

COMMUNITY STRUCTURE, ECOLOGY, AND CONSERVATION ISSUES OF AVIFAUNA OF TWO HUMAN-DOMINATED LANDSCAPES IN FARIDPUR DISTRICT, BANGLADESH DURING COVID-19 PANDEMIC

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Abstract

A study was conducted on community structure, ecology, and conservation issues of the avifauna of two human-dominated landscapes in a lower Ganges Madhukhali Upazila, under the Faridpur district during the COVID-19 pandemic period. Direct field observations were made from April 2020 to March 2021. In total, 109 species of birds belong to 18 orders, and 49 families were observed, with a total count of 5,453 individuals. Resident bird species (93 species, 85.32%) dominant in the study area, whereas the migratory species were only 16 (14.68%). The highest number of bird species (93 species, 85.32%) with the highest number of individuals (n=3171, 58.15%) was observed in Beleswar (rural site) area. Shannon diversity index value ($H=3.89$, $Ds=0.9724$) was higher in the rural site than Madhukhali municipal area (urban site). In the winter season, the highest number of bird species (95 species, 87.15%) with the highest number of individuals (n=2303, 42.23%) was observed. Among micro-habitats, trees, particularly the native tree species, were the preferable sites for bird nesting, foraging, and roosting. Among birds, *Acridotheres tristis* was the most abundant species (n=316, 5.79%) in the study area, and an uneven distribution of species in the community structure was observed. The abundance of birds shows that 59 (54.12%) species were very common, 8 (7.33%) common, 9 (8.25%) uncommon, and 33 (30.27%) rare. Among the bird species, *Ichthyophaga ichthyaetus* was categorised as Near Threatened (NT), and the rest are Least Concerned (IUCN Bangladesh 2015). Illegal hunting of birds, especially waterbirds, is the major threat in the rural site. Preparing a proper management plan based on the baseline data is essential for protecting of avian diversity in the study area.

Key words: Bird, Habitat utilization, Urban area, Rural area, Illegal hunting, Conservation.

Introduction

Birds are one of the most glorious and common components of the ecosystem that act as a bio-indicator in response to environmental pollution (Sekercioglu, 2006, Slabbekoorn and Ripmeester, 2008; Mistry *et al.*, 2008). Avifaunal diversity gives rise to the primary

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part of the natural environment, and they play a key role as agents of predators, scavengers, pollinators, seed dispersers, and ecosystem engineers in the food chain (Sekercioglu *et al.*, 2004). Birds act as pest control agents in agricultural sectors (Whelan *et al.*, 2008).

Bangladesh is a south Asian country, and the geographical location of this country expresses the transitional zone as it is situated at the junction of two enriched biogeographic realms named Indo-Himalayas and Indo-China sub-regions of the oriental region (IUCN Bangladesh, 2015; Khan, 2018). This country is located in the Ganges-Brahmaputra delta which, makes it rich in natural resources and amazing wildlife fauna despite being the eighth-most populous country in the world (Khan, 2018). Among the faunal group in Bangladesh, birds play an important role in the ecological, environmental, and cultural sectors. Though Bangladesh is a small country, it is blessed with more than 700 bird species which is 7.64% of the total global avifauna and almost the same as the avifaunal diversity of Europe. Among them, 380 resident birds are found in our country, 209 winter visitors, 11 summer visitors, and the rest are vagrant species (Khan, 2018). Unfortunately, the populations of many bird species are declining gradually due to the increase in threats, including habitat loss, rapid urbanization, excessive use of herbicides, insecticides, and pesticides with hunting, poisoning, and trapping (Sarker and Sarker, 1988; IUCN Bangladesh, 2015; Barkat *et al.*, 2021). In Bangladesh, from 2010 to 2020 (until June), 70% of illegal bird hunting is typically conducted in wetlands areas (*Haor, Baor, and Beel*) and hunting mostly promoted by trapping and netting, particularly in the winter season (Datta, 2021). To monitor the threats, as well as spatial and temporal frame of bird diversity, baseline studies are needed to be conducted.

Outside protected areas of Bangladesh harbor a number of bird species, but pertinent data on those birds are absent (Mandal *et al.*, 2021). At the same time conservation initiative is also missing in that areas, and the human population is increasing. Anthropogenic activities of human in the natural habitat of birds are declining rapidly, and a number of habitat-specialized species are vanishing very rapidly (Shome *et al.*, 2022a). Local people are also unaware of the conservation of bird species, and the illegal trade of birds and bird hunting is one of the major obstacles to conserving birds, especially in rural areas (Shome and Jaman, 2021). Besides, misconceptions and superstitions are present among local people not only about birds but also about other wildlife (Jaman *et al.*, 2020; Shome and Jaman, 2021).

The lower Ganges portion of Bangladesh is enriched with avian diversity because of the presence of different types of natural habitats (e.g., wetlands, forests, green patches, sandbars, etc.). Still proper data on those birds are absent, and a small amount of research work was done in that region (Shome *et al.*, 2022b; Mandal *et al.*, 2021, Shome *et al.*,

2020). The study aims to determine the avifaunal composition within the community, seasonality, habitat utilization, threats, and conservation issues of Madhukhali Upazila, Faridpur. Besides, this research will help constitute a conservation plan to protect birds and other wildlife fauna in the study area.

Materials and Methods

Study area: The study was conducted in Madhukhali Upazila (230.2 km²) under Faridpur district (23°32'32.61"N, 89°37'51.21"E) as a part of ecological research (Fig. 1). The study was carried out from April 2020 to March 2021 and divided into three time period like summer (March-June), rainy (July-October), and winter (November-February) (Shome *et al.*, 2021b). Two study sites were selected for a better survey, a semi-urban area (Madhukhali municipality area-MMA) and a rural area (Beleswar-BW). Railway stations, playgrounds, markets, highways, small ponds, canals, rivers, homestead forests, grasslands, etc., possess MAA. In contrast, BW includes homestead forests, Bamboo patches, agricultural lands, grasslands, *beels*, ponds, ditches, canals, rivers (Kumar), etc.

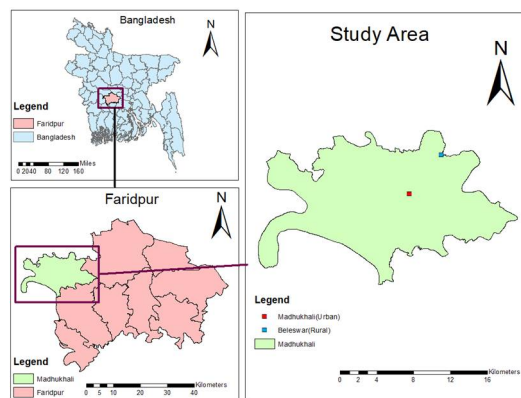


Fig. 1. Map of the study area.

Data collection: The sample was collected through direct field observations from March 2020 to February 2021 using transect line methods (Gaston, 1975). Data collection has been done at least 3 days a month in rural and urban areas. To correlate with birds' peak activity, the survey was conducted in the early morning (06:30 AM to 10:30 AM) and the afternoon (03:30 PM to 07:00 PM). To get information on nocturnal birds, sometimes survey was conducted at night. At least 9 hours of effort per day was spent to complete a field visit. The species sampling was well-adequate according to richness estimators. The calls or songs of the birds were recorded by smartphone (Realme X2) to identify those

normally hidden or camouflaged in the bushes, jungles, and branches of trees. To observe birds at night, torch light was used while performing each survey. The photograph was taken by a Canon 80D DSLR Camera with a 55-250 mm VR lens for proper identification. We also followed popular field guides for identifying bird species (Khan, 2015).

Data analysis: Data has been analyzed using PAST (version 4.07), MS Excel, R 4.0.5 (R Core Team 2020), and the ggplot2 package spreadsheets. The species accumulation curve was developed using Magurran's (2013) rarefaction approach to confirm sample completeness according to first and second-order Jackknife, Bootstrap, and Chao richness estimators, which were used to estimate the total number of species in the study area. This was done using the 'specpool' function from Vegan Package (Oksanen *et al.*, 2019). Using the mean of these four indices, the estimated number of species (x) was calculated following Fils *et al.*, (2014). Following the formula sampling completeness was calculated as: Sampling completeness = the Observed number of species (n)/ Estimated number of species (x) × 100. The relative abundance of bird species was measured by following the formula -

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

Based on the total occurrences per survey effort, Khan (2015) was applied to assess the observation status as very common (VC), 80–100%, common (C), 50–79%, uncommon (UC), 20–49%, and few (F), 10–19%. A rank abundance plot was constructed following Whittaker (1965) to describe dominance patterns. Shannon-Wiener (Shannon and Wiener, 1949) and Simpson's indices (Simpson, 1949) were used to compute the diversity indices evenness was calculated, by dividing the Shannon-Wiener index value by the natural log of species richness.

Result and Discussion

Species composition and abundance: A total of 109 species of birds were observed, and 5453 individuals were counted under 18 orders and 49 families (Table 1). The highest number of bird species (45 species, 41.28%) and individuals (n=3093, 56.72%) were under the order Passeriformes. Non-passerine birds (54 species, 58.72%) were dominant over passerine birds in the study year. Species diversity was the highest (7 species, 6.42%) and individuals (n=509, 9.33%) under the family Ardeidae. Among the observed bird diversity, 93 (85.32%) species were resident, whereas 16 (14.68%) species were migratory. Among the migratory bird species, 2 species were summer migratory (*Cuculus micropterus* and *Merops philippinus*).

Table 1. List of observed avifauna in the study area. (SN- Scientific name, EN- English Name, SI- Site, R- Rural area, U- Urban area, B- All areas; RA- Relative abundance; OS- Observation Status; VC- Very Common, C - Common, UC- Uncommon, Few- F; Se- Season W-Winter, S- Summer and R- Rainy, A- Year round).

Sl.No.	EN	Sl.No.	RA	Se	OS
<i>Accipiter badius</i>	Shikra	R	0.02	R	R
<i>Acridotheres fuscus</i>	Jungle Myna	B	3.21	A	VC
<i>Acridotheres tristis</i>	Common Myna	B	5.79	A	VC
<i>Acrocephalus agricola</i>	Paddy-field Warbler	R	0.11	A	C
<i>Actitis hypoleucos</i>	Common Sandpiper	U	0.06	W	R
<i>Aegithina tiphia</i>	Common Iora	B	0.26	A	VC
<i>Alcedo atthis</i>	Common Kingfisher	B	1.60	A	VC
<i>Amaurornis phoenicurus</i>	White-breasted Waterhen	B	0.90	A	VC
<i>Anastomus oscitans</i>	Asian Openbill	B	1.27	A	VC
<i>Apus nipalensis</i>	House Swift	B	1.87	A	VC
<i>Ardea alba</i>	Great Egret	B	0.44	A	VC
<i>Ardea intermedia</i>	Intermediate Egret	B	0.22	A	VC
<i>Ardeola grayii</i>	Indian Pond Heron	B	3.81	A	VC
<i>Artamus fuscus</i>	Ashy Woodswallow	U	0.04	W	R
<i>Athene brama</i>	Spotted Owlet	B	0.28	A	VC
<i>Bubulcus ibis</i>	Cattle Egret	B	3.10	A	VC
<i>Cacomantis merulinus</i>	Plaintive Cuckoo	U	0.02	S	R
<i>Centropus bengalensis</i>	Lesser Coucal	U	0.04	W	R
<i>Centropus sinensis</i>	Greater Coucal	B	1.47	A	VC
<i>Ceryle rudis</i>	Pied Kingfisher	B	0.66	A	VC
<i>Charadrius dubius</i>	Little Ringed Plover	R	0.09	W	R
<i>Cisticola juncidis</i>	Zitting Cisticola	U	0.11	S	UC
<i>Columba livia</i>	Rock Dove	B	2.48	A	VC
<i>Copsychus saularis</i>	Oriental Magpie-robin	B	2.62	A	VC
<i>Coracias benghalensis</i>	Indian Roller	B	0.31	A	VC
<i>Corvus levaillantii</i>	Jungle Crow	B	1.98	A	VC
<i>Corvus splendens</i>	House Crow	B	4.88	A	VC
<i>Cuculus micropterus</i>	Indian Cuckoo	U	0.04	R	R
<i>Cypsiurus balasiensis</i>	Asian Palm Swift	B	3.21	A	VC
<i>Dendrocitta vagabunda</i>	Rufous Treepie	B	0.42	A	VC
<i>Dendrocopos macei</i>	Fulvous-breasted Woodpecker	B	0.40	A	VC
<i>Dendrocygna bicolor</i>	Fulvous Whistling Duck	U	0.04	W	R
<i>Dendrocygna javanica</i>	Lesser Whistling Duck	B	2.49	A	VC
<i>Dicrurus aeneus</i>	Bronzed Drongo	B	0.26	A	VC

(Table 1 contd.)

Table 1 contd.

Sl.No.	EN	Sl.No.	RA	Se	OS
<i>Dicrurus leucophaeus</i>	Ashy Drongo	B	0.31	A	VC
<i>Dicrurus macrocercus</i>	Black Drongo	B	3.52	A	VC
<i>Dinopium benghalense</i>	Black-rumped Flameback	B	1.82	A	VC
<i>Egretta garzetta</i>	Little Egret	B	1.63	A	VC
<i>Elanus caeruleus</i>	Black-winged Kite	B	0.33	A	VC
<i>Eudynamis scolopaceus</i>	Western Koel	B	0.59	A	VC
<i>Falco tinnunculus</i>	Common Kestrel	U	0.04	R	R
<i>Ficedula albicilla</i>	Taiga Flycatcher	U	0.04	W	R
<i>Gallinago gallinago</i>	Common Snipe	R	0.04	W	R
<i>Haliastur indus</i>	Brahminy Kite	B	0.24	A	VC
<i>Hierococcyx varius</i>	Common Hawk-Cuckoo	B	0.22	A	VC
<i>Hirundo rustica</i>	Barn Swallow	B	2.60	A	VC
<i>Hydrophasianus chirurgus</i>	Pheasant-tailed Jacana	B	0.70	W	UC
<i>Hypothymis azurea</i>	Black-naped Monarch	R	0.04	R	R
<i>Ichthyophaga ichthyaetus</i>	Grey-headed Fish-eagle	R	0.02	W	R
<i>Ixobrychus cinnamomeus</i>	Cinnamon Bittern	R	0.11	R,W	UC
<i>Ketupa zeylonensis</i>	Brown Fish Owl	B	0.15	R,W	C
<i>Lanius cristatus</i>	Brown Shrike	U	0.04	W	R
<i>Lanius schach</i>	Long-tailed Shrike	B	1.03	A	VC
<i>Lanius tephronotus</i>	Grey-backed Shrike	R	0.04	W	R
<i>Larus brunnicephalus</i>	Brown-headed Gull	R	0.04	W	R
<i>Lonchura atricapilla</i>	Chestnut Munia	U	0.04	S	R
<i>Lonchura malabarica</i>	White-throated Munia	U	0.09	S	R
<i>Lonchura malacca</i>	Tricoloured Munia	R	0.02	W	R
<i>Lonchura punctulata</i>	Scaly-breasted Munia	B	0.64	A	VC
<i>Lonchura striata</i>	White-rumped Munia	R	0.22	S,W	UC
<i>Malacocincla abbotti</i>	Abbott's Babbler	B	0.18	S,W	C
<i>Mareca strepera</i>	Gadwall	R	0.04	W	R
<i>Merops leschenaulti</i>	Chestnut-headed Bee-eater	R	0.07	R,W	UC
<i>Merops orientalis</i>	Asian Green Bee-eater	B	0.73	A	VC
<i>Merops philippinus</i>	Blue-tailed Bee-eater	R	0.07	S	R
<i>Metopidius indicus</i>	Bronze-winged Jacana	B	0.88	A	VC
<i>Microcarbo niger</i>	Little Cormorant	B	1.74	A	VC
<i>Milvus migrans</i>	Black Kite	B	0.06	S	UC
<i>Motacilla citreola</i>	Citrine Wagtail	U	0.26	W	UC
<i>Motacilla madaraspatensis</i>	White-browed Wagtail	R	0.04	R	R
<i>Nectarinia asiatica</i>	Purple Sunbird	B	0.24	A	VC

(Table 1 contd.)

Table 1 contd.

Sl.No.	EN	Sl.No.	RA	Se	OS
<i>Nectarinia zeylonica</i>	Purple-rumped Sunbird	U	0.06	W	R
<i>Nettapus coromandelianus</i>	Cotton Pygmy-goose	R	0.06	W	R
<i>Ninox scutulata</i>	Brown Boobook	B	0.17	A	VC
<i>Nycticorax nycticorax</i>	Black-crowned Night Heron	R	0.02	S	R
<i>Oriolus chinensis</i>	Black-naped Oriole	R	0.07	A	C
<i>Oriolus xanthornus</i>	Black-hooded Oriole	B	1.19	A	C
<i>Orthotomus sutorius</i>	Common Tailorbird	B	1.08	A	VC
<i>Passer domesticus</i>	House Sparrow	B	5.41	A	VC
<i>Pelargopsis capensis</i>	Stork-billed Kingfisher	B	0.29	A	VC
<i>Pericrocotus cinnamomeus</i>	Small Minivet	R	0.26	R,W	UC
<i>Pernis ptilorhynchus</i>	Oriental Honey Buzzard	R	0.02	R	R
<i>Phalacrocorax carbo</i>	Great Cormorant	R	0.26	W	R
<i>Ploceus philippinus</i>	Baya Weaver	B	2.92	A	VC
<i>Prinia gracilis</i>	Graceful Prinia	R	0.07	W	R
<i>Prinia inornata</i>	Plain Prinia	B	0.31	A	VC
<i>Psilopogon asiaticus</i>	Blue-throated Barbet	B	1.25	A	VC
<i>Psilopogon haemacephala</i>	Coppersmith Barbet	B	0.40	A	VC
<i>Psilopogon lineatus</i>	Lineated Barbet	B	0.88	A	VC
<i>Psittacula krameri</i>	Rose-ringed Parakeet	B	0.86	A	VC
<i>Pycnonotus cafer</i>	Red-vented Bulbul	B	5.24	A	VC
<i>Spilopelia chinensis</i>	Eastern Spotted Dove	B	2.82	A	VC
<i>Spilornis cheela</i>	Crested Serpent Eagle	R	0.04	W	R
<i>Streptopelia decaocto</i>	Eurasian Collared Dove	U	0.09	R	R
<i>Streptopelia tranquebarica</i>	Red Turtle Dove	R	0.22	W	R
<i>Sturnus contra</i>	Asian Pied Starling	B	5.28	A	VC
<i>Sturnus malabaricus</i>	Chestnut-tailed Starling	B	1.65	A	VC
<i>Tachybaptus ruficollis</i>	Little Grebe	R	0.18	A	C
<i>Tephrodornis pondicerianus</i>	Common Woodshrike	R	0.11	W	R
<i>Terpsiphone paradisi</i>	Indian Paradiseflycatcher	B	0.15	R,W	C
<i>Treron phoenicopterus</i>	Yellow Footed Green Pigeon	R	0.20	R,W	UC
<i>Turdoides striata</i>	Jungle Babbler	B	3.30	A	VC
<i>Turnix suscitator</i>	Barred Buttonquail	B	0.11	A	C
<i>Tyto alba</i>	Common Barn Owl	B	0.22	A	VC
<i>Upupa epops</i>	Common Hoopoe	B	0.29	A	VC
<i>Vanellus cinereus</i>	Grey-headed Lapwing	U	0.13	W	R
<i>Vanellus indicus</i>	Red-wattled Lapwing	B	0.48	A	VC
<i>Zoothera citrina</i>	Orange-headed Thrush	B	0.26	A	VC
<i>Zosterops palpebrosus</i>	Oriental White-eye	B	0.35	A	VC

Table 2. Bird diversity in different areas in Bangladesh.

Location	Number of Individuals	Reference
Sreepur Upazila, Magura	84	Mandal <i>et al.</i> , 2021
Magura Sadar Upazila	140	Shome <i>et al.</i> , 2020
Kahimpur, Gazipur	72	Islam <i>et al.</i> , 2018
Keshabpur, Jessore	105	Jaman <i>et al.</i> , 2015
Ruhipur Union, Keraniganj, Dhaka	55	Jaman <i>et al.</i> , 2014
Pashukhali and Gajdhar village, Netrokona	101	Khan <i>et al.</i> , 2015
Dharala and Brahmaputra rivers in Kurigram	105	Khan and Nahar, 2015
Padma River charland (Godagari to Charghat), Rajshahi	141	Reza <i>et al.</i> , 2014
Char-kishoreganj, Munshiganj	58	Chowdhury <i>et al.</i> , 2007
Shoipara Beel of Mohanpur Upazilla, Rajshahi	96	Hasan <i>et al.</i> , 2017
Chapadal, Shree Rampur <i>beel</i> , Mithapur, Paharpur, Jogodishpur, Kastogaree <i>beel</i> and Asranga of Joypurhat	89	Amin <i>et al.</i> , 2020
Atrai, Raninagar and Naogan Sadar, Naogaon	105	Amin and Hasan, 2019
Kashipur Union, Barishal	141	Shome and Jaman, 2021
Jamalpur Sadar Upazila	136	Shome <i>et al.</i> , 2021a
Sandwip Island, Chattogram	119	Jaman <i>et al.</i> , 2022
Dhaka megacity	161	Jaman <i>et al.</i> , 2021
Faridpur Sadar Upazila	168	Shome <i>et al.</i> , 2022a
Mymensingh City Corporation	180	Shome <i>et al.</i> , 2022b
Madhukhali Upazila, Faridpur	109	Present study

This result indicates that the study area is the home of 16% (109) of the total bird species found in Bangladesh (Khan, 2018). This result reveals that species richness is higher in this study site than in other sites (Table 2).

Area-wise bird diversity: Among the two study sites, the Beleswar (rural site) area showed the highest diversity of bird species (93 species, 85.32%) with a higher number of individuals (n=3171, 58.15%) than the Madhukhali Municipal Area (Urban site) (Fig. 2). Richness estimators predicted a range of 109-120 species, which is relatively close to the 109 species identified during the field visit. This is confirmed by 95.33% of the samples being completed, indicating that the study area was sampled adequately. The diversity indices also show a higher value for the Beleswar (rural site) ($H=3.89$, $D_s=0.9724$). Species were more evenly distributed in Beleswar (rural site) (Table). Between the two study sites, variation of species richness ($\chi^2 = 0.69143$, $df = 1$, $p\text{-value} = 0.4057$) has not differed significantly but abundance ($\chi^2 = 144.93$, $df = 1$, $p\text{-value} < 0.0001$)

differed significantly. The number of species was almost similar in the two sites, the urbanization effects were not so prominent in the study area as well as the habitat structure was almost identical; thus, their evenness was also; In rural sites, disturbance to birds is lower than in the urban site, and more suitable habitats for birds are present in rural site. Thus, the number of bird species is higher in rural areas (Tryjanowski *et al.*, 2015; Shome *et al.* 2020).

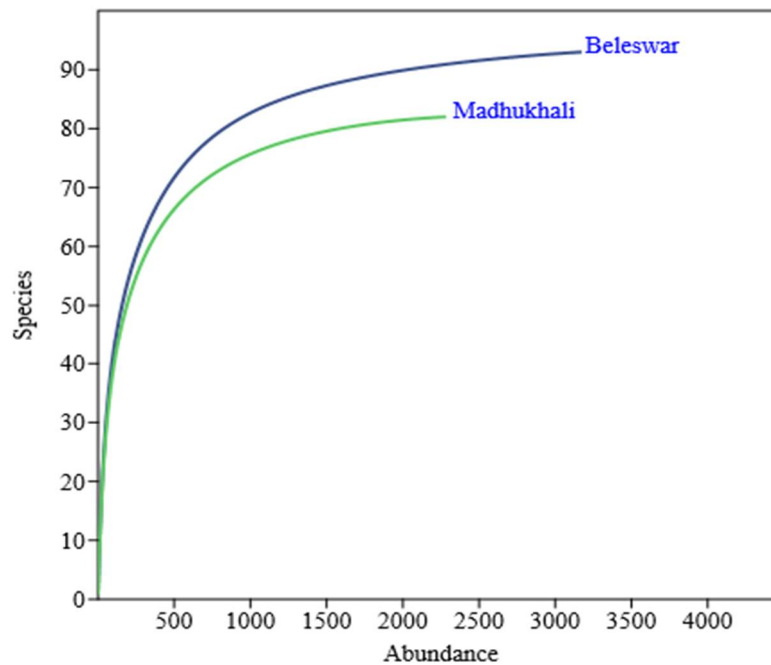


Fig. 2. Rarefaction curves in two study sites.

Seasonal variation: In the winter, the highest number of bird species (95 species, 87.15%) was observed, with the highest number of counted bird individuals ($n=2303$, 42.23%). In both study sites, the highest number of bird species and individuals were observed in winter. Diversity indices also show the highest ($H=3.94$, $D_s= 0.974$) value for the winter season. Species were more evenly distributed during the rainy season ($E=0.5929$). During the winter season, due to the presence of migratory bird species, the number of birds was higher in that period (Sandoval, 2019; Gomes *et al.*, 2017; Aung *et al.*, 2020; Shome *et al.*, 2022a).

Table 3. Species richness, abundance and diversity indices in different areas, seasons and habitats. (Species richness (S), Abundance (A), Simpson's Index (D_s), Shannon-Weiner Index (H), Evenness (E) in different areas, seasons, and habitats).

Categories		S	A	D _s	H	E
Area	Beleswar (Rural)	93	3171	0.9724	3.89	0.5257
	Madhukhali (Urban)	82	2282	0.9672	3.756	0.5219
Seasonal variation	Rainy	77	1495	0.9712	3.821	0.5929
	Summer	73	1655	0.9624	3.628	0.5157
	Winter	95	2303	0.974	3.94	0.5411
Seasonal variation in Beleswar (Rural)	Rainy	74	874	0.9716	3.831	0.623
	Summer	69	953	0.9637	3.643	0.5538
	Winter	86	1344	0.975	3.946	0.6018
Seasonal variation in Madhukhali (Urban)	Rainy	64	621	0.9684	3.735	0.6548
	Summer	59	702	0.9575	3.494	0.5578
	Winter	72	959	0.9683	3.742	0.5856
Macro- habitat	Aquatic	21	722	0.8404	2.187	0.4241
	Arboreal	65	3497	0.9523	3.378	0.451
	Terrestrial	23	1234	0.8721	2.323	0.4437
Micro-habitat	Bushy area	1	14	0	0	1
	Fallow land	2	140	0.06937	0.1576	0.5854
	Floating plant	4	300	0.4788	0.8921	0.6101
	Grass land	12	309	0.672	1.638	0.4288
	Mud flat	6	33	0.7595	1.612	0.8356
	Tree	65	3497	0.9523	3.378	0.451
	Urban Settlements	6	754	0.7447	1.443	0.7058
	Water body	11	389	0.7609	1.674	0.4847
Waste disposal site	2	17	0.3088	0.4954	0.8206	

Habitat uses: Among the observed bird species, the highest number of bird species (65 species, 59.63%) and individuals (n=3497, 64.12%) prefer arboreal types of habitats as their macro habitat. The tree was the preferable microhabitat with the highest number of birds, and diversity indices also shows the highest value for trees (H=3.378, D_s= 0.9523). A good number of native tree species are present in the study area, which provides the proper a wide array of opportunities for livelihood to different groups of bird species in the study area; thus, number of birds species is higher in trees (Fontana *et al.*, 2011; Kaushik *et al.*, 2022).

Bird response during COVID-19 lockdown situation: The movement of bird species in the study area, especially in the urban area, was more frequent than at other times. The urban site was busy with traffic on the Dhaka-Jashore highway, industry, crowds of local and people, pollution. But those all were absent during the lockdown situation, even the movement of local people also. Movement of *Athene brama*, *Cacomantis merulinus*, *Centropus bengalensis*, *Centropus sinensis*, *Cisticola juncidis*, *Coracias benghalensis*, *Cuculus micropterus*, *Dendrocitta vagabunda*, *Dendrocygna javanica*, *Hydrophasianus chirurgus*, *Zosterops palpebrosus*, *Upupa epops*, *Terpsiphone paradise*, *Psittacula krameri*, *Psilopogon asiaticus*, *Psilopogon haemacephala*, *Ninox scutulata*, *Lonchura striata*, *Amaurornis phoenicurus* was frequent than any other time in that area. Throughout the world at that time, the freely movement of wildlife was also observed in the study site for less anthropogenic activities (Shome *et al.*, 2021a).

Relative abundances, observation status, threats and conservation issues: Among the observed 109 species of bird species, *Acridotheres tristis* was the most abundant bird species (n=316, 5.79%) in the study area. The other most abundant bird species were *Passer domesticus*, *Sturnus contra*, *Pycnonotus cafer*, *Corvus splendens*, *Ardeola grayii*, *Dicrurus macrocercus*, *Turdoides striata*, *Acridotheres fuscus*, and *Cypsiurus balasiensis*. The ten most dominant species constituted 43.40% of total individuals, whereas the 40 least dominant species held only 2.24%. This signifies an uneven distribution of species in the community, which is explained in the rank abundance plot (Fig. 5A). Between the two study sites, the urban site (Madhukhali) signifies the most uneven distribution of species compared to the rural site (Beleswar). In urban sites, the ten most dominant species constituted 48.22% of total individuals, whereas in rural sites comprised 43.66% (Fig. 5B). This result also indicates that in urban site distribution of birds is uneven than the rural area and the population of scavengers birds (e.g., *Passer domesticus*, *Corvus splendens*, *Acridotheres tristis*, *Sturnus contra* and *Acridotheres fuscus*) are higher than rural area (Jaman *et al.*, 2021; Jessop *et al.*, 2012; Reboló-Ifrán *et al.*, 2017; Nepali *et al.*, 2021).

Observation status shows that among the observed 109 bird species, 59 bird species were very common (54.12%), 8 common (7.33%), 9 uncommon (8.25%), and 33 species were few (30.27%).

Among the bird species, *Ichthyophaga ichthyaetus* was categorised as Near Threatened (NT) according to IUCN Bangladesh (2015), and the rest are Least Concern (LC). Illegal bird hunting, especially water birds, is the major threat to bird species in the study area, especially in rural areas. Birds like heron, egret, bittern, wild duck and water fowl are

hunted by local people for their feeding (Shome *et al.*, 2022b). Trade of wild bird species is absent. At present urbanisation and habitat fragmentation are major threats to wild bird species in urban sites.

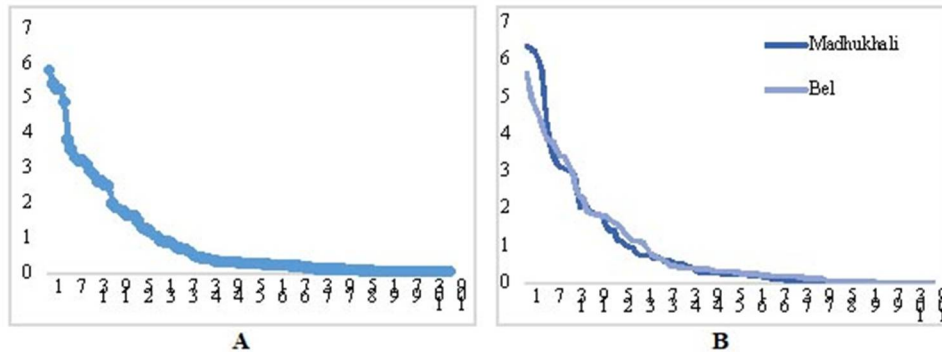


Fig. 5. Rank abundance plot for species recorded from the (A) total study area and (B) in two study sites. The y-axis shows the relative abundance, and the x-axis ranks the species in order of their abundance from the highest to the lowest.

Conclusion

Currently, the conservation of bird species in urban and rural areas of Bangladesh is important, for this, baseline information is essential. This research provides the actual scenario of status, community structure, seasonal variation, threats, and conservation issues of the study area. Although, the rich diversity of birds has indicated the suitability of the habitats for different groups of bird species, they are facing an existential crisis. Details research work is essential to know about the ecology, threats, and conservation issues. In addition to this awareness, creation is essential among local people with preparing and implementing the proper management plan and regular monitoring in the remote areas.

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