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ECOLOGY AND DIVERSITY OF WILDLIFE IN DHAKA UNIVERSITY CAMPUS, BANGLADESH

ASHIKUR RAHMAN SHOME, MD MAHABUB ALAM, MD FAZLE RABBE, MD MOKHLESUR RAHMAN AND MOHAMMAD FIROJ JAMAN*

Department of Zoology, University of Dhaka, Dhaka-1000, Bangladesh

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Abstract

Nowadays urbanization continues, and poses a serious threat to wildlife globally. A survey-based study on wildlife was conducted for three years from March 2017 to February 2020 in Dhaka University campus. Data was collected through direct visual encounter observations. A total of 94 species of wildlife under 20 orders and 52 families were observed. Of the documented wildlife, 5 (5.32%) species belongs to amphibians, 10 (10.64%) reptiles, 70 (74.47%) birds and 9 (9.57%) mammals. The highest species richness (72, 76.60%) was observed in the third year (March 2019 to February 2020), particularly in winter season. Although the lowest richness was (63, 67.02%) found in the first year (March 2017 to February 2018), but the evenness was the highest this year, particularly in summer season. We counted the highest number of individuals (n=5227, 35.73%) in the first year (March 2017 to February 2018) but these counts have gradually decreased with the lowest in the third year (March 2019 to February 2020). Among 94 species, 44 species (46.80%) were very common, 3 (3.19%) common, 17(18.09%) uncommon and 30 (31.91%) were few. *Duttaphrynus melanostictus* was the most abundant (66.89%) among amphibians, *Hemidactylus frenatus* (40.82%) for reptiles, *Psittacula krameri* (18.73%) for birds and *Mus musculus* (28.68%) for mammals. Rampant human movements and sound pollution were frequent inside the campus that might affect wildlife. Therefore, long-term systematic monitoring is necessary to understand the species diversity and population trend of wildlife in the campus. Moreover, this baseline information may help urban policymakers to take proper management measures for the protection of wildlife in the study area.

Introduction

Over the past few centuries, the world is experiencing a trend or basically, a human-modified transformation called urbanization due to the increased number of human populations. Until now, more than 55% of the world's human population is currently living in urban areas and by 2050 it is expected to rise more than 68%[1-3]. This increasing population provides more velocity to the rapid urbanization process which changes the

*Author for correspondence: <mfjaman4@gmail.com>.

structure of landscape ecology. Consequently, this process exposes a major threat to biodiversity through both local species extinction due to habitat conversion and biotic homogenization[4-8]. Nonetheless, urban habitats give shelter to many adaptive species making them encounter more natural stressors[9-10]. These habitats offer a wide range of benefits to some species like increased accessibility to food resources and relief from predators[11-12] which support a higher level of species diversity compared to rural or its surrounding habitats. In this way, urban habitats play a significant role in protecting local biodiversity despite the fact that this process is degrading biodiversity too[2,3,6,10].

Bangladesh has a rich and diverse wildlife species due to its location at the junction of the Indo-Himalayas and Indo-China sub-regions. The species of two biogeographic regions overlap and make the country a transitional zone for both flora and fauna among South Asia[15]. Depending upon such features, this country harbours a total of 57 amphibian species, 167 reptiles, 690 birds, and 127 species of mammals[13-18].

Dhaka is the largest overpopulated fastest-growing megacity (360 km^2) of Bangladesh, situated in the central region of the country. Once the city was rich with diverse wildlife and habitats including wetlands, homestead forests, jungles, grassland and ponds[19-21]. Due to recent expansion of the city and several ongoing megaprojects such as metrorail, flyovers/multilayer roads cause the massive changes in its landscape structure that can eventually affect wild animals[22]. As a result, wildlife habitats have gradually reduced in Dhaka city[13,19, 23].

Some studies were previously done only on avian diversity in the Dhaka University campus[19,23,24]. Until now, no systematic study on wildlife diversity was done in the campus. Therefore, this study aimed to prepare baseline information on wildlife diversity, status, abundance, seasonal occurrence and habitat usage in the University of Dhaka that may help conserve wildlife and their habitats.

Materials and Methods

Study area: The University of Dhaka (23.7340°N, 90.3928°E) is situated in the central region of Dhaka megacity under Shahbag thana (Fig. 1) and covers an area of 2.43 km^2. This area is relatively undisturbed for wildlife compared with other parts of Dhaka city[24]. The study area has at least 541 species of trees including herbs, shrubs, creepers and climbers[25]. Besides, this area is diverse with natural habitats that include permanent and temporary waterbodies, ponds, bushy areas and small gardens around academic and residential buildings.

Data collection: We conducted a three years survey started from March 2017 to February 2020 in the Dhaka University campus (i.e. first year - March 2017 to February 2018, second year – March 2018 to February 2019, third year - March 2019 to February 2020). The study period was divided into three seasons such as summer (March - June), rainy (July - October) and winter season (November - February). Data collection was

done through direct visual encounter observations in the field. A total of 99 days (33 days×3 year) were spent in the field. An equal amount of time was spent on the survey in each season (11 field trips in each season). Observations were conducted in the early morning (06:30 – 10:30 am), afternoon (03.30 – 06.30 pm) and night (08:00 – 10:00 pm). The night surveys were conducted for amphibians, reptilians, nocturnal birds and mammals because they are mostly active at night. Some avifauna which usually hide in the bushes, jungles and branches of trees, were recorded by receiving their song and calls. Sometimes, calls were recorded by Huawei GT3 Phone which was later identified in the laboratory. Upon spotting any wildlife during the survey, we photographed them by Nikon D7100 DSLR Camera with 70-300 mm VR lens for accurate identification. For the identification of wildlife, some popular field guides on wildlife were followed[13,15,26,27].

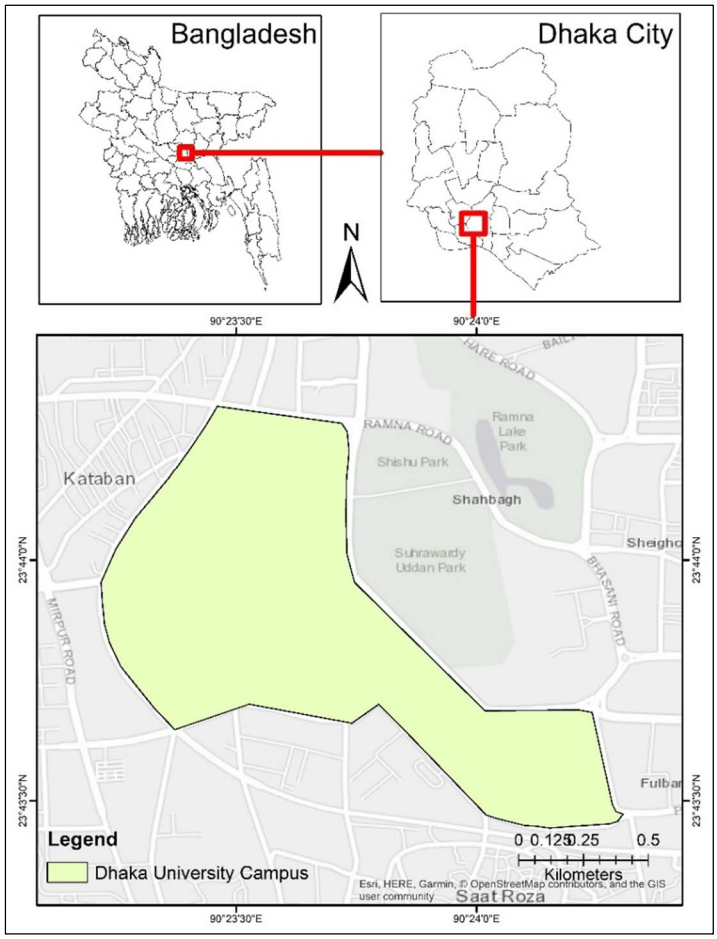

Fig. 1. Map of the study area.

In this study, we followed a random sampling method to observe nocturnal birds and mammals[28]. At least 8 hours of effort (3 hours in the morning + 3 hours in the afternoon + 2 hours at night) per day totalling 792 hours was ensured. We used plot counting for amphibians and reptilians, while birds and mammals were surveyed by the employing transect line survey method[29]. We sampled 20 plots with a size of 10m×10m as well as 20 transect lines which measure about 100m×20m to cover the whole study area. Each plot and transect line was observed repeatedly at least two times in a season. We categorized all the habitats into six types- (1) grounds includes fallow land, playground, yard; (2) trees such as orchard, small garden, roadside tree, tree around buildings; (3) urban settlements includes poles, buildings, towers; (4) permanent waterbody for example pond, tanks; (5) temporary waterbody contains small shallow, seasonal waterbodies; and (6) bushes.

Data analysis: The relative abundance of particular bird species was calculated following the formula-

$$\text{Relative abundance} = \frac{\text{Number of individual of a species}}{\text{Total number of individuals of all species}}.00$$

The observation status was calculated following Khan[27]. We plotted species abundance rank in the samples following Whittaker[30].We calculated diversity indices following Shannon-Wiener index[32], Simpson's index[31] of diversity. Evenness (quantifies how numerically equal the community is) in the study area was also calculated following formula-

Evenness, $E = H/ln\ (S)$ (natural log).

Results and Discussion

Species composition and abundance: A total of 94 species of wildlife under 20 orders and 52 families were observed in the study area, of which 5 (5.32%) were amphibians, 10 (10.64%) reptiles, 70 (74.47%) birds and 9 (9.57%) mammals (Table 1). Species composition of this study area represents 43.06% wildlife species of megacity Dhaka[43]. We found 14,630 individuals of wildlife in total , of which 601 individuals (4.17%) were of amphibians, 343 (2.34%) reptiles, 12884 (88.06%) birds and 802 (5.48%) mammals (Table 1). Among the 94 species of wildlife, 44 species (46.80%) were very common, 3 (3.20%) common, 17(18.10%) uncommon and 30 (31.90%) were few (Table 1).

Amphibia: The highest number of frog species was recorded from the family Dicroglossidae (2 species, 40%) (Table 1). The highest number of individuals was observed during the first year (March 2017 to February 2018). But this number gradually decreased in the following year. We did not observe any Microhylid frog in the last year (March 2019 to February 2020) of the study in the campus. Destruction of temporary waterbodies due to construction works in the campus might contribute to the decrease

Table 1. Wildlife in the Dhaka University Campus observed during March 2017 to February 2020.

Scientific Name	Common Name	N	RA	OS	Year	MH	PR
Mammalia							
Bandicota bengalensis	Lesser Bandicoot Rat	44	5.49	UC	Y3	G	NO
Bandicota indica	Large Bandicoot Rat	1	0.12	FE	Y1	G	NO
Funambulus pennantii	Five-striped Palm Squirrel	139	17.33	VC	Y1, Y2, Y3	T	NO
Herpestes auropunctatus	Small Indian Mongoose	29	3.62	VC	Y1, Y2, Y3	BU	NO
Macaca mulatta	Rhesus Macaque	3	0.37	UC	Y2, Y3	US	NO
Mus musculus	House Mouse	230	28.68	VC	Y1, Y2, Y3	US	NO
Pipistrellus coromandra	Indian Pipistrelle	64	7.98	VC	Y1, Y2, Y3	T	NO
Pteropus giganteus	Indian Flying Fox	124	15.46	VC	Y1, Y2, Y3	T	NO
Rattus rattus	Common House Rat	168	20.95	VC	Y1, Y2, Y3	US	NO
Aves							
Accipiter badius	Shikra	1	0.01	FE	Y3	T	NEW
Acridotheres fuscus	Jungle Myna	655	5.08	VC	Y1, Y2, Y3	T, G	S1,S2,S3
Acridotheres ginginianus	Bank Myna	3	0.02	FE	Y2	G	S3
Acridotheres tristis	Common Myna	407	3.16	VC	Y1, Y2, Y3	T	S1,S2,S3
Acrocephalus dumetorum	Blyth's Reed Warbbler	1	0.01	FE	Y2	T	S3
Aegithina tiphia	Common Iora	2	0.02	FE	Y1	T	S1, S3
Alcedo atthis	Common Kingfisher	39	0.30	VC	Y1, Y2, Y3	T	S1,S2,S3
Amaurornis phoenicurus	White-breasted Waterhen	1	0.01	FE	Y2	PW	New
Anthus rufulus	Paddyfield Pipit	3	0.02	FE	Y1	BU	S1,S3
Apus nipalensis	House Swift	1287	9.99	VC	Y1, Y2, Y3	T, G	S1,S2,S3
Ardeola grayii	Indian Pond Heron	121	0.94	VC	Y1, Y2, Y3	PW	S1,S2,S3
Artamus fuscus	Ashy Woodswallow	2	0.02	FE	Y3	T	NEW
Athene brama	Spotted Owlet	93	0.72	UC	Y3, Y2	T	S1,S2,S3
Bubulcus ibis	Cattle Egret	2	0.02	FE	Y1	PW	S2
Butorides striata	Green-backed Heron	1	0.01	FE	Y2	PW	NEW
Cacomantis merulinus	Plaintive Cuckoo	1	0.01	FE	Y3	T	S1,S2,S3
Columba livia	Rock Dove	308	2.39	VC	Y1, Y2, Y3	US, G, T	S1,S2,S3
Copsychus saularis	Oriental Magpie-robin	244	1.89	VC	Y1, Y2, Y3	G, T, BU	S1.S2,S3
Corvus levaillantii	Large-billed Crow	159	1.23	VC	Y1, Y2, Y3	T, G	S1,S2,S3
Corvus splendens	House Crow	730	5.67	VC	Y1, Y2, Y3	T, G	S1,S2,S3
Cypsiurus balasiensis	Asian Palm -swift	317	2.46	VC	Y1, Y2, Y3	T	S1,S2,S3
Dendrocitta vagabunda	Rufous Treepie	36	0.28	VC	Y1, Y2, Y3	T	S1,S2,S3
Dendrocopos macei	Fulvous-breasted Woodpecker	51	0.40	VC	Y1, Y2, Y3	T	S1,S2,S3
Dicaeum erythrorhynchos	Pale-billed Flowerpecker	36	0.28	VC	Y1, Y2, Y3	T	S1,S2,S3

Scientific Name	Common Name	N	RA	OS	Year	MH	PR
Dicrurus macrocercus	Black Drongo	96	0.75	VC	Y1, Y2, Y3	T	S1,S2,S3
Dinopium benghalense	Black-rumped Flameback	124	0.96	VC	Y1, Y2, Y3	T	S1,S2,S3
Egretta garzetta	Little Egret	130	1.01	VC	Y1, Y2, Y3	TW, PW	S3
Eudynamys scolopaceus	Asian Koel	114	0.88	VC	Y1, Y2, Y3	T	S1,S2,S3
Falco tinnunculus	Common Kestrel	1	0.01	FE	Y3	T	S3
Ficedula albicilla	Taiga Flycatcher	8	0.06	UC	Y1, Y2, Y3	BU	S1,S2,S3
Halcyon smyrnensis	White-breasted Kingfisher	62	0.48	VC	Y1, Y2, Y3	T	S1,S2,S3
Haliastur indus	Brahminy Kite	5	0.04	UC	Y2, Y3	T, PW	S1,S2,S3
Hirundo rustica	Barn Swallow	2	0.02	FE	Y3	T	S3
Lanius cristatus	Brown Shrike	8	0.06	UC	Y1, Y2, Y3	T, BU	S1,S2,S3
Lanius schach	Long-tailed Shrike	28	0.22	VC	Y1, Y2, Y3	T	S1,S3
Acrocephalus aedon	Thick-billed Warbler						X
Aethopyga gouldiae	Mrs. Gould's sunbird						X
Centropus sinensis	Greater Coucal						X
Clamator jacobinus	Pied crested Cuckoo						X
Coracias benghalensis	Indian Roller						X
Coracina melanoptera	Black-headed Cuckooshrike						X
Dendrocygna javanica	Lesser Whistling Duck						X
Dicrurus leucophaeus	Ashy Drongo						X
Falco chicquera	Red-headed Falcon						X
Gyps bengalensis	White-rumped Vulture						X
Gyps himalayensis	Himalayan Griffon						X
Hierococcyx varius	Common Hawk Cuckoo						X
Jynx torquilla	Eurasian Wryneck						X
Larbivora brunnea	Indian Blue Robin	1	0.01	FE	Y1	BU	S2,S3
Lonchura malabarica	White-throated Munia	5	0.04	UC	Y1, Y3	BU	S1,S3
Lonchura punctulata	Scaly-breasted Munia	10	0.08	UC	Y3	T	S3
Merops orientalis	Asian Green Bee-eater	69	0.54	UC	Y1, Y2, Y3	T	S1,S2,S3
Microcarbo niger	Little Cormorant	14	0.11	UC	Y3	T, PW	S1,S2,S3
Micropternus brachyurus	Rufous Woodpecker	1	0.01	FE	Y2	T	S1,S2,S3
Milvus migrans	Black Kite	1825	14.16	VC	Y1, Y2, Y3	T	S1,S2,S3
Motacilla alba	White Wagtail	22	0.17	UC	Y1, Y2, Y3	PW	S1.S2,S3
Motacilla madaraspatensis	White-browed Wagtail	9	0.07	UC	Y1, Y2, Y3	PW	S3
Nectarinia asiatica	Purple Sunbird	61	0.47	VC	Y1, Y2, Y3	T	S1,S2,S3
Nectarinia zeylonica	Purple-rumped Sunbird	49	0.38	VC	Y1, Y2, Y3	T	S2,S3
Ninox scutulata	Brown Boobook	7	0.05	UC	Y2, Y3	T	NEW
Nycticorax nycticorax	Black-crowned Night Heron	7	0.05	UC	Y3	T	S3

Scientific Name	Common Name	N	RA	OS	Year	MH	PR
Oriolus xanthornus	Black-hooded Oriole	43	0.33	VC	Y1, Y2, Y3	T	S1,S2,S3
Orthotomus sutorius	Common Tailorbird	216	1.68	VC	Y1, Y2, Y3	T, BU	S1,S2,S3
Otus lettia	Collared Scops Owl	1	0.01	FE	Y3	T	NEW
Parus major	Great Tit	5	0.04	FE	Y2	T	S1,S2,S3
Passer domesticus	House Sparrow	1140	8.85	VC	Y1, Y2, Y3	T, G	S1,S2,S3
Phylloscopus fuscatus	Dusky Warbler	4	0.03	UC	Y1, Y3	BU	S3
Phylloscopus reguloides	Blyth's Leaf Warbler	1	0.01	FE	Y2	T	S2
Psilopogon asiaticus	Blue Throated Barbet	11	0.09	UC	Y1, Y2	T	NEW
Psilopogon haemacephala	Coppersmith Barbet	94	0.73	VC	Y1, Y2, Y3	T	S1,S2,S3
Psilopogon lineatus	Lineated Barbet	82	0.64	VC	Y1, Y2, Y3	T	NEW
Psittacula alexandri	Red Breasted Parakeet	4	0.03	FE	Y3	T	S3
Psittacula cyanocephla	Plum-headed Parakeet	27	0.21	UC	Y2, Y3	T	NEW
Psittacula eupatria	Alexandrine Parakeet	123	0.95	VC	Y1, Y2, Y3	T	S1,S2,S3
Psittacula krameri	Rose-ringed Parakeet	2413	18.73	VC	Y1, Y2, Y3	T	S1,S2,S3
Pycnonotus cafer	Red-vented Bulbul	356	2.76	VC	Y1, Y2, Y3	T	S1,S2,S3
Spilopelia chinensis	Eastern Spotted Dove	620	4.81	VC	Y1, Y2, Y3	US, G, T	S1,S2,S3
Streptopelia decaocto	Eurasian Collared Dove	1	0.01	FE	Y1	G	NEW
Sturnus contra	Asian Pied Starling	313	2.43	VC	Y1, Y2, Y3	G,T	S1,S2,S3
Sturnus malabaricus	Chestnut-tailed Starling	237	1.84	VC	Y1, Y2, Y3	T	S1,S2.S3
Treron phoenicopterus	Yellow-footed Green Pigeon	33	0.26	UC	Y1, Y3	T	NEW
Tyto alba	Common Barn Owl	1	0.01	FE	Y2	T	S2,S3
Acrocephalus stentoreus	Clamorous Reed Warbler	1	0.01	FE	Y2	T	S1,S2,S3
Lanius tephronotus	Grey-backed Shrike						X
Lonchura atricapilla	Chestnut Munia						X
Pelargopsis capensis	Stork-billed Kingfisher						X
Pericrocotus roseus	Rosy Minivet						X
Phoenicurus ochruros	Black Redstart						X
Picoides canicapillus	Grey-capped Woodpecker						X
Picus xanthopygaeus	Streak-throated Woodpecker						X
Ploceus philippinus	Baya Weaver						X
Pycnonotus jocosus	Red-whiskered Bulbul						X
Terpsiphone paradisi	Asian Paradise-flycatcher						X
Upupa epops	Common Hoopoe						X
Zoothera citrina	Orange-headed Trush						X
Zoothera dauma	Eurasian Scaly Thrush						X

Scientific Name	Common Name	N	RA	OS	Year	MH	PR
Reptilia							
Calotes versicolor	Common Garden Lizard	1	0.29	FE	Y2	T	NO
Eutropis carinata	Common Skink	1	0.29	FE	Y2	G	NO
Gekko gecko	Tokay Gecko	1	0.29	FE	Y2	US	NO
Hemidactylus flaviviridis	House Lizard	32	9.33	C	Y1, Y2, Y3	US	NO
Hemidactylus frenatus	Common House Gecko	140	40.82	VC	Y1, Y2, Y3	US	NO
Indotyphlops braminus	Brahminy Blind Snake	1	0.29	FE	Y3	G	NO
Lissemys punctata	Spotted Flapshell Turtle	1	0.29	FE	Y3	PW	NO
Pangshura tecta	Roofed Turtle	128	37.32	VC	Y1, Y2, Y3	PW	NO
Varanus bengalensis	Bengal Lizard	1	0.29	FE	Y2	G	NO
Xenochrophis piscator	Checkered Keelback	37	10.79	VC	Y1, Y2, Y3	PW	NO
Amphibia							
Duttaphrynus melanostictus	Common Toad	402	66.89	VC	Y1, Y2, Y3	TW	NO
Microhyla sp.	Microhylid Frog	3	0.50	FE	Y1	BU	NO
Fejervarya asmati	Asmat's Cricket Frog	99	16.47	C	Y1, Y2, Y3	BU, G	NO
Hoplobatrachus tigerinus	Indian Bull Frog	94	15.64	VC	Y1, Y2, Y3	TW	NO
Polypedates leucomystax	Common Tree Frog	3	0.50	FE	Y2	T	NO

Note: N- Number of individuals counted during study period; RA- Relative Abundance; OS- Observation Status, VC- Very Common, C-Common, UC- Fairly Common; Few- FE, LC- Least Concern, NT- Near Threatened; MH- Micro-habitat, T- Tree, US- Urban Settlement, G- Ground, PW- Permanent Waterbody, TW- Temporary Waterbody, BU- Bush; W- Winter, S- Summer and R- Rainy; Y1- First year, Y2- Second year, Y3- Third year; PR- Previous Record, S1- Akash *et al.*[19] (Curzon Hall), S2- Banu *et al.*[23] (Dhaka University Campus), S3- Chowdhury *et al.*[24] (Dhaka University Campus), New- Not observed in previous studies but present in this study, X- Observed in previous studies but not recorded in this study, NO-not studied previously but recorded in the present study.

of frog species. For instance, a part of the botanical garden at Curzon Hall has been replaced by a greenhouse for research purposes. Actually, this place was a suitable breeding ground during the breeding season for Indian Bullfrog, Microhylid Frog and some species of Cricket Frogs. These habitat changes caused the decrease for these frog species[33]. All five amphibian species were observed in the rainy season with more than half (53.6%) of the total observed individuals (Table 1). Generally, the rainy season is the peak breeding season for amphibians and they are the most active during this season[34]. Asian Common Toad *Duttaphrynus melanostictus* was abundant (66.89%) and dominant among amphibians (Table 1, Fig. 2), because of their ability to adapt in all types of habitats adjacent to water sources[34].

Reptilia: Among 10 species of reptiles, 8 belong to the order Squamata and the rest are of Testudines (Table 1). Family Gekkonidae contained the highest number of species (3 Species, 30%). No venomous reptiles were recorded in this study. We found the highest

(8 species) number of species with the highest individual number in the second year (March 2018 to February 2019) for reptiles. This result indicates that some species of reptiles may adapt in the modified urban habitat[42]. The abundance of Common House Gecko *Hemidactylus frenatus* was the highest (40.82%) followed by Roofed Turtle *Pangshura tecta* (37.31%) (Table 1, Fig. 2). This may be because Roofed Turtles was found to breed in permanent water of Curzon Hall pond and Common House Gecko was found in trees, buildings, household.

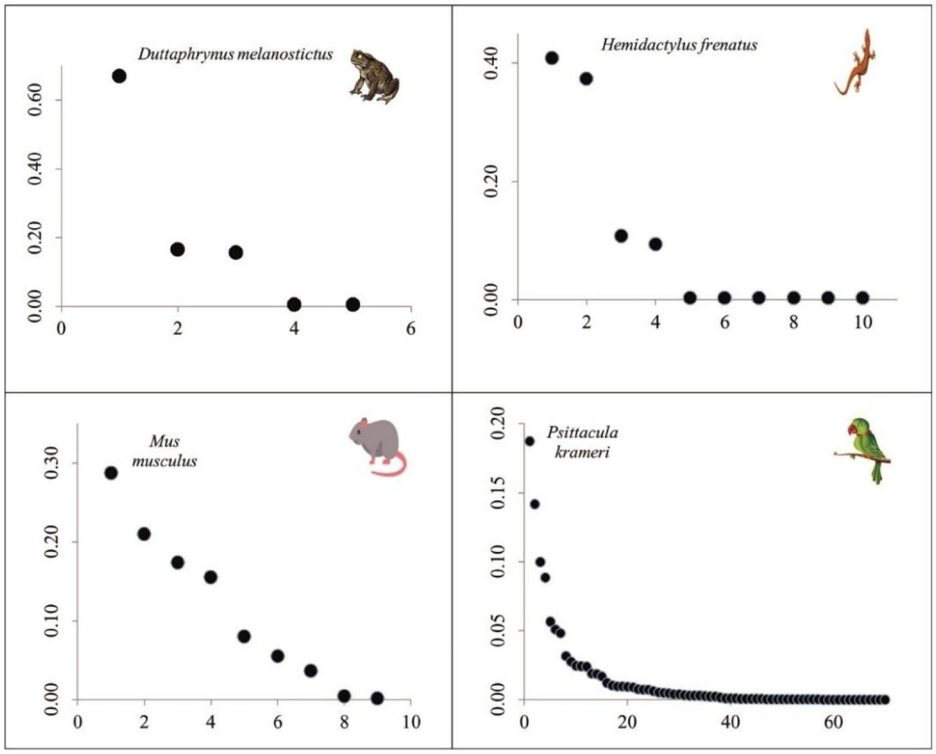

Fig. 2. Rank-abundance curve of the four groups of wildlife where species abundance represented vertically and species rank represented horizontally. (Clock-wise: Amphibia-Reptilia-Aves-Mammalia). The x-axis ranks the species in order of their abundance from the highest to lowest and then y-axis shows the relative abundance.

Aves: Resident bird species were dominant among avifauna (60 species, 85.71%), followed by winter migratory birds (9 species, 12.90%) and only one species was passage visitor (1.42%). The order Passeriformes contains the highest number of bird species (34 species, 48.57%) among the 13 orders. Rose-ringed Parakeet *Psittacula krameri* was the highest (18.73%) in abundance followed by Black Kite *Milvus migrans* (14.16%) as they are supported by suitable tree species those providing enough food, shelter and nesting facilities for them (Table 1, Fig. 2).

Mammalia: We observed 9 species of mammals in total and of them, 5 (55.56%) species were rodents, mostly murids (4 species) (Table 1). House Mouse *Mus musculus* (28.68%) was the most abundant mammal followed by Common House Rat *Rattus rattus* (20.95%). Although, there is a huge possibility of the presence of some predatory species for these rodents and we observed only Small Indian Mongoose *Herpestes auropunctatus*. The excessive reproduction rate may have increased the rat population in the study area causing the dominancy over other mammals (Fig. 2). Urban habitat provides suitable facilities such as food sources and absence of natural stressors (e.g. less predation) for some particular species of mammals[11,12].

No published literature is available on total wildlife diversity in Dhaka megacity except some scattered studies on birds (Table 2). The present study found 70 bird species in 3 year period indicating the decrease of avian species in the study area. Nine birds species were newly recorded from the study site which were not documented in the previous studies. Conversely, 26 species of birds were previously recorded but these were not observed during the present study (Table 1). The comparison with other studies on birds of Dhaka city showed that bird diversity is higher in Dhaka University campus than in any other location of the city (Table 2). This indicates that this study area is an ideal habitat for avifauna which may be due to the presence of diverse plant species, mostly trees and relative food availability. But, recent developmental activities in the campus such as metro rail, residence buildings may cause the decline of the bird population from this area.

Table 2. A review of the bird diversity in different areas in Dhaka megacity.

Study area	Number of species	Reference no.
Uttara (Sectors 7 and 9)	27	35
Curzon Hall	50	19
Dhaka University Campus	78	24
National Botanical Garden, Mirpur, Dhaka	65	36
Sher-e-Bangla Agricultural University Campus	60	37
Ramna Park	50	38
Buriganga River	38	39
Dhaka University Campus	54	23
Megacity Dhaka	162	43
Dhaka University Campus	70	Present Study

Species diversity indices, richness, individual counts across years, season and habitats: Species diversity of wildlife was the highest in the third year (72 species, 76.60%) and the lowest was observed in the first year (63 species, 67.02%). Although, species diversity was the least during the first year, we observed the highest number of individuals 5,227

(35.73%) in this year followed by 4,791(32.75%) individuals in second year and 4,612 (31.52%) individuals in third year (Table 3). In 2018, the university administration has taken some developmental projects (e.g. Science Cafeteria development project, greenhouse project in the botanical garden, construction of academic and residential, building) that might have affected wildlife in the study site. Besides, according to our observation, sound pollution, traffic jams and huge public movements have increased day by day causing the decline of wildlife in the study area.

Table 3. Diversity indices in terms of year, habitats and seasons.

Year-wise diversity	Year	H'	E	D_s	S	A
	First year	3.166	0.376	0.929	63	5227
	Second year	3.198	0.344	0.929	71	4791
	Third year	3.265	0.363	0.933	72	4612
Habitat-wise diversity	Microhabitat	H'	E	D_s	S	A
	Bush	1.634	0.466	0.749	8	277
	Ground	2.045	0.483	0.842	11	1803
	Permanent Waterbody	1.697	0.455	0.775	16	426
	Tree	2.790	0.270	0.890	60	10546
	Temporary Waterbody	0.7216	0.686	0.405	12	538
	Urban settlement	1.69	0.677	0.801	3	1040
	Macro-habitat	H'	E	D_s	S	A
	Aquatic	1.743	0.440	0.762	13	962
	Arboreal	2.885	0.280	0.900	64	11190
	Terrestrial	2.484	0.444	0.898	27	2478
Seasonal diversity	Season	H'	E	D_s	S	A
	Rainy	3.178	0.363	0.931	62	4705
	Summer	3.187	0.391	0.930	66	4964
	Winter	3.244	0.361	0.932	71	4961

Note: Shannon-Weiner Index (H'); Evenness (E); Simpson's Index (D_s); Species Richness (S), Species Abundance (A).

Different types of flowering plants and fruit trees attract birds in the Dhaka University campus. Tree was the most used (60 species, 63.83%) microhabitat probably due to the availability of native trees in the different parts of this campus which provided good shelter, food, roosting and nesting facilities for birds[23]. In total, 10,546 individuals of wildlife (72.08%) were counted in trees (Table 3). Considering macro-habitat, arboreal species were dominant and their diversity was the highest following terrestrial and aquatic species. A total of 11,190 individuals representing 64 species were recorded in arboreal habitats (Table 3).

Species diversity index (H' =3.244, D_s=0.932) was the highest in the winter season (Table 3). This might have resulted due to the presence of winter migratory birds. Previous studies also suggested that the highest diversity of birds in winter probably due to the influx of migratory birds[40,41]. In addition, some insectivore birds get more insects, frugivorous birds forage on fruits and nectar feeder birds feed nectar when flowers bloom in winter.

In conclusion, this three year study provides the scenario of total wildlife in Dhaka University Campus. Proper planning and management for the wildlife are desirable since new developmental activities are interrupting the breeding and foraging grounds of wildlife in and around the campus. Moreover, human disturbances, particularly the visitors make a great problem to wildlife in the area. Visitors dispose of waste materials such as plastics, polythene, styrofoam food boxes, chips packets and other garbage in aquatic and terrestrial habitats are also responsible for making some disturbances to wildlife. Besides, drying up the temporary waterbody hampers the breeding of amphibians causing the death of tadpoles and eggs. Therefore, strict maintenance of the campus habitats is in need by limiting visitors and making awareness among teachers, students and staff in the campus area.

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