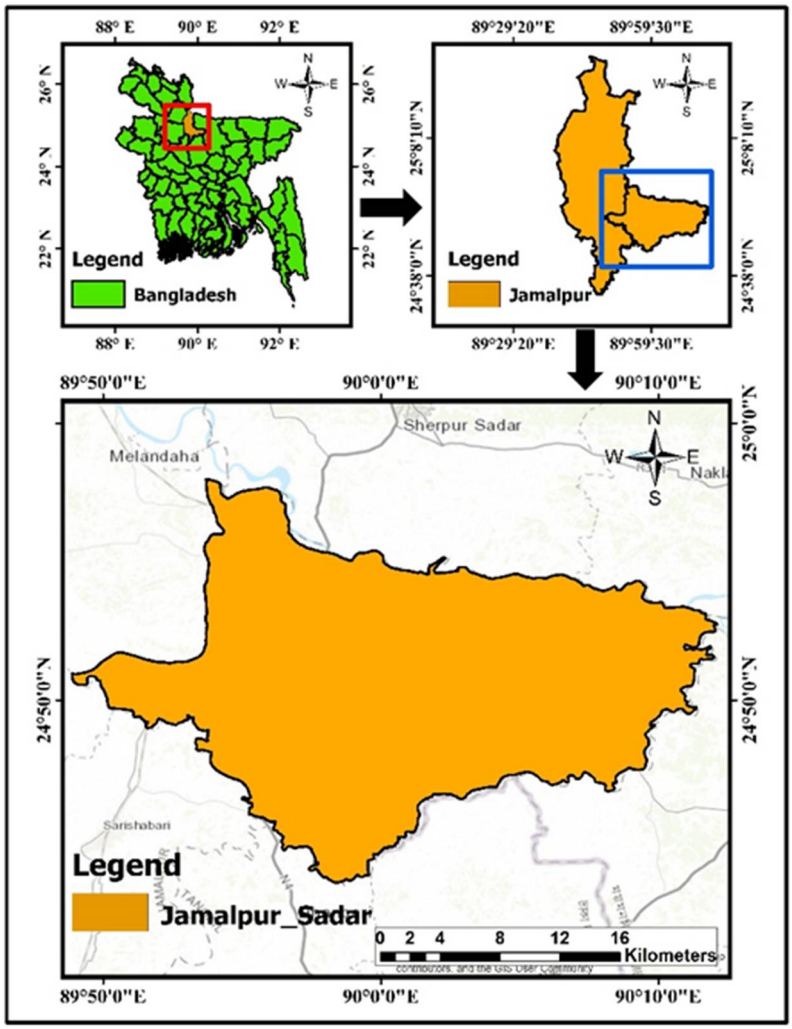

Fig. 1. Map of the Jamalpur Sadar upazila

Some species of birds were recorded by receiving their song and call sound, which were normally hidden in the bushes, jungles, and branches of trees. The calls were recorded by the Samsung A50 Phone, which the authors later identified. Nocturnal bird survey was difficult in the pandemic situation. We used torchlight and sometimes focused it on the branches of trees. We photographed (D7100 DSLR Camera with 200-500 mm VR lens) and identified when any birds were seen. We followed the most authentic Bangladeshi field guide of birds for identification[22,23]. Threats to the birds were also noted during fieldwork.

Data analysis: We considered species richness, abundance, relative abundance, observation status, diversity index, and habitat similarity index for calculation. Species richness expresses the number of species, while abundance marks the total number of individuals. The relative abundance of particular bird species was calculated following the formula:

$$\text{Relative abundance} = \frac{\text{Number of individual of a species}}{\text{Total number of individuals of all species}} \times 100$$

We determined the observation status for each species following Khan[23]. The diversity indices were calculated following the Shannon-Wiener index[24], Simpson's index[25] of diversity. Evenness, which measures the community's equity, was enumerated by dividing the diversity indices with the natural log of species richness. The habitat similarity plot or cluster analysis for microhabitats was performed following the method by the Bray-Curtis index[26]. All analyses were done in spreadsheet and PAST software[27].

Results and Discussion

Species composition: A total of 134 birds with 4338 individuals under 17 orders and 51 families were observed (Table 1). This represents 19.56% of the total bird species of Bangladesh[17]. The number of non-passerine bird species (72 species, 53.37%) was more than passerine bird species (62 species, 46.63%). The highest number of bird species was observed under the order Passeriformes (62 species, 46.63%), followed by Cuculiformes (10 species, 7.46%), Coraciiformes (9 species, 6.71%), and Pelecaniformes (7 species, 5.22%). The highest number of birds belonged to the family Cuculidae (10 Species, 7.46%).

Among 134 species, 115 (85.82%) were residents and the rest 19 (14.07%) were migratory birds (Table 1). The migratory bird species *Clamator jacobinus, Cuculus micropterus* and *Merops philippinus* were summer migrants and *Cuculus canorus* was passage migrant. This study was conducted in the summer and rainy season during the lockdown period of the COVID-19 pandemic; hence the number of winter migrant birds was meager (15 species, 11.11%). There is no published scientific study for comparison about the birds of the study area.

Table 1. List of avifauna in urban landscape in Jamalpur Sadar Upazila, from March 2020-October 2020.

Scientific Name	English Name	RA	MH	ST	SN	OS
Accipiter badius	Shikra	0.05	T	RS	R	RE
Acridotheres fuscus	Jungle Myna	3.00	RS, MF, T	RS	S,R	VC
Acridotheres ginginianus	Bank Myna	1.78	GL, FL, RS, MF	RS	S,R	VC
Acridotheres tristis	Common Myna	3.64	RS, T, FL, GL	RS	S,R	VC
Acrocephalus agricola	Paddyfield Warbler	0.05	BU	WV	S	RE
Acrocephalus dumetorum	Blyth's Reed-warbler	0.09	BU	WV	S	RE
Actitis hypoleucos	Common Sandpiper	0.23	MF	RS	S	UC
Aegithina tiphia	Common Iora	1.01	T	RS	S,R	VC
Alcedo atthis	Common Kingfisher	0.67	T	RS	S,R	VC
Amaurornis phoenicurus	White-breasted Waterhen	3.50	PW, TW, T	RS	S,R	VC
Anastomus oscitans	Asian Openbill	1.27	T	RS	S,R	VC
Anthus hodgsoni	Olive-backed Pipit	0.07	GL	WV	S	RE
Anthus rufulus	Paddyfield Pipit	0.41	GL	RS	S	C
Apus nipalensis	House Swift	2.28	US,T	RS	S	VC
Ardea alba	Great White Egret	0.16	T	RS	S,R	UC
Ardea intermedia	Intermediate Egret	0.74	PW, TW	RS	S,R	VC
Ardeola grayii	Indian Pond Heron	0.44	PW, T,GL, TW	RS	S,R	C
Artamus fuscus	Ashy Woodswallow	0.39	US,T	RS	S,R	C
Athene brama	Spotted Owlet	0.44	T	RS	S,R	VC
Bubulcus ibis	Cattle Egret	1.15	PW, GL, TW, FL	RS	S,R	VC
Cacomantis merulinus	Plaintive Cuckoo	0.28	T	RS	S,R	C
Cacomantis passerinus	Grey-bellied Cuckoo	0.05	T	RS	S	RE
Centropus bengalensis	Lesser Coucal	0.02	T	RS	S	RE
Centropus sinensis	Greater Coucal	0.02	GL	RS	S	RE
Ceryle rudis	Pied Kingfisher	0.32	T	RS	S,R	C
Charadrius dubius	Little Ringed Plover	0.44	MF	RS	S,R	UC
Cisticola juncidis	Zitting Cisticola	0.32	GL	RS	S,R	C
Clamator jacobinus	Jacobin Cuckoo	0.07	T	SV	S,R	UC
Columba livia	Rock Dove	3.25	US,T	RS	S	VC

Table 1 contd.

Scientific Name	English Name	RA	MH	ST	SN	OS
Copsychus saularis	Oriental Magpie-robin	2.97	RS, T, FL	RS	S, R	VC
Coracias affinis	Indochinese Roller	0.37	T	RS	S, R	C
Coracias benghalensis	Indian Roller	0.67	T	RS	S, R	C
Coracina macei	Large Cuckoos-shrike	0.05	T	RS	R	RE
Coracina melanoptera	Black-headed Cuckoo-shrike	0.05	T	RS	S	RE
Coracina melaschistos	Black-winged Cuckoo-shrike	0.05	T	WV	S	RE
Corvus levaillantii	Jungle Crow	1.29	RS, T	RS	S, R	VC
Corvus splendens	House Crow	2.90	US, T, RS	RS	S, R	VC
Cuculus canorus	Common Cuckoo	0.02	T	PV	S	RE
Cuculus micropterus	Indian Cuckoo	0.14	T	SV	S	UC
Cypsiurus balasiensis	Asian Palm Swift	1.41	T, US	RS	S, R	VC
Dendrocitta vagabunda	Rufous Treepie	0.41	T	RS	S, R	VC
Dendrocopos macei	Fulvous-breasted Woodpecker	1.13	T	RS	S, R	VC
Dendrocygna javanica	Lesser Whistling Duck	1.27	PW	RS	S, R	VC
Dicaeum erythrorhynchos	Pale-billed Flower pecker	0.39	T	RS	S, R	VC
Dicrurus aeneus	Bronzed Drongo	0.02	T	RS	S	RE
Dicrurus leucophaeus	Ashy Drongo	0.02	T	WV	S	RE
Dicrurus macrocercus	Black Drongo	1.80	T, US	RS	S, R	VC
Dinopium benghalense	Black-rumped Flameback	1.06	T	RS	S, R	VC
Egretta garzetta	Little Egret	1.50	GL, TW, MF	RS	S, R	VC
Elanus caeruleus	Black-winged Kite	0.23	PW, T	RS	S, R	UC
Eudynamys scolopaceus	Western Koel	1.52	T	RS	S, R	VC
Falco chicquera	Red-headed Falcon	0.02	T	RS	R	RE
Falco tinnunculus	Common Kestrel	0.05	T	WV	S	RE
Ficedula albicilla	Taiga Flycatcher	0.07	T	WV	S	RE
Gallinula chloropus	Common Moorhen	0.05	PW	RS	S	RE
Halcyon smyrnensis	White-breasted kingfisher	0.95	T	RS	S, R	VC
Haliastur indus	Brahminy Kite	3.11	T, US	RS	S, R	VC
Hierococcyx varius	Common Hawk-Cuckoo	0.18	T	RS	S, R	C

Table 1 contd.

Scientific Name	English Name	RA	MH	ST	SN	OS
Hirundo rustica	Barn Swallow	0.37	T	RS	S, R	C
Hypothymis azurea	Black-naped Monarch	0.25	T	RS	S, R	UC
Ixobrychus cinnamomeus	Cinnamon Bittern	0.02	TW	RS	R	RE
Ixobrychus sinensis	Yellow Bittern	0.05	PW	RS	R	UC
Ketupa zeylonensis	Brown Fish Owl	0.02	T	RS	S	RE
Lanius cristatus	Brown Shrike	0.12	T, BU	WV	S	UC
Lanius schach	Long-tailed Shrike	0.67	T, US	RS	S, R	VC
Lanius tephronotus	Grey-backed Shrike	0.02	T	RS	S	RE
Larus brunnicephalus	Brown-headed Gull	0.16	PW	RS	S	RE
Lonchura malabarica	White-throated Munia	0.39	GL, T	RS	S, R	C
Lonchura malacca	Tricoloured Munia	0.25	T, GL	RS	S	UC
Lonchura punctulata	Scaly-breasted Munia	3.02	GL	RS	S, R	VC
Lonchura striata	White-rumped Munia	0.53	FL, GL	RS	S, R	RE
Malacocincla abbotti	Abbott's Babbler	0.05	T	RS	S	C
Megalurus palustris	Striated Grassbird	0.14	GL	RS	S, R	UC
Merops leschenaulti	Chestnut-headed Bee-eater	0.05	T	RS	S	RE
Merops orientalis	Asian Green Bee-eater	0.71	T	RS	S, R	C
Merops philippinus	Blue-tailed Bee-eater	0.44	T	SV	S	UC
Metopidius indicus	Bronze-winged Jacana	1.08	PW	RS	S, R	C
Microcarbo niger	Little Cormorant	1.45	TW, PW	RS	S, R	VC
Celeus brachyurus	Rufous Woodpecker	0.05	T	RS	R	RE
Milvus migrans	Black Kite	1.89	US	RS	S, R	VC
Mirafra assamica	Rufous-winged Lark	0.07	T	RS	S	RE
Motacilla alba	White Wagtail	0.07	MF	WV	S	RE
Motacilla madaraspatensis	White-browed Wagtail	0.25	MF	RS	S, R	UC
Nectarinia asiatica	Purple Sunbird	0.92	T	RS	S, R	VC
Nectarinia zeylonica	Purple-rumped Sunbird	0.46	T	RS	S, R	VC
Ninox scutulata	Brown Boobook	0.35	T	RS	S, R	VC
Nisaetus cirrhatus	Changeable Hawk-eagle	0.02	T	RS	R	RE
Oriolus xanthornus	Black-hooded Oriole	1.27	T	RS	S, R	VC

Table 1 contd.

Scientific Name	English Name	RA	MH	ST	SN	OS
Orthotomus sutorius	Common Tailorbird	1.29	BU, FL, RS	RS	S, R	VC
Otus lettia	Collared Scops Owl	0.02	T	RS	R	RE
Parus major	Great Tit	0.60	T	RS	S, R	VC
Passer domesticus	House Sparrow	1.43	T, US, BU	RS	S, R	VC
Passer montanus	Eurasian Tree Sparrow	2.72	US, T, RS	RS	S, R	VC
Pelargopsis capensis	Stork-billed Kingfisher	0.23	T	RS	S, R	UC
Pericrocotus cinnamomeus	Small Minivet	0.58	T	RS	S	UC
Pernis ptilorhyncus	Oriental Honey Buzzard	0.16	T	RS	S, R	UC
Phaenicophaeus tristis	Green-billed Malkoha	0.12	T	RS	R	UC
Phylloscopus fuscatus	Dusky Warbler	0.09	BU	WV	S	RE
Phylloscopus inornatus	Inornate Warbler	0.05	BU	WV	S	RE
Phylloscopus trochiloides	Greenish Warbler	0.05	BU	WV	S	RE
Picus xanthopygaeus	Streak-throated Woodpecker	0.48	T	RS	S, R	VC
Ploceus benghalensis	Black-breasted Weaver	0.07	GL	RS	R	RE
Ploceus philippinus	Baya Weaver	1.18	T, GL	RS	S, R	VC
Prinia gracilis	Graceful Prinia	0.51	T, BU, GL	RS	S, R	C
Prinia hodgsonii	Grey-breasted Prinia	0.07	BU	RS	S	RE
Prinia inornata	Plain Prinia	0.18	GL, BU	RS	S, R	UC
Psilopogon asiaticus	Blue-throated Barbet	1.61	T	RS	S, R	VC
Psilopogon haemacephalus	Coppersmith Barbet	1.68	T	RS	S, R	VC
Psilopogon lineatus	Lineated Barbet	0.60	T	RS	S, R	VC
Psittacula eupatria	Alexandrine Parakeet	0.28	T	RS	S,R	C
Psittacula krameri	Rose-ringed Parakeet	2.47	T	RS	S, R	VC
Pycnonotus cafer	Red-vented Bulbul	6.11	T	RS	S, R	VC
Rhipidura albicollis	White-throated Fantail	0.23	BU, T	RS	S, R	C
Rostratula benghalensis	Greater Painted Snipe	0.25	TW	RS	R	UC
Spilopelia chinensis	Eastern Spotted Dove	1.57	US, T, AG	RS	S, R	VC
Spilornis cheela	Crested Serpent Eagle	0.05	T	RS	S	RE
Streptopelia decaocto	Eurasian Collared Dove	0.16	GL, FL, US	RS	S, R	UC
Streptopelia tranquebarica	Red Turtle Dove	0.92	AG, GL	RS	S, R	VC

Table 1 contd.

Scientific Name	English Name	RA	MH	ST	SN	OS
Sturnus contra	Asian Pied Starling	3.62	FL, RS, T, US	RS	S,R	VC
Sturnus malabaricus	Chestnut-tailed Starling	2.60	T	RS	S,R	VC
Tephrodornis pondicerianusz	Common Woodshrike	0.09	T	RS	S	RE
Terpsiphone paradisi	Asian Paradise Flycatcher	0.18	T	RS	S,R	UC
Threskiornis melanocephalus	Black-headed Ibis	0.05	TW	WV	R	RE
Treron phoenicopterus	Yellow Footed Green Pigeon	0.05	T	RS	S	RE
Tringa glareola	Wood Sandpiper	0.07	MF	WV	S	RE
Tringa ochropus	Green Sandpiper	0.09	MF	WV	S	RE
Turdoides earlei	Striated Babbler	0.23	GL	RS	R	RE
Turdoides striata	Jungle Babbler	0.39	T, BU	RS	S,R	UC
Tyto alba	Common Barn Owl	0.02	T	RS	S	RE
Upupa epops	Common Hoopoe	0.74	FL,GL, T	RS	S,R	C
Vanellus cinereus	Grey-headed Lapwing	0.07	MF	RS	S	RE
Vanellus indicus	Red-wattled Lapwing	0.83	GL, MF	RS	S,R	C
Zoothera citrina	Orange-headed Thrush	0.09	BU	RS	S,R	UC
Zosterops palpebrosus	Oriental White-eye	0.14	T	RS	S	RE

(Note: RA- Relative Abundance; MH- Microhabitats, BU- Bushy Area, FL- Fallow Land, RS- Roadside, MF- Mudflat, GL- Grassland, T- Tree, US- Urban Settlement, PW- Permanent Waterbody, TW- Temporary Waterbody, AG- Agricultural Land; ST- Status, RsS- Resident, WV- Winter Visitor, SV- Summer Visitor; SN-Season, W-Winter, S- Summer and R- Rainy Season; OS- Observation Status, VC- Very Common, C-Common, UC- Uncommon, RE- Rare).

Primarily, the Bangladesh Bureau of Statistics enlisted 59 species of birds in 2011 in the Jamalpur district. Compared to other studies on birds in different districts[28-30] in Bangladesh, this study showed a higher number of species except for the Magura Sadar upazila[16]. The high species richness in the study area indicates that the urban landscape favored more species due to limited movements of people during the pandemic situation. Although there are no published scientific data on birds from the study area, we assume that the pandemic situation created more opportunities in the free movement of birds with fewer human disturbances.

Richness, abundance and diversity in months and seasons: **S**pecies richness and abundance were more in March (89 species, 659 individuals) followed by April (61 species). The lowest individual was counted for in July (499 individuals) (Table 2). In the summer season, we counted

52.51% (n=2278) of total individuals presenting 120 species higher than rainy season 2060 individuals (47.49%). The richness and abundance in the two seasons differed but the variation of seasonal diversity was minor. Diversity was the highest in June (H=4.122, D_s=0.980), though the difference was not high considering Simpson's index (Table 2). The calculated evenness was the highest for October (0.788), signifying a higher similarity in this month. At the beginning of summer, some winter migratory birds were observed along with summer migratory birds. Besides, this season is also the breeding period of different resident species sustaining more diversity. In Bangladesh, from March to June movement and general office activities of humans were completely prohibited due to COVID 19, so birds may have more opportunities to move in the urban area[10-12]. Therefore, it is assumed that species richness and diversity in March and June have increased due to decreased human movement activity.

Table 2. Species richness (S), abundance (A), evenness (E), diversity [Shannon-Weiner Index (H), Simpson's Index (D_s)] in different months, seasons and habitats.

Category/Parameters		S	A	H	E	D_s
Months	March	89	659	4.087	0.669	0.978
	April	61	566	3.819	0.747	0.973
	May	63	541	3.855	0.750	0.974
	June	84	512	4.122	0.734	0.980
	July	75	499	3.977	0.711	0.975
	August	67	513	3.949	0.774	0.976
	September	76	520	4.083	0.780	0.980
	October	64	528	3.920	0.788	0.976
Seasons	Rainy	95	2060	4.103	0.637	0.979
	Summer	120	2278	4.168	0.534	0.978
Micro habitats	AG	2	62	0.680	0.987	0.487
	BU	14	79	2.224	0.660	0.834
	FL	9	131	1.938	0.771	0.828
	GL	23	368	2.499	0.529	0.847
	MF	11	180	1.999	0.671	0.826
	PW	11	187	1.866	0.588	0.800
	RS	9	303	1.981	0.806	0.843
	T	94	2476	3.876	0.513	0.969
	TW	9	157	1.806	0.677	0.807
	US	14	395	2.294	0.708	0.879
Macro habitats	Aquatic	24	546	2.714	0.629	0.921
	Arboreal	94	2502	3.882	0.516	0.969
	Terrestrial	51	1290	3.323	0.544	0.950

Richness, abundance and diversity in habitats: We observed mostly arboreal species (94 species, n=2502) followed by terrestrial (51 species, n=1290) and aquatic (24 species, n=546) species. Among the observed birds, 94 species representing 57.67% of total individuals were found in trees which were the highest. The diversity indices also showed the uppermost diversity (H=3.876, D_s=0.969) in the tree among all types of microhabitats. All birds (including terrestrial and aquatic) use the tree for nesting, roosting, and resting sites, although their niche usage can differ. This turns the tree into a diverse source of microhabitat. The richness of native trees species is very high in our study areas, especially in residential, office areas, homestead forests, roadside areas which supported more species to get shelter, food, roosting and nesting. The evenness was the highest (E = 0.987) in the agricultural land area in the study area (Table 2). Agricultural land is usually similar in type and vegetation structure; thus, it can harbor birds with the same food preference. This also elucidates the higher evenness of aquatic bird species than other macrohabitats (Table 2).

To determine the similarity among 10 types of microhabitat, we performed the Bray-Curtis similarity index. Three large clusters were formed in this index. Roadside area and fallow land formed a cluster, where permanent water bodies and temporary water bodies formed the second and tree and urban settlement formed the third cluster. Roadside area and fallow lands show more similarities with mudflats and formed another cluster. Then grassland formed another cluster with the roadside area, fallow lands and mudflats. Later, another large cluster was formed among roadside areas, fallow lands, mudflats, and grasslands with tree and urban settlement. This plot also showed that agricultural land and bush formed individual clusters among all microhabitats (Fig. 2).

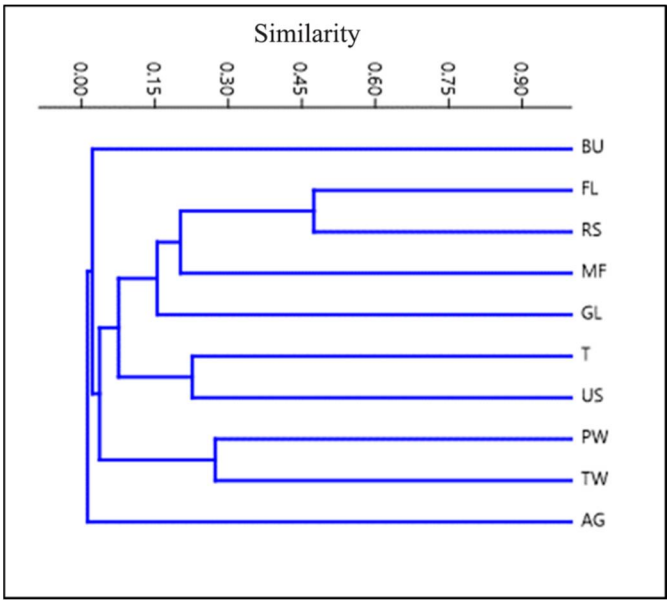

Fig. 2. Similarity profile test among microhabitats using Bray-Curtis index.

Relative abundance and observation status: Red-vented Bulbul *Pycnonotus cafér* was the most abundant bird species with the highest relative abundance (6.11%). Observation status showed that 49 (36.29%) birds were very common, 18 (33.33%) were common, 24 (17.77%) were uncommon and 44 (32.59%) were rare. *Pycnonotus cafer* mainly feeds on fruits, grain, nectar, and insects[17]. Covid-19 lockdown stops worsening habitat and allows birds to visit the study ground more frequently than past. Besides, the breeding season of this species starts in March and continues to August, which might have caused the higher detectability and count of the species.

Observed threats and threatened status: Among the observed bird species, all birds are categorized as least concern (LC) according to IUCN Red List Bangladesh (2015) except *Threskiornis melanocephalus,* which is categorized as vulnerable (VU). During the study period, major anthropogenic activities and urbanization processes were not observed due to the Covid-19 pandemic. Different bird species (e.g., *Metopidius indicus, Anastomus oscitans, Amaurornis phoenicurus, Streptopelia tranquebarica, Lonchura malacca, Lonchura punctulata, Passer montanus, Ploceus philippinus, Threskiornis melanocephalus, Picus xanthopygaeus and Dendrocygna javanica*) moved very frequently around the human habitat in the urban Llandscape of the study area. But, plastic pollution was repeatedly observed, and people were reluctant to dispose of surgical instruments like mask and gloves inappropriate places.

In conclusion, this study shows the scenario of avifaunal diversity in the urban area of Jamalpur Sadar upazila during lockdown due to the COVID-19 pandemic. A detailed study is essential for understanding the wildlife and ecological services of them in this area, which will help take proper management and conservation plan for avifauna. Awareness creation among local people, especially young communities, is essential in conserving and protecting habitats.

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References

1. Rocha EA and MDE Fellowes 2018. Does urbanization explain differences in interactions between an insect herbivore and its natural enemies and mutualists? Urban Ecosyst. **21**:405-417.
2. McKinney ML 2006. Urbanization as a Major Cause of Biotic Homogenization. Biol. Conserv.**127**: 247-60.
3. Bolwig S, D Pomeroy, H Tushabe and D Mushabe. 2006. Crops, trees, and birds: Biodiversity change under agricultural intensification in Uganda's farmed landscapes. GeografiskTidsskrift-Danish. J. Geogr. **106**(2): 115-130.
4. Evans KL, DE Chamberlain, BJ Hatchwell, RD Gregory and KJ Gaston 2011. What makes an urban bird? Glob. Change Biol. **17**(1): 32-44.
5. Strohbach MW, D Haaseand and N Kabisch 2009. Birds and the city: urban biodiversity, land use, and socioeconomics. Ecol. Soc. **14**(2): 31.
6. Gatesire T, D Nsabimana, ANyiramana, JL Seburanga and MO Mirville 2014. Bird diversity and distribution in relation to urban landscape types in Northern Rwanda. Sci. World J. **2014**: 1-12.

7. Jessop TS, P Smissen, F Scheelings and T Dempster 2012. Demographic and phenotypic effects of human mediated trophic subsidy on a large Australian lizard (*Varanus varius*): meal ticket or last supper?. PLoS one **7**(4): e34069.
8. Rebolo-Ifrán N, JL Tella and M Carrete 2017. Urban conservation hotspots: predation release allows the grassland-specialist burrowing owl to perform better in the city. Sci. Rep**. 7**(1): 1-9.
9. Gibbs JP, MF Buff and BJ Cosentino 2019. *In*: Hall M and S Balogh (Eds), Understanding Urban Ecology, The Biological System-Urban Wildlife, Adaptation, and Evolution: Urbanization as a Driver of Contemporary Evolution in Gray Squirrels (*Sciurus carolinensis*). Springer, Cham, pp. 269-286.
10. Sahagun L 2020. Coyotes, falcons, deer and other wildlife are reclaiming L.A. territory as humans stay at home. Los Angeles Times. Available at: https://www. latimes.com/environment/story/2020-04-21/wild life-thrives-amid-coronavirus-lockdown
11. Gordo O, L Brotons, S Herrando and G Gargallo 2021. Rapid behavioural response of urban birds to COVID-19 lockdown. Proc. R. Soc. B. **288**(1946): 20202513.
12. Zellmer AJ, EM Wood, T Surasinghe, BJ Putman, GB Pauly, SB Magle, SL Jesse, AMK Cria and M Fidino 2020. What can we learn from wildlife sightings during the COVID-19 global shutdown? Ecosphere **11**(8): e03215.
13. Venter ZS, K Aunan, S Chowdhury and J Lelieveld 2020. COVID-19 lockdowns cause global air pollution declines. Proc. Natl Acad. Sci. **117**: 18984- 18990.
14. Lecocq T, SP Hicks, K van Noten, K van Wijk, P Koelemeijer, RSM de Plaen, F Massin, G Hillers, RE Anthony, MT Apoloner and H Xiao 2020. Global quieting of high-frequency seismic noise due to COVID-19 pandemic lockdown measures. Science **369**(6509): 1338-1343.
15. IUCN Bangladesh 2015. *Red List of Bangladesh Vol. 3*. IUCN, International Union for Conservation of Nature, Bangladesh Country Office, Dhaka, Bangladesh. pp xvi+676.
16. Shome AR, MM Alam, MF Rabbe, MM Rahman and MF Jaman 2020. Diversity, status and habitat usage of avifauna at sadar upazila, Magura, Bangladesh. Bangladesh J. Zool. **48**(2): 441-456.
17. Khan MMH 2018. *A Photographic Guide to Wildlife of Bangladesh*. Arannayk Foundation, Dhaka, Bangladesh. pp. 488.
18. Jaman MF, SU Sarker and NJ Sarker 1999. Food habits and feeding behavior of black drongo, *Dicrurus macrocercus albirictus* (Hodgson). Bangladesh J. Zool. **26**(2): 57-66.
19. Rajia S, MM Alam, GW Chowdhury, M Akash and MA Islam 2015. Status and diversity of birds of Ramna Park, Dhaka, Bangladesh. Bangladesh J. Zool. **43**(2): 291-301.
20. Islam N, MF Jaman, MM Rahman and MM Alam. 2018. Wildlife Diversity and Population Status of Kashimpur Union, Gazipur, Bangladesh. J. Asiat. Soc. Bangladesh, Sci. **44**(2): 101-115.
21. Gaston AJ 1975. Methods for estimating bird populations. J. Bomb. Nat. Hist. Soc. **72**: 271-273.
22. Khan MAR 2015. *Wildlife of Bangladesh-checklist and guide*. Chayabithi, Purana Paltan, Dhaka 1000, pp. 568.
23. Halder RR 2010. *A photographic guide to the bird of Bangladesh*. Baikal Teal Publication, Dhaka, Bangladesh, pp. 257.
24. Shannon CE and W Wiener 1949. *The mathematical theory*. University of Illinois press, Urbana, pp. 117.
25. Simpson EH 1949. Measurement of diversity. Nature **163**: 688.
26. Bray JR and JT Curtis 1957. An ordination of the upland forest communities of southern Wisconsin. Ecol. Monogr. **27**(4): 325-349.
27. Hammer Ø, DAT Harper and PD Ryan 2001. PAST: Palaeontological Statistics software package for education and data analysis. Palaeontol. Electron. **4**:1-9.

28. Jaman MF, MS Rahman and ME Haque 2011. Diversity of avifauna at the Bangladesh Academy for Rural Development (BARD), Kotbari, Comilla. Univ. J. Zool. Rajshahi Univ. **30**: 41-44.
29. Karmakar S, S Parween and AS Reza 2011. Birds of Joypurhat district, Bangladesh. J. Life Earth Sci. **6**: 51-57.
30. Amin A and KA Hasan 2019. Checklist and relative diversity of avifauna of Atrai, Raninagar and Naogan Sadar upazillas of Naogaon district of Bangladesh. Int. J. Zoo. Studies. **4**(6): 38-45.

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