

Avian Species Diversity of Dhanmondi Lake Area, Dhaka, Bangladesh: Role of an Urban Ecosystem in Supporting Bird's Conservation

*Md. Kamrul Islam, Md. Anisur Rahman and S. M. Mainuddin
Wildlife Section, Bangladesh Forest Research Institute, Chattogram-4211, Bangladesh.

*Corresponding Author: kamrul79bfri@yahoo.com

Abstract

The Dhanmondi Lake Area (DLA), Dhaka possesses an overview performance for being an ideal site for bird's habitat because of its landscape, planted vegetation coverage, old trees and wetland. A study on the avian species diversity, richness and abundance, status, and seasonal variation was conducted from July 2019 to June 2021 in the green space of Dhanmondi Lake Area, Dhaka, Bangladesh. A total 57 species of avian fauna belonging to 12 orders, 27 families and 43 genera were recorded during the study period. Among the bird species passerines constituted the highest 30 species (56% of the total species) belonging to 15 families and 23 genera and non-passerine represented 27 species (44% of the total species) belonging to 13 families and 20 genera. Among the total species recorded during the study period 47 (82.46%) were resident bird species and 10 (17.54%) were migratory species. Identified birds' abundances, richness and threats to them were also discussed in this article.

সারসংক্ষেপ

ঢাকার ধানমন্ডি লেক এলাকার জলাভূমি, এর তীরভূমিতে রোপণ করা গাছপালা ও পুরানো বৃক্ষ মিলে যে সবুজায়ন গড়ে উঠেছে তাকে আপাতদৃষ্টিতে পাখি প্রজাতির উপযোগী আবাসস্থল বলে প্রতীয়মান হয়। এখানে পাখির প্রজাতি বৈচিত্র্য, প্রাচুর্য, বর্তমান অবস্থা ও ঋতুগত বৈচিত্র্যের উপর জুলাই, ২০১৯ হতে জুন, ২০২১ পর্যন্ত একটি গবেষণা কার্যক্রম পরিচালনা করা হয়। এ সময়ে সর্বমোট ৫৭ প্রজাতির পাখি রেকর্ড করা হয়, যারা ১২টি বর্গের ২৭টি গোত্রভুক্ত এবং ৪৩ গণের অন্তর্ভুক্ত। রেকর্ড করা পাখিদের মধ্যে সর্বোচ্চ ৩০টি (৫৬%) প্রজাতি ছিল গায়ক (passerines) এরা ১৫টি গোত্রভুক্ত এবং ২৩ গণের অন্তর্ভুক্ত এবং ২৭টি (৪৪%) প্রজাতি ছিল অগায়ক (non-passerines) যারা ১৫টি গোত্রভুক্ত এবং ২৩ গণের অন্তর্ভুক্ত ছিল। এসব পাখি প্রজাতির মধ্যে ৪৭টি (৮২.৪৬%) প্রজাতি স্থায়ী ও ১০টি (১৭.৫৪%) প্রজাতি ছিল পরিযায়ী। ধানমন্ডি লেক এলাকা হতে শনাক্তকৃত পাখি প্রজাতিগুলির প্রাচুর্য, সমৃদ্ধি এবং এখানে তাদের প্রতি হুমকিসমূহও এ নিবন্ধে আলোচনা করা হয়েছে।

Key words: Birds' abundances, Dhanmondi lake, Green space, Habitat, Status.

Introduction

Geographical location, landscape, climate and ecosystem of Bangladesh support rich avian species diversity and population. About 10,500 species of birds inhabit in the world of which a total of 718 species is expected to home in Bangladesh (IUCN 2015). Entire Bangladesh was an ideal habitat for birds at one time. But, in course of time, with the increase of population and their needs bird's natural habitat has been faced damaged, alteration and ongoing thinning for housing, food producing and building infrastructure facilities for the over grown citizens. Similar to the other region of the world, urban areas are expanding in size and number in Bangladesh. Cities are typically located near large river bank, water bodies, estuaries or long coast lines that traditionally support rich vertebrate community especially avifauna. As a result, large parks and reserves in urban areas may support high species diversity because these sheltered areas are the fragmented habitat of highly diverse, productive ecosystems. Several species of the existing wildlife of Bangladesh can be present in some small areas at a very low population (Rahman 2009). In recent times, conservation biologists of non-government organization and universities are collecting data on wildlife of protected areas and reserve forest areas and focused predominantly on the protection of natural ecosystem but have given little importance on urban biodiversity (Jules 1997; Rahman 2013; Rahman 2014). But, it is very vital to understand the diversity and abundance of avian species as a tool to value ecological significance and biodiversity conservation of a landscape in high human pressure (Chettri 2001; Payra 2017). Plants and wildlife of the green open areas in highly modified city areas impact urban environment. And thus, bird species distribution and diversity is associated

to the existing habitat feature and the extent of urbanization (Fontana *et al.* 2011; Pickett *et al.* 2011). Bird population and species could spread and use various habitats from plain land, forest, desert, ocean, mountain, ice zone to man habitation. So, any detrimental change of an ecosystem reflects on bird's varieties and numbers, thus it roles as an ideal barometer of a healthy ecosystem (Khan *et al.* 2011). Capital Dhaka has past historic jubilee of 400 years. In the past it was a small city within rivers, swamps and jungles. Wildlife was very rich in numbers and diversity from the present record. As regards of birds, waterfowls, pheasants, partridges, bustards, cranes, storks, eagle, hawks, falcons, owls, herons and egrets etc. were existing in Dhaka except present city birds (Simpson 1882; Tytler 1854).

Capital Dhaka is an over-populated city with more than 21.7 million citizens in 2021 within an area of 306 square kn. There is no wildlife habitat that has not been damaged, alternated and polluted. A few existing and restored green spaces provide home to birds. Dhanmondi Lake, established in the heart of Dhaka city, and tree cover along the lake side land is considered as safe haven for birds. No scientific and systematic monitoring of bird has been done yet at DLA, Dhaka, endowed with planted and regenerated trees, other plants and a vast water body. For better understanding of the possible changes and greater sustainability of urban ecosystem of Dhaka city, it is very important to study and assess avian species diversity of the DLA for taking further sophisticated initiatives of future sustainable conservation of the biodiversity and eradicate adverse effects on their existence in this area. So this study has been taken to find out the basic data on avian fauna with its status at the DLA. The study findings will eventually be helpful for implementing the conservation measures to protect the birds of the area.

Materials and Methods

Study area

The Dhanmondi Lake Area is amassing of unique green space and wetland within Dhaka metropolitan area. It is situated between 23°44'12'' and 23°45'22'' north latitudes and between 90°22' and 90°23' east longitudes (Fig. 1). The Dhanmondi Lake Area is amassing of unique green space and wetland within Dhaka metropolitan area. It is situated in the middle of Dhaka City at 23°43' North latitude and 90°26' East longitude (Fig. 1). It lies within the vicinity of Dhanmondi residential area. Originally Dhanmondi Lake was an abandoned channel of the 'Karwan Bazar Nadi' whose alignment was possibly along Begunbari Khal-Green Road-Kalabagan-Dhanmondi Lake to the Turag River. Expansion of urbanization in this area during Pakistan period has changed the natural water system in this place. Dhanmondi residential area was developed in 1956 with 240.74 ha of land including the lake. The lake is about 16% of the total area of Dhanmondi. Beginning from Jigatola (Dhanmondi Road - 2) the lake extends up to Road - 27 (new 16A), and bounded by the Mohammadpur-Lalmatia area in the north, Satmasjid Road in the west, BGB Gate (Dhanmondi Road -2) in the south and in the east by Kalabagan residential area. It is 3 km in length, 35-100 m in width, with a maximum depth of 4.77 m and the total area of the water body is 37.37 ha. There is one box culvert in the lake near Sukrabad area, which is the only outlet of the lake (Wikipedia 2021).

The lake is under the management of several authorities looking after its various aspects. At present, part of the lake used for sport fishing and the Fisheries Department looks after fishery development and aquaculture; the Dhaka South is the principal civic body, exercises some responsibility in its

improvement. The Department of Environment (DoE) looks after the aspects of proper environment and protection of aquatic resources of the lake. In and around Dhanmondi Lake some renovation works and tree plantation were carried out from 1998 to 2001 with a view to making the lake a pollution free, green and recreation zone (Hossain 2014; Banglapedia 2021).

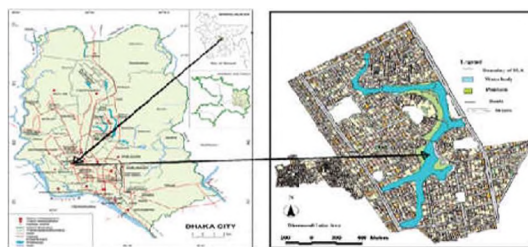


Figure 1. Map of Dhanmondi Lake Area, Dhaka, Bangladesh

Data collection and analysis

The study was carried out from July, 2020 to June, 2021. Study period covered three seasons i.e., monsoon (July-October), winter (November-February) and summer (March-May). A periodical survey, of 5 days per month was conducted in the field during the study.

The observations started early in the morning and continued to 11:00 am, and in the afternoon session from 3:00 pm to late the evening. Data were collected through direct field observation along the selected line transects about 1 km long and 10 m wide on both sides of wake ways in the lake areas. A pair of binocular and a digital camera (PowerShot Sx70HS) has been used for watching the avian species, and taking photo of birds for identification. If failed to identify any species in the field, pictures were used to identify by checking field guides. The local status of species was determined on the basis of relative species presence as stated by Khan (1982): (1) **very common** – species observed 80-100% of the field visits and good number

(2) **common**- species seen 50-79% of the field visits (3) **uncommon**- species detected 20-49% during the field visits and (4) **rare**- species witnessed less than 19% of the field visits and in very small number. Shannon-Weaver Index (1964), Simpson's index (1949) of diversity, evenness (quantifies how numerically equal the

community is) of species and effective numbers of species (Jost 2006) in the study area were also calculated using the following formulas (Suryakant 2017) (Table 1). The collected data were computed using MS Excel programme.

Table 1. The list of formulae used for calculating bird species diversity indices of the DLA.

Equation No.	Biodiversity indices	Formula	References
1.	Shannon-Weaver's diversity index (H')	$H' = \sum_{i=1}^s -P_i \ln P_i$	Shannon and Weaver (1964)
2.	Simpson's diversity index (D)	$D = \frac{\sum n(n-1)}{N(N-1)}$	Simpson (1949)
3.	Species evenness index (E)	$E = \frac{H'}{\log(S)}$	Shannon and Weaver (1964)
4.	Effective number of species (Ens)	Ens = EXP(H')	Jost (2006)

(Where, $P_i = \frac{n}{N}$, n = (Number of individuals of one species (N)) / (Total number of all individuals (S)) number of individuals of each species,

H' = Shannon Weaver diversity index)

Results

The Dhanmondi Lake Area (DLA), located in the heart of the capital and enriched with cover of native and exotic tree species, planted on both sides of the lake and a big water body

supported a good number of bird species. A total 57 species of avian fauna belonging to 12 orders, 27 families and 43 genera were recorded during the study (Table 2).

Table 2. Bird species observed at Dhanmondi Lake Area, Dhaka from July, 2020 to June, 2021.

Sl. No.	Order	Family	Scientific Name	Common English Name	Resident Status	Observed Status
01.	Anseriformes	Antidae	<i>Dendrocygna javanica</i>	Lesser whistling Duck	r	R
02.	Columbiformes	Columbidae	<i>Columba livia</i>	Rock Pigeon	r	Vc
03.	Columbiformes	Columbidae	<i>Streptopelia decaocto</i>	Eurasian Collared Dove	r	C
04.	Columbiformes	Columbidae	<i>Streptopelia chinensis</i>	Eastern Spotted Dove	r	Vc
05.	Cuculiformes	Cuculidae	<i>Eudynamys scolopacea</i>	Asian Koel	r	Vc

Sl. No.	Order	Family	Scientific Name	Common English Name	Resident Status	Observed Status
06.	Cuculiformes	Cuculidae	<i>Cacomantis merulinus</i>	Plaintive Cuckoo	r	R
07.	Pelecaniformes	Ardidae	<i>Butorides striata</i>	Striated Heron	r	R
08.	Pelecaniformes	Ardidae	<i>Ardeola grayii</i>	Indian Pond Heron	r	C
09.	Pelecaniformes	Ardidae	<i>Nycticorax nycticorax</i>	Black-crowned Night Heron	r	R
10.	Suliformes	Phalacrocoracidae	<i>Microcarbo niger</i>	Little Cormorant	r	Vc
11.	Caprimulgiformes	Apodidea	<i>Cypsiurus balasiensis</i>	Asian Palm Swift	r	Uc
12.	Caprimulgiformes	Apodidea	<i>Apus nipalensis</i>	House Swift	r	Vc
13.	Psittaciformes	Psittacidae	<i>Psittacula krameri</i>	Rose Ringed Parakeet	r	Vc
14.	Psittaciformes	Psittacidae	<i>Psittacula alexanderi</i>	Red-breasted Parakeet	r	R
15.	Psittaciformes	Psittacidae	<i>Psittacula eupatria</i>	Alexander Parakeet	r	Vc
16.	Accipitriformes	Accipitridae	<i>Milvus migrans</i>	Black Kite	r	Vc
17.	Strigiformes	Srtigidae	<i>Athene brama</i>	Spotted Owlet	r	R
18.	Strigiformes	Srtigidae	<i>Tyto alba</i>	Common Barn Owl	r	R
19.	Strigiformes	Srtigidae	<i>Ninox scutulata</i>	Brown Boobook	r	R
20.	Coraciformes	Alcedinidae	<i>Halcyon smyrnensis</i>	White-throated Kingfisher	r	Vc
21.	Coraciformes	Alcedinidae	<i>Halcyon atthis</i>	Common Kingfisher	r	Vc
22.	Coraciformes	Alcedinidae	<i>Halcyon capensis</i>	Stork-billed Kingfisher	r	Uc
23.	Coraciformes	Meropidae	<i>Merops orientalis</i>	Asian Green Bee-eater	r	Uc
24.	Piciformes	Picidae	<i>Dinopium macei</i>	Fulvous-breasted Woodpecker	r	C
25.	Piciformes	Picidae	<i>Dinopium benghalense</i>	Black - rumped Woodpecker	r	Vc
26.	Piciformes	Picidae	<i>Micropternus brachyurus</i>	Roufous Woodpecker	r	R
27.	Piciformes	Megalaimidae	<i>Megalaima haemacephala</i>	Coppersmith Barbet	r	Vc
28.	Passeriformes	Lanidae	<i>Lanius cristatus</i>	Brown Shrike	Wm	Uc
29.	Passeriformes	Lanidae	<i>Lanius schach</i>	Long-tailed Shrike	r	R
30.	Passeriformes	Lanidae	<i>Lanius tephronotus</i>	Grey backed Shrike	Wm	R
31.	Passeriformes	Oriolidae	<i>Oriolus xanthornus</i>	Black-hooded Oriole	r	Vc

Sl. No.	Order	Family	Scientific Name	Common English Name	Resident Status	Observed Status
32.	Passeriformes	Dicruridae	<i>Dicrurus macrocercus</i>	Black Drongo	r	C
33.	Passeriformes	Dicruridae	<i>Dicrurus leucophaeus</i>	Ashy Drongo	Wm	R
34.	Passeriformes	Corvidae	<i>Corvus splendens</i>	House Crow	r	Vc
35.	Passeriformes	Corvidae	<i>Corvus macrorhynchos</i>	Jungle Crow	r	C
36.	Passeriformes	Corvidae	<i>Dendrocitta vagabunda</i>	Tree Pie	r	Vc
37.	Passeriformes	Paridae	<i>Parus major</i>	Great Tit	r	Vc
38.	Passeriformes	Sylviidae	<i>Orthotomus sutorius</i>	Common Tailorbird	r	Vc
39.	Passeriformes	Sylviidae	<i>Phylloscopus fuscatus</i>	Dusky Warbler	m	Vc
40.	Passeriformes	Sylviidae	<i>Phylloscopus trochiloides</i>	Greenish Warbler	m	R
41.	Passeriformes	Sylviidae	<i>Acrocephalus dumetorum</i>	Blyth's Reed warbler	m	Uc
42.	Passeriformes	Sylviidae	<i>Phylloscopus inornatus</i>	Yellow-browed Warbler	m	C
43.	Passeriformes	Sturnidae	<i>Acridotheres tristis</i>	Common Myna	r	Vc
44.	Passeriformes	Sturnidae	<i>Acridotheres fuscus</i>	Jungle Myna	r	Vc
45.	Passeriformes	Sturnidae	<i>Sturnus contra</i>	Pied Starling	r	Vc
46.	Passeriformes	Sturnidae	<i>Sturnus malabaricus</i>	Chestnut-tailed Starling	r	Vc
47.	Passeriformes	Muscicapidae	<i>Muscicapa dauurica</i>	Asian Brown Flycatcher	m	R
48.	Passeriformes	Muscicapidae	<i>Ficedula albicilla</i>	Taiga Flycatcher	m	Vc
49.	Passeriformes	Muscicapidae	<i>Eumyias thalassina</i>	Verditer Flycatcher	m	R
50.	Passeriformes	Muscicapidae	<i>Copsychus saularis</i>	Oriental Magpie-robin	r	Vc
51.	Passeriformes	Pycnonotidae	<i>Pycnonotus cafer</i>	Red-vented Bulbul	r	Vc
52.	Passeriformes	Nectarinidae	<i>Nectarinia asiatica</i>	Purple Sunbird	r	Vc
53.	Passeriformes	Nectarinidae Sunbird	<i>Nectarinia zeylonica</i>	Purple rumped	r	C
54.	Passeriformes	Passeridae	<i>Passer domesticus</i>	House Sparrow	r	Vc
55.	Passeriformes	Estrilidae	<i>Lonchura punctulata</i>	Scaly breasted Munia	r	R
56.	Passeriformes	Motacilidae	<i>Motacilla madaraspatensis</i>	White browed Wagtail	r	R
57.	Passeriformes	Turdidae	<i>Zoothera citrina</i>	Orange headed	r	R

Code used: Vc = Very common, C = Common, Uc = Uncommon and R= Rare; r = resident and m = migratory

Among the presently recorded bird species Passeriformes constituted the largest order (in terms of number of species) in the Lake areas and it includes 30 species (56% of the total species) belonging to 15 families and 23 genera and non-passerine represented 27 species (44% of the total species) included 13 families and 20 genera. There were 47 (82.46%) resident bird species and 10 (17.54%) migratory bird species recorded during study in the area. The resident bird species were more than about five times higher than those of migratory ones.

Status and relative abundance of avifauna

Over all relative abundance showed that 44% birds were very common, 7% common, 19% uncommon 30% rare (Fig. 2).

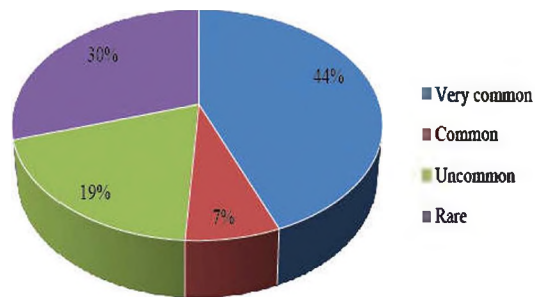


Figure 2. Status of different bird species in the study area from July, 2020 to June, 2021.

The highest number of individuals were found in the month of January (1327 individuals) followed by February (1123 individuals), December (1018 individuals), and lowest number were in the month of July (645 individuals) followed by August (720 individuals) and June (732 individuals) (Fig. 3).

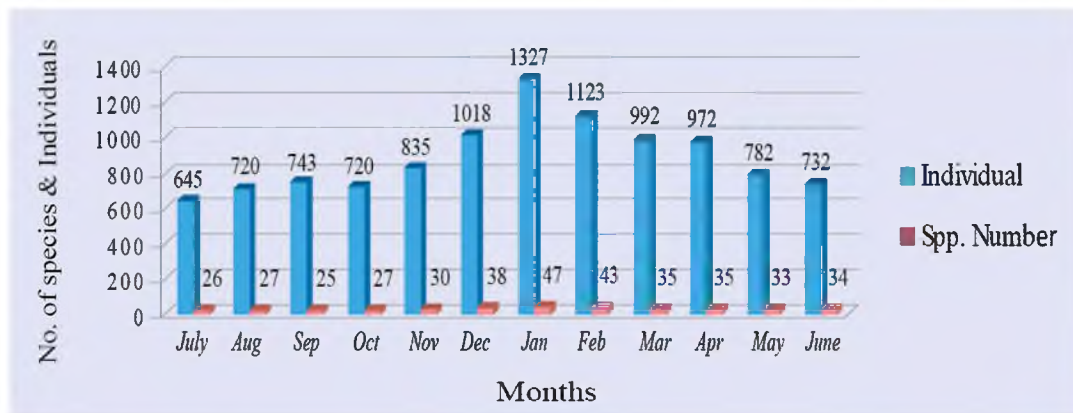


Figure 3. Monthly variation of bird species and individuals observed from July, 2020 to June, 2021.

Corvus splendens was the dominating species followed by *Passer domesticus*, *Sturnus contra* and *Milvus migrans* among the observed avifauna during the study at the DLA.

Variation was observed in the effective number of Species at DLA among the three seasons. In winter, the highest numbers of species (30 spp.) were active in the area followed by summer (25 spp.) and monsoon (18 spp.) (Fig. 4).

Species diversity indices

The value of Shannon-Weaver index was calculated the highest ($H' = 3.3960$) in the winter season (Nov-Feb), followed by ($H' = 3.2133$) summer (Mar-Jun) and the lowest ($H' = 2.9054$) was in the monsoon (Jul-Oct). Similarly, value of Simpson's index of diversity was found to be maximum ($D = 0.09581$) in the winter, followed by summer

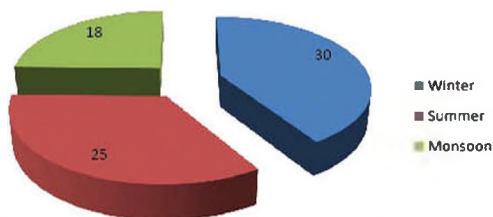


Figure 4. Seasonal variation of the bird Species at DLA from July, 2020 to June, 2021.

($D=0.9504$) and monsoon ($D=0.9231$). The study also calculated species evenness which found that birds species were more evenly distributed ($E=0.8710$) in the summer season, then in winter (0.8680) and lowest in the monsoon ($E=0.8460$) (Table 3).

Table 3. Species diversity indices according to season at DLA from July, 2020 to June, 2021.

Parameter	Monsoon	Winter	Summer
Shannon-Weaver index (H')	2.9054	3.3960	3.2133
Simpson's index of diversity (D)	0.9504	0.9581	0.9231
Evenness (E)	0.8460	0.8680	0.8710
Observed species	31	50	40
Observed Individuals	2822	4639	3586

Threats to conservation

Dhanmodi Lake Area is a popular zone for visiting. On a hot summer, walking beside the lake can be very relaxing and delightful to pass the leisure times. Many trees around the lake take various look of colors and beauty such as red, orange, pink, yellow, white and purple with the changes of seasons. Presence of 57 species of birds has been confirmed from DLA at this study but they are facing vulnerability due to the following threats –

Over visitors' pressure

Visitors start coming at dawn for exercising, walking, and sports. With the rising sun their numbers and movements increase and peak at

the evening for recreations, selling and buying goods. At the weak end their numbers raise and multiply on the events especially at the time of cultural functions and sport fishing at dry season. Consequently, bird's habitat of DLA is severely disturbed by over crowd of visitors.

Sound and light pollution

There are two streets around DLA, Mirpur road in the east, and Satmasid road in the west. A huge numbers of vehicles ply through the roads all days and nights. Numerous roads of residential area, and through the DLA always carry out hundreds of cars, motor bikes, auto rickshaws, rickshaws and vans. Thus the area is affected by serious sound pollution from noise of car engine and whistle, and din and bustle from mass people gathering and their activities. In the same way light pollution occurs from severe beam of vehicles, lighting and fireworks at the time of occasions in and around the lake area. Both terrify bird and damage suitability of its habitat.

Water pollution

Water body of DLA is subjected to the various anthropogenic and natural pollution like, discharge of residential garbage, waste water from nearby household, shops, commercial activities, rain water runoff with waste, dumping of plastics, polythene, chips packets, unused papers etc. Polluted lake water is directly or indirectly detrimental to lake ecosystems and associated bio-diversity.

Discussion

A total of 57 species of birds were recorded at Dhanmodi Lake Area, Dhaka. The recorded species of birds from DLA covered 10.07% of the country's total avifauna species 566 (IUCN 2015). There are some confirmations of bird's diversity recording within the capital. For instance, Akash *et al.* (2013) stated 50 species of birds consisting of 12 orders and 30 families at Curzon Hall premises of Dhaka University. Banu *et al.* (2016) identified 54 species were in

10 orders and 27 families from Dhaka university campus. Rajia *et al.* (2015) found 50 species of birds belonging to 11 orders and 28 families at Ramna Park area, Dhaka. As, the existing bird habitat of these areas are about similar and the same kind of disturbance prevail, therefore bird species recording is about nearer to the present study.

Islam *et al.* (2014) confirmed a total of 65 species of birds under 11 orders and 28 families from National Botanical Garden, the protected area, less disturbed and enriched habitat in Dhaka. It is the highest record of avian species diversity in the capital. The recent documentation of 57 species of birds by this study at DLA is the second highest diverse presence of birds within the capital Dhaka. Khan (1982) concluded that a bird watcher could record minimum 50 species of birds in a city of Bangladesh. Therefore, the study area demands conservation requirements as a potential habitat for birds.

Although there is a large water body (37.37 ha) in the DLA, it could not attract resident and migratory water fowl. This is because of high disturbance as a result of sound pollution and crowd existing there all the year round. So, only a few resident aquatic birds viz. little egret, black crown night heron, little cormorant, green backed heron and kingfishers were recorded there. Alexandar parakeet (*Psittacula eupatria*) is the most attractive and beautiful bird of DLA.

From December migratory birds join the resident's birds, and increased species diversity and population of the area that peaks in the January and continues till February. In the summer, beginning of breeding season for resident birds, though decrease species variety but their members found high in numbers. On the other hand, high temperature, low food availability, expanding of grazing habitat at the onset of rains that attracts and scatters species to nearby agriculture ecosystem may be the reason of low species diversity and population.

Conclusion

The existence of 57 species of bird and their population, seasonal variation at DLA has indicated significant baseline data on avian species diversity and present status. The study indicates that plantation along the lake side open space has made DLA area green and attractive to winged beauties. Water body of DLA is about twice comparing to lake side land area cover. Assemble of a unique green space and water body, DLA attracts bird species with availability of diversified habitat, food and cover. But birds' habitat is severely disturbed by existing threats to the DLA. The anthropogenic activities and human influence directly or indirectly affects the avian fauna. There is a requirement of conservation of green space and wetland of DLA for their further conservation of birds and associated other biodiversity. So, for recovering the soundness of the lake, strong regulation need to introduce; illegal encroachment and waste dumping have to stop through implementation of existing laws and regulations. Moreover driving of public awareness activities is necessary. Remedial and conservation initiatives need to undertake for restoration of the lake areas such as preventing or reducing of processes degrading or polluting lake water quality, preventing developments that are directly or indirectly detrimental to lake ecosystems, creating and maintaining existing buffer zones between the lake and other public amenities.

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