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Habit and habitual status with relative diversity study of avifauna of Jaipurhat district of Bangladesh

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ABSTRACT: This investigation was carried out to observe the migration status and the feeding guild of the avian fauna including the relative diversity of Jaipurhat district of Bangladesh. Data were collected from November 2017 to October 2019. During the study period, 89 avian species were recorded that belong to 32 families under 11 orders among which 8 (8.99%) species were common winter visitors, 3 (3.37%) were common summer visitors, 8 (8.99%) were resident migratory, 1 (1.12%) were rare resident and 69 (77.53%) were resident birds. Among the birds observed in the study area during the study period the highest number of birds was found to be insectivorous (41.57%), then the carnivorous (8.99%), then omnivorous, piscivorous and picio carnivorous (7.87%), then insecto frugivorous (6.67%), then frugivorous (5.62%), then frugio graminivorous (4.49%), then nectarivorous (3.39%), then graminivorous and molluscio carnivorous (2.25%) and insecto carnivorous (1.12%). The hight avian diversity (69.662%) was observed in Mithapur which is human inhabited area with crop lands and a lot of fruit trees and the lowest (32.584%) diversity was in Shree Rampur Bill and Kastogari Bill which has large water bodies. This study will be helpful to understand the status of birds in different season in the study area.

KEYWORDS: Birds, relative diversity, species diversity, feeding guild, migration status.

INTRODUCTION

Zoo geographically Bangladesh is located at the Indo-Malayan and Indo- China sub region of the Oriental region and for this bio geographical location Bangladesh acts as a corridor of wildlife among the neighboring countries, India, Myanmar and Bhutan. Bangladesh is famous for its avian diversity. This country shelters a lot of resident birds and a lot of migratory birds come to this country both in summer and winter for food and shelter. Birds are common dwellers of any ecosystem and very important ecological indicator as well. Diversity of avifauna is one of the most important ecological indicators to evaluate the quality of habitats [1]. In any type of ecosystem, avian fauna constitutes one of the major biotic components [2]. Birds play significant ecological roles like pollination, seed dispersion, maintaining ecological balance etc. The rich avian diversity indicates a healthy ecosystem.

A recent census of birds, informed that being a biodiversity hotspot Bangladesh harbors 690 species of birds [3], which is 7% of the world total species of 9,600 (MFA compiled, unpublished report). Published regional avifauna of Bangladesh are found in literature viz., Islam [4] from Rangpur District; Husain [5, 6] from Chittagong Hill Tracts and Pablakhali Wildlife Sanctuary; Banerjee [7] and Das [8] from Curzan Hall area of the University of Dhaka and the Ramna Park of Dhaka respectively; Das [8] from Sylhet District; Sarker & Sarker [9] from the Sundarbans, Haque & Rahman [10] from the Ramna Park and Suhrawardy Uddyan,

Dhaka; Akhter [11] from the Boldha Garden, Dhaka; Sarker et al. [12] from the Moheshkhali Island; Reza et al. [13] from Rajshahi University Campus; and Reza et al. [14] from the Padma Charlands near Rajshahi City, etc. Sarkar [15] published seabirds of the Bay of Bengal of Bangladesh Coast and their conservation; Jaman et al. [16, 17] studied ecology, conservation problems and status of avifauna of Noakhali Charbata Coastal area. Sarker *et al*. [18, 19] reported diversity of avifauna of Bagkhali Range and Cox's Bazar; Sarker *et al*. [20] reported the avifauna from two urban sites of the Uttara Model Town, Dhaka. Literature on the avian diversity are very scanty from the Rajshahi region. Haque [21] published a list of birds from the Rajshahi University campus, which was later updated by Reza et al. [13]. Karmakar *et al*. [22] published an article on birds of Joypurhat District. Reza et al. [14], Reza & Parween [23] reported on the waterbirds of the Padma River and the migratory birds of the Padma River Charlands, Hasan *et al*. [24] published an article on birds of Shoipara Beel of Mohanpur Upazilla, Rajshahi District and Amin & Hasan reported on the birds of Naogaon District respectively [25]. This study will illustrate the status of birds of the study area.

MATERIALS AND METHODS

Study area

Joypurhat is a District of Rajshahi Division that has an area of 965.44 sq. km. It is bounded by Dinajpur in the north, Naogaon in the south, and Bogra and Gaibandha in the east, Bogra and Naogaon and West Bengal, India in the west [33]. For the convenience of the field work, the study area was divided into seven sites follows: Chapadal, Shree Rampur Bill, Mithapur, Paharpur, Jogodishpur, Kastogaree bill and Asranga (site A, B, C, D, E, F and G). The study area might be differentiated into two major groups

Bill areas

Shree Rampur Bill (site B) and Kastogari Bill (site F) has large water body with thin human houses and wide agricultural lands.

Human locality

Chapadal (site A), Mithapur (site C), Paharpur (site D), Jogodishpur (site E) and Asranga (site G) were human inhabited areas with villages, small ponds, lots of fruit trees and agricultural lands.

Study period

The study was carried out from November 2017 to October 2019.

Study design

The study was carried out whole the year round. Specially, during three seasons i.e. Rainy (July to October), winter (November to February) and summer (March to June) seasons, birds were observed by regular visits (At least 8 days in a month). Look and see method was opted for bird's survey.

Data collection techniques

Field data of birds were observed during winter season at morning hours between 6.30 to 9.00 a.m. and in the evening from 4.00 to 6.00 p.m., during summer season at morning hours between 5.00 to 8.00 a.m. and evening from 5.00 to 7.00 p.m. while, during the rainy season at morning hours between 6.00 to 8.30 a.m. and evening from 4.30 to 6.30 p.m. All types' of habitats were surveyed carefully for birds. The area was visited by walking; sometimes small boat was used to cover the wetland areas. The birds were observed with binoculars (Bushnell 20 × 200 mm with multicoated lens) and photographed using digital cameras (Nikon P 530).

Identification of birds

The birds were identified from their photographs in the Central library, Seminar library and with the help of the book Name of Bangladesh birds: prespective written by Professor Dr. Aminuzzaman Saleh Reza, Department of Zoology, University of Rajshahi. Also consulted literatures for bird identification were Ali and Ripley [26], Ali [27], Khan [3, 28], Halder [29], Grewal [30].

Migration status

The birds were categorized according to their status at the study area, which are Common Resident (R), Rare Resident (RR), Resident Migratory (RM), Migratory, summer visitors (MSV) and Migratory, Winter Visitors (MWV).

Social status

The status of the resting or foraging types were studied. Some birds were found to rest or forage either solitary or in pair or in small parties. The water birds were found to forage mostly in different sized family flocks or in

mixed species flocks. The symbols for the social status of the birds are used as S (solitary/single), P (pair), F (flock), LF (large flock), and SF (small flock),

Feeding guild

Feeding habits of the observed birds were studied. The bird species were identified accordingly their feeding guild. The feeding guilds were categorized as frugivorous (FV), carnivorous (CV), nectivorous (NV), molluscivorous (MV), piscivorous (PV), granivorous (GV), insectivorous (IV) and Omnivorous (OM).

Statistical analysis

Systematic lists were constructed following Ali and Ripley (1996) [26] to yield Relative Diversity (RD):

$$\text{Relative diversity} = \frac{\text{Number of species in a family}}{\text{Total number of species}} \times 100$$

Relative abundance was assessed as 'very common' (seen on 75–100% of visits), 'common' (seen on 50–74% of visits), 'uncommon' (seen on 25–49% of visits), and 'rare' (seen on <25% of visits).

RESULTS

Species diversity

A total of 89 species of birds were recorded from the study area. A check list of birds found in the Jaipurhat District is given in Table 1. Distribution, abundance of birds in different blocks, local status, social status and feeding guild and IUCN status of birds are represented in Table 2. Number and percentages of families and species under each order and Relative abundance of bird species under each family is given in Table 3. Among the total 89 species only one (*Ichthyophaga ichthyaetus*) is globally threatened [31]. The observed species are representatives of 11 orders and 32 families.

Migration status

Among the 89 species of birds 8 (8.99%) species were common winter visitors, 3 (3.37%) were common summer visitors, 8 (8.99%) were resident migratory, 1 (1.12%) were rare resident and 69 (77.53%) were resident birds (Table 2, Figure 1). Among the birds listed in this area, the most common winter visitors were Fulvous whistling duck (*Dendrocygna bicolor*), Lesser whistling-duck (*Dendrocygna javanica*), Common Snipe (*Gallinago gallinago*), Common Swallow (*Hirundo rustica*), White-Browed Wagtail (*Motacilla maderaspatensis*), White Wagtail (*Motacilla alba*), Yellow Wagtail (*Motacilla flava*) and Tickell's Leaf wabler (*Dicaeum cruenatum*); summer visitors were Blue-tailed Bea-Eater (*Merops philippinus*), Pied Cuckoo (*Clamator jacobinus)* and Common Hawk Cuckoo (*Hierococcyx varius*). Grey-Headed fish eagle (*Ichthyophaga ichthyaetus*) was seen in this study area as well which is considered as a rear resident bird that is a globally threatened at present time according to IUCN. Night Heron (*Nycticorax nycticorax*), Great Egret (*Casmerodicus albus*), Asian openbill (*Anastomus oscitans*), Little Cormorant (*Phalacrocorsx carbo*), Jungle Crow (*Corvus macrorhynchos*) and Ashy Drongo (*Dicrurus leucophaeus*) were seen periodically because of their resident migratory habit. The rest were seen all years around.

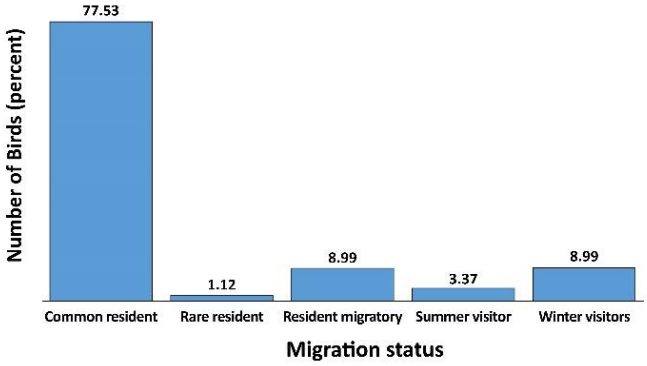

Figure 1. Migration status of birds in the study area

Social status

Birds are different in social status as well as their feeding status. Sometime they are found in solitary or in pairs. Some birds are formed small to large groups. Some birds are visited in a small to large or loose flocks. The number of species found as single (solitary) was 13 (14.61%), paired 1 (1.12%) and may single or in pairs was 32 (35.96%). However, 4 (4.49%) species were found in small flock and 2 (2.25%) were found in large flock. Some birds were found in single or small flocks, some were found in paired or small flock while some were seen in small or large flocks and the numbers of these groups of birds are 11 (12.36%), 6 (6.74%) and 4 (4.49%) respectively. About 9 (10.11%) birds were seen in single, paired or forming small flocks; 5 (5.62%) were single, paired or in large flocks, and 2 (2.25%) bird species were seen single or formed both small and large flocks. All these statuses are shown in Table 2 and Figure 2.

Table 1. Checklist of the birds found in Jaipurhat district

Order (Family)	Sl. No	Scientific Name	Bangle Name	English Name
Anseriformes (Dendrocygnidae)	1	*Dendrocygna bicolor* (Vieillot, 1837)	Boro sorali	Fulvous whistling duck
	2	*Dendrocygna javanica* (Horsfield, 1821)	Choto Sorali	Lesser whistling-duck
Apodiformes (Apodidae)	3	*Apus affinis* (Gray,1830)	Ababil, Ghore, Batasi	House Swift
	4	*Cypsiurus balasiensis* (Selater,1866)	Talchata, Tal Batasi	Palm Swift
Ciconiiformes 1.(Accipitridae)	5	*Milvus migrans* (Sykes,1832)	Bhuban Chil	Black Kite
	6	*Haliastur indicus* (Boddaert,1783)	Sankha / Lal Chil	Brahminy Kite
	7	*Spilornis cheela* (Latham,1790)	Tila Baj	Crested Serpent Eagle
	8	*Ichthyophaga ichthyaetus* (Horsfield, *1821)*	Boro Machmural	Grey-Headed fish eagle
	9	*Elanus caeruleus* (Desfontainese, 1789)	Dhola Chil	Black-Shouldered Kite
2.(Ardeidae)	10	*Bubulcus ibis* (Boddaert,1783)	Go Bok	Cattle Egret
	11	*Nycticorax nycticorax* (Linnaeus,1758)	Nishi Bok	Night Heron
	12	*Ardeola grayii* (Sykes,1832)	Kani Bok	Indian Pond Heron
	13	*Ixobrychus cinnamomeus*(Gmelin,1789)	Lal Bok	Cinnamon Bittern
	14	*Casmerodicus albus* (Gray,1831)	Boro Sada Bok	Great Egret
	15	*Egretta garzetta* (Linnaeus,1766)	Choto Sada Bok	Little Egret
	16	*Butorides striatus* (Horsfield,1857)	Choto / Shabuj Bok	Little (Green) Heron
3.(Ciconiidae)	17	*Anastomus oscitans* (Boddaert, 1873)	Shamuk khol	Asian openbill
4.(Scolopacidae)	18	*Gallinago gallinago* (Linnaeus, 1758)	Metey Chega	Common Snipe
5.(Threskiornithidae)	19	Pseudibis papillosa (Temminck, 1824)	Kastechora	Black Ibis
6.(Phalacorcoracidae)	20	Phalacrocorsx carbo (Linnaeus, 1758)	Boro Pankouri	Great Cormorant
	21	Phalacrocorsx niger (Vieillot, 1817)	Choto Pankouri	Little Cormorant
Columbiformes (Columbidae)	22	*Columba livia* (Gmelin,1789)	Jalali Kobutor	Rock Pigeon
	23	*Streptopelia chinensis* (Gmelin, 1789)	Tila Ghughu	Spotted Dove
	24	*Streptopelia decaocto* (Frivaldszky,1838)	Konthi Ghughu	Eurasian Collared Dove
Coraciiformes 1.(Alcedinidae)	25	*Alcedo atthis* (Gmelin,1788)	Pati/Choto Machranga	Common Kingfisher
2.(Cerylidae)	26	*Ceryle rudis* (Reichenbach,1851)	Pakra Machranga	Pied Kingfisher
3.(Dalcelonidae)	27	*Halcycon smyrnensis(Linnaeus,1758)*	Sada-Buk Machranga	White-Throated Kingfisher
	28	*Halcycon capensis* (Linnaeus,1766)	Megh-Hou	Stork-Billed Kingfisher
4.(Meropidae)	29	*Merops orientalis* (Latham,1801)	Shobuj Shuichora	Green Bee-Eater
	30	*Merops philippinus* (Linnaeus, 1758)	Nil –Lej Shuichora	Blue-tailed Bea-Eater
Cuculiformes 1.(Centropodidae)	31	*Centropus krameri* (Scopoli, 1769)	Choto Kanakukka	Lesser Coucal
	32	*Centropus sinensis* (Hume,1873)	Boro Kanakukka	Greater Coucal
2.(Cuculidae)	33	*Eudynamys scolopaceaI* (Linniaeus, 1758)	Kokil	Asian Koel
	34	*Cuculus micropterus* (Gould,1838)	Bou- Kotha -Kou	Indian Cuckoo
	35	*Clamator jacobinus* (Boddaert,1783)	Chatok	Pied Cuckoo
	36	*Hierococcyx varius* (Vahl, 1797)	Peukaha / Pati Chokhgelo	Common Hawk Cuckoo
Gruiformes (Rallidae)	37	*Amaurornis phoenicurus* (Pennant, 1769)	Dahuk	White-Breasted Waterhen
Passeriformes 1.(Corvidae)	38	*Dendrocitta vagabunda* (Latham, 1790)	Harichacha	Rufous Treepie
	39	*Oriolus xanthornus* (Linnaeus,1758)	Haldey Pakhi / ktiturn	Black-Hooded Oriole
	40	*Corms splendens* (Vieillot,1817)	Pati Kak	House Crow
	41	*Corvus macrorhynchos* (Lesson,1831)	Dar Kak	Large-Billed / Jungle Crow
	42	*Rhipidura albicollis* (Vieillot, 1818)	Lej Nachune	Fantail Flycatcher

	43	*Terpsiphone paradise* (Linnaeus,1758)	Dudhraj / Sah Bulbul	Asian Paradise Flycatcher
	44	*Aegithina tiphia* (Linnaeus,1758)	Fotikijal / Taufiq	Common iora
	45	*Dicrurus macrocercus* (Vieillot,1817)	Fingey / Kalo Fingey	Black Drongo
	46	*Dicrurus leucophaeus* (Vieillot,1817)	Dhushorav Fingy	Ashy Drongo
	47	*Dicrurus aeneus* (Vieillot,1817)	Bronze Fingey	Bronzed Drongo
	48	*Dicrurus paradiseus* (Linnaeus, 1766)	Keshraj	Spangled Drongo
	49	*Tephrodornis pondicerianus* (Gmelin 1789)	Kath Kosai	Common Wood Shrike
	50	*Pericrocotus cinnamomeus* (Linnaeus,1766)	Satsaheli	Small Minivet
	51	*Pericrocotus flammeus* (froster, 1781)	Altapori	Scarlet inivet
2.(Hirundinidae)	52	*Hirundo rustica* (Linnaeus, 1758)	Ababil	Barn / Common Swallow
3.(Irenidae)	53	*Chloropsis cochinchinensis* (Gameline, 1789)	Choto horeal	Golden fronted Leaf Bird
4.(Laniidae)	54	*Lanius schach* (Hodgson,1837)	Kalomatha Kosai	Long-Tailed Shrike
5.(Muscicapidae)	55	*Zoothera citrina* (Latham,1790)	Dama / Komla Bou	Orange-Headed Thrush
	56	*Copsychus saularis* (Linnaeus,1758)	Doel	Oriental Magpie Robin
6.(Pycnonotidae)	57	*Pycnonotus cafer* (Linnaeus,1766)	Bulbuli	Red-Vented Bulbul
	58	*Pycnonotuscafer*(Linnaeus,1758)	Shipahi Bulbuli	Red-whiskered Bulbul
7.(Passeridae)	59	*Passer domestica* (Linnaeus,1758)	Chorui	House Sparrow
	60	*Ploceus philippinus* (Linnaeus,1766)	Babui	Baya weaver
	61	*Lonchura punctulata* (Linnaeus,1758)	Tila munia	Scaly breasted munia
	62	*Anthus rufulus* (Vieillot, 1818)	Dhani tulika	Paddyfield pipit
	63	*Motacilla maderaspatensis*(Gmelin,1789)	Pakra Khonjon	White-Browed Wagtail
	64	*Motacilla alba* (Linnaeus,1758)	Sada Khonjon	White Wagtail
	65	*Motacilla flava* (Linnaeus,1758)	Halud Khonjon	Yellow Wagtail
8.(Sylviidae)	66	*Locustella naevia* (Boddaent, 1783)	Foring Warbler	Grasshopper Warbler
	67	*Megalurus palustris*,(Horsefield, 1821)	Jolar chatare	Striated Wabber
	68	*Phylloscopus affinis* (Tickell, 1833)	Tickeller pata futki	Tickell's Leaf wabler
	69	*Turdoides striatus* (Dumont,1823)	Bon Chhatare	Jungle Babbler
	70	*Orthotomus sutorius* (Pennaut,1769)	Tuntuni	Common Tailorbird
9.(Sturnidae)	71	*Acridotheres tristis* (Linnaeus,1766)	Bhat Shalik	Common Myna
	72	*Acridotheres fuscus* (Vagler,1827)	Jhuti Shalik	Jungle Myna
	73	*Sturnus malabaricus* (Gmelin,1789)	Kath Shalik	Chestnut-Tailed Starling
	74	*Sturnus contra* (Linnaeus, 1758)	Gobrey / Go Shalik	Asian Pied Starling
10.(Nectarniidae)	75	*Cinnyris asiaticus* (Latham,1790)	Niltuni	Purple Sunbird
	76	*Nectarinia zeylonica*(Linnaeus, 1766)	Moutushi	Purple rumped Sunbird
	77	*Dicaeum cruenatum* (Linnaeus, 1758)	Lal pati Fuljhuri	Scarlet-backed flower picker
11.(Paridae)	78	*Parus major* (Linnaeus, 1758)	Ramgangra	Great Tit
12.(Zosteropidae)	79	*Zosterops palpebrosus*	Babunai	Oriental white eye
Piciformes (Picidae)	80	*Dendrocopos macei* (Vicillot,1818)	Pakra Kaththokra	Fulvous-Breasted Woodpecker
	81	*Dinopium benghalense* (Linnaeus,1758)	Choto Lalpith Kaththokra	Black-Rumped Flameback
	82	*Dinopium javanicus* (Liungh, 1797)	Pati kaththoktra	Indian Golden-back woodpecker
	83	*Picus xanthopygaeus* (Gray And Gray,1874)	Shobuj Kath Thokra	Streak-Throated Woodpecker
	84	*Megalaima asiatica* (Latham,1790)	Boro Basantabauri	Blue-Throated Barbet
	85	*Megalaima haemacephala* (Muller,1776)	Choto Basantabauri	Coppersmith Barbet
Psittaciformes (Psitacidae)	86	*Psitacula krameri* (Scopoli, 1769)	Tia	Rose-Ringed Parakeet
Strigidiformes 1.(Strigidae)	87	*Ketupa zeylonensis* (Gmelin, 1788)	Bhutub	Brow fish Owl
	88	*Athene brama* (Temminck, 1822)	Khuruley pencha	Spotted owlet
2.(Tytonidae)	89	*Tyto alba* (Scopoli, 1769)	Laxmi pencha	Barn Owl

Table 2: Distribution, abundance of birds in different blocks, local status, social status and feeding guild and IUCN status

Name of birds	Distribution of Birds in different Blocks							Abundance	Migration status	Social status	Feeding guild	IUCN status
	B1	B2	B3	B4	B5	B6	B7					
Fulvous whistling duck			✓	✓		✓		Moderate	M (WV)	LF/ SF	OM	LC
Lesser whistling-duck			✓			✓		Moderate	M (WV)	LF/ SF	OM	LC
House Swift	✓	✓	✓	✓	✓	✓	✓	Moderate	R (M)	LF	IV	LC
Palm Swift	✓	✓	✓	✓		✓	✓	Moderate	R	LF	IV	LC
Black Kite	✓			✓			✓	Moderate	R	S	CV	LC
Brahminy Kite		✓						Thin	R	S	CV	LC
Crested Serpent Eagle				✓		✓		Very Thin	R	S	CV	LC
Grey-Headed fish eagle		✓			✓		✓	Very Thin	R (RR)	S / P	PV /CV	NT
Black-Shouldered Kite			✓			✓		Very Thin	R	S	CV	LC
Cattle Egret	✓		✓	✓		✓		Moderate	R	S / SF	IV + CV	LC
Night Heron				✓	✓			Thin	R (M)	SF / LF	PV + CV	LC
Indian Pond Heron	✓	✓	✓	✓	✓	✓	✓	Moderate	R	S / SF /LF	PV + CV	LC
Cinnamon Bittern			✓		✓			Thin	R	S / P	PV + CV	LC
Great Egret			✓		✓	✓	✓	Thin	R (M)	S / SF /LF	PV + CV	LC
Little Egret			✓			✓		Thin	R	SF	PV + CV	LC
Little (Green) Heron	✓				✓	✓		Thin	R	S	PV+ CV	LC
Asian openbill		✓	✓		✓	✓		Moderate	R (M)	SF / LF	MV + CV	LC
Common Snipe	✓	✓		✓		✓	✓	Thin	M (WV)	S / P / SF	IV	LC
Black Ibis		✓			✓			Thin	R	S / P / SF	MV + CV	NT
Great Cormorant		✓				✓		Moderate	R	S / P / SF	PV	LC
Little Cormorant		✓	✓		✓	✓	✓	Moderate	R (M)	S / P / SF	PV	LC
Rock Pigeon	✓	✓		✓	✓		✓	Moderate	R	S / P / LF	FV + GV	LC
Spotted Dove	✓	✓	✓	✓		✓	✓	Thick	R	S / P / LF	FV + GV	LC
Eurasian Collared Dove			✓				✓	Thin	R	S / P	FV + GV	LC
Common Kingfisher	✓	✓	✓	✓	✓	✓	✓	Moderate	R	S	PV	LC
Pied Kingfisher	✓		✓	✓	✓			Thin	R	S / P	PV	LC
White-Throated Kingfisher	✓		✓	✓	✓			Thin	R	S	PV	LC
Stork-Billed Kingfisher	✓	✓	✓				✓	Thin	R	S	PV	LC
Green Bee-Eater	✓		✓	✓	✓		✓	Moderate	R	S / P	IV	LC

Blue-tailed Bea-Eater	✓		✓	✓	✓		✓	Moderate	M (SV)	S / P	IV	LC
Lesser Coucal	✓				✓			Thin	R	S / P	CV	LC
Greater Coucal	✓			✓		✓		Moderate	R	S	CV	LC
Asian Koel	✓		✓	✓	✓		✓	Moderate	R	S / P	OM	LC
Indian Cuckoo	✓		✓	✓	✓	✓		Moderate	R	S / P	IV	LC
Pied Cuckoo	✓		✓	✓	✓		✓	Thin	M (SV)	S	IV	LC
Common Hawk Cuckoo			✓		✓			Thin	M (SV)	S	IV	LC
White-Breasted Waterhen		✓	✓		✓	✓		Moderate	R	S / P	OM	LC
Rufous Treepie	✓			✓			✓	Thin	R	S / P	OM	LC
Black-Hooded Oriole	✓		✓	✓	✓		✓	Thin	R	S / P	IV + FV	LC
House Crow	✓		✓	✓	✓		✓	Moderate	R	S / P / LF	OM	LC
Large-Billed / Jungle Crow	✓			✓	✓			Thin	R (M)	S / P / LF	OM	LC
Fantail Flycatcher	✓		✓	✓	✓			Thin	R	S / P	IV	LC
Asian Paradise Flycatcher	✓		✓	✓			✓	Thick	R (M)	S / P	IV + FV	LC
Common iora	✓		✓	✓	✓		✓	Thick	R	S / SF	IV	LC
Black Drongo	✓	✓		✓				Thick	R	S / SF	IV	LC
Ashy Drongo		✓	✓	✓		✓		Moderate	R (M)	S / SF	IV	LC
Bronzed Drongo	✓						✓	Thin	R	S / SF	IV	LC
Spangled Drongo				✓			✓	Very Thin	R	S / SF	IV	LC
Common Wood Shrike			✓				✓	Thin	R	S	IV	LC
Small Minivet	✓		✓	✓	✓		✓	Thick	R	SF	IV	LC
Scarlet inivet	✓		✓	✓	✓			Thick	R	SF	IV	LC
Barn / Common Swallow		✓	✓			✓		Thick	M (WV)	SF	IV	LC
Golden fronted Leaf Bird			✓		✓			Thin	R	S / P	IV	LC
Long-Tailed Shrike	✓	✓	✓	✓	✓	✓	✓	Moderate	R	S / P	IV	LC
Orange-Headed Thrush	✓		✓		✓		✓	Thin	R	S / P	IV	LC
Oriental Magpie Robin	✓	✓	✓	✓	✓		✓	Thick	R	S / P	IV	LC
Red-Vented Bulbul	✓	✓		✓	✓		✓	Thick	R	S / P	FV	LC
Red-whiskered Bulbul		✓		✓			✓	Moderate	R	S / P	FV	LC

House Sparrow	✓		✓	✓	✓		✓	Moderate	R	S / P / SF	FV + GV	LC
Baya weaver			✓		✓			Moderate	R	P / SF	GV	LC
Scaly breasted munia	✓				✓			Thin	R	P / SF	GV	LC
Paddyfield pipit	✓		✓	✓	✓		✓	Moderate	R	S/ P	IV	LC
White-Browed Wagtail	✓		✓	✓	✓	✓		Moderate	M (WV)	S/ P / SF	IV	LC
White Wagtail	✓	✓	✓	✓	✓	✓	✓	Very Thick	M (WV)	S/ P / SF	IV	LC
Yellow Wagtail	✓		✓	✓	✓		✓	Thick	M (WV)	P / SF	IV	LC
Grasshopper Warbler							✓	Thin	R	P / SF	IV	LC
Striated Wabber		✓		✓		✓		Moderate	R	P / SF	IV	LC
Tickell's Leaf wabler			✓	✓	✓		✓	Thin	M (WV)	P	IV	LC
Jungle Babbler	✓		✓	✓	✓			Thick	R	S / SF	IV	LC
Common Tailorbird	✓		✓	✓	✓		✓	Thick	R	S / P	IV	LC
Common Myna	✓	✓	✓	✓	✓	✓	✓	Thick	R	S / SF	IV + FV	LC
Jungle Myna	✓	✓	✓	✓	✓	✓	✓	Moderate	R	S / SF	IV + FV	LC
Chestnut-Tailed Starling	✓	✓		✓	✓		✓	Moderate	R	S / SF	IV + FV	LC
Asian Pied Starling	✓	✓	✓	✓	✓		✓	Thick	R	S / SF	IV + FV	LC
Purple Sunbird	✓		✓				✓	Thin	R	S / P / SF	NV	LC
Purple rumped Sunbird	✓			✓			✓	Moderate	R	S / P / SF	NV	LC
Scarlet-backed flower picker		✓		✓				Thin	R	P / SF	NV	LC
Great Tit	✓		✓	✓	✓		✓	Thin	R	S / P	IV	LC
Oriental white eye			✓					Thin	R	S / P	IV	LC
Fulvous-Breasted Woodpecker	✓		✓		✓		✓	Thin	R	S / P	IV	LC
Black-Rumped Flameback	✓		✓	✓	✓	✓	✓	Moderate	R	S / P	IV	LC
Indian Golden-back woodpecker	✓		✓	✓	✓		✓	Moderate	R	S / P	IV	LC
Streak-Throated Woodpecker	✓		✓	✓	✓		✓	Thin	R	S / P	IV	LC
Blue-Throated Barbet	✓		✓	✓	✓		✓	Moderate	R	S / P	FV	LC
Coppersmith Barbet	✓		✓	✓	✓		✓	Thin	R	S / P	FV	LC
Rose-Ringed Parakeet				✓	✓			Thin	R	S / P / LF	FV	LC
Brow fish Owl	✓		✓					Moderate	R	S	PV	LC
Spotted owlet	✓			✓	✓		✓	Moderate	R	S / P	CV	LC

Barn Owl	✓	✓	✓	✓	Thin	R	S / P	CV	LC

B 1 = Chapadal. B 2 = Shree Rampur Bill, B 3 = Mithapur, Block 4 = Paharpur, B 5 = Jogodishpur, B 6 = Kastogaree bill, B 7 = Asranga, Migration status: R = Common Resident; R (RR) = Rare Resident; R (M) =Resident Migratory; M (SV) = Migratory, summer visitors; M (WV) = Migratory; Winter Visitors. Social status: S = Single; P = Paired; SF = Small Flock; LF = Large Flock. Feeding guild: OM = Omnivorous; CV = Carnivorous; IV = Insectivorous; FV = Frugivorous; PV = Piscivorous, GV = Graminivorous; NV = Nectarivorous; MV = Molluscivorous. IUCN status: LC = Least Concern; NT= Near-threatened.

Table 3: Number and percentages of families and species under each Order and Relative abundance of bird species under each Family.

Order	Family	No of bird spp. under family	Percentage of families under order	Percentage of species under order	Relative Diversity
Anseriformes	1. Dendrocygnidae	2	3.125	2.247	2.247
Apodiformes	1. Apodidae	2	3.125	2.247	2.247
	1. Accipitridae	5			5.617
	2. Ardeidae	7			7.865
Ciconiiformes	3. Ciconiidae	1	18.750	19.101	1.124
	4. Scolopacidae	1			1.124
	5. Threskiornithidae	1			1.124
	6. Phalacorcoracidae	2			2.247
Columbiformes	1. Columbidae	3	3.125	3.370	3.370
	1.Alcedinidae	1			1.124
Coraciiformes	2. Cerylidae	1	12.500	6.742	1.124
	3. Dalcelonidae	2			2.247
	4. Meropidae	2			2.247
Cuculiformes	1. Centropodidae	2	6.250	6.742	2.247
	2. Cuculidae	4			4.494
Gruiformes	1. Rallidae	1	3.125	1.124	1.124
Passeriformes	1. Corvidae	14	37.500	47.191	15.730
	2. Hirundinidae	1			1.124
	3. Irenidae	1			1.124
	4. Laniidae	1			1.124
	5. Muscicapidae	2			2.247
	6. Pycnonotidae	2			2.247
	7. Passeridae	7			7.865
	8. Sylviidae	5			5.618
	9. Sturnidae	4			4.494
	10. Nectarniidae	3			3.370
	11. Paridae	1			1.124

	12. Zosteropidae	1			1.124
Piciformes	1. Picidae	6	3.125	6.742	6.742
Psittaciformes	1. Psitacidae	1	3.125	1.124	1.124
Strigiformes	1.Strigidae	2	6.250	3.370	2.247
	2.Tytonidae	1			1.124
Total					
11	**32**	**89**	**100**	**100**	**100**

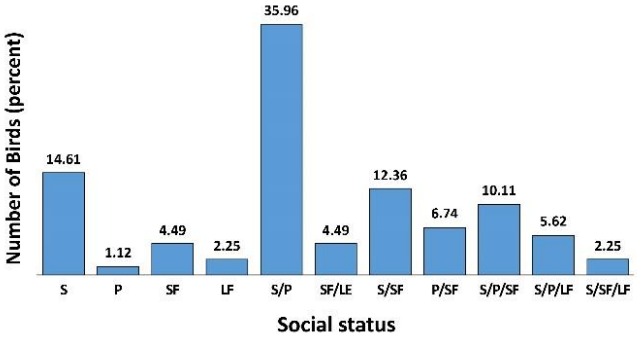

Figure 2. Social status of birds in the study area.(S = Single, P = Paired, SF = Small flock, LF = Large flock, S/P = Single or paired, SF/LF = Small or large flock, S/SF = Single or small flock, P/SF = Pared or small flock, S/P/SF = Single or paired or small flock, S/P/LF = Single or paired or large flock, S/SF/LF = Single or Small flock or large flock.

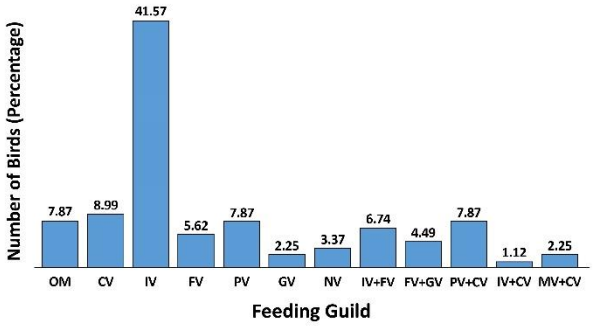

Figure 3. Feeding guild of birds of in study area (OM= Omnivorous, CV = Carnivorous, IV = Insectivorous, FV = Frugivorous, PV = Piscivorous, GV = Graminivorous, NV = Nectarivorous, IV+FV = insecto frugivorous, FV + GV frugio graminivorous, PV + CV = picio carnivorous, IV + CV = insecto carnivorous, MV + CV = molluscio carnivorous).

Feeding guild

The guild-wise percentages of the 89 species are shown in Figure 3. Among the species 41.57% were insectivorous, followed by omnivorous 7.87%, carnivorous 8.99%, fruityvorous 5.62%, piscivorous 7.87%, nectarivorous 3.37% and graminivorous 2.25%. Some species has also intermediate feeding guild such as picivorous-carnivorous 7.87% and insectivorous-fruityvorous 6.74%, frugivorous-graminivorous 4.49%, insectivorous-carnivorous 1.12% and molluscivorous-carnivorous 2.25%.

Relative diversity of birds on the basis of different study sites

Bird diversity and dispersion depends on the habitat and availability of the food sources. For example aquatic birds like duck, cormorant etc. are very common near water bodies, fruit eaters are seen in trees usually, and grain eaters love to forage in the crop fields. The study area was divided into seven sites under two major habitat, bill area and human locality. The relative diversity of birds on the basis of different study sites is given in figure 4. Bird diversity was found higher in human locality than the bill areas. In Mithapur the highest bird diversity was observed (69.622%), then in Chapadal (66.292%), then in Jogodishpur (65.168%), then in Asranga (59.55%). The lowest diversity was observed in Shree Rampur Bill and Kastogaree Bill (32.584%)

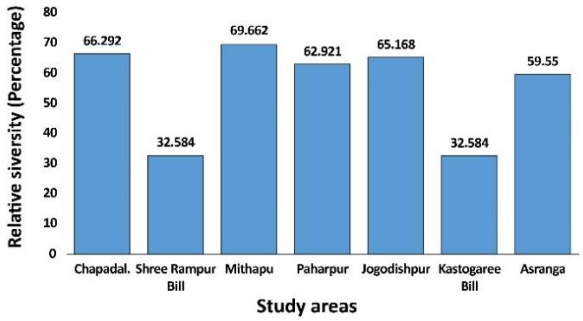

Figure 4. Relative diversity of birds.

DISCUSSION

During this study period 89 bird species were observed that are the representatives of 11 orders and 32 families which support the findings of Karmakar *et al*. [22]. According to Siddiqui *et al* [32] there are a total 650 species of birds found in the Bangladesh territory, among which 477 are regular species. Out of these regular species 301 are residents of the country and 176 are seasonal migrants. The number of winter migrants is 160, summer migrants are 6 and spacing or passage migrants are 10. Based on relative abundance of birds 143 are vagrants, 176 are rare, 103 are uncommon and 198 are common species of Bangladesh [3, 28 and 32]. Among the birds of Bangladesh IUCN declared 40 species as globally threatened. But Rhett A. Butler mentioned only 607 birds are present and 36 are threatened in Bangladesh in ‘‘Total Number of Bird Species by Country’’ at July 1, 2019 [35]. The avifauna of Jaipurhat District enlists total 89 species which is 13.69% of the Bangladeshi species. The study area includes Small River, marsh land, wetland, cropland, village groves and orchards along with some fallow lands. During this study birds have been recorded 8.99% common winter visitors, 3.37% common summer visitors, 8.99% resident migratory, 1.12% were rare resident and 77.53% resident birds among the total amount of birds.

In this study according to social status the findings was that the highest number of bird species as single or in pairs 35.96% ; others followed by 14.61% solitary, 1.12% paired, small flock 4.49%, large flock 2.25% , single or small flocks 12.36%, paired or small flock 6.74%, small or large flocks 4.49% respectively. About 10.11% birds were seen in single, paired or forming small flocks; 5.62% were single, paired or in large flocks, and 2.25% bird species were seen single or formed both small and large flocks. And according to feeding guild the highest number of bird species as insectivorous 41.57% and lowest number of bird species as insectivorous-carnivorous 1.12% were recorded. Bird diversity was found higher in human locality than the bill areas. In Mithapur the highest bird diversity was observed (69.622%), then in Chapadal (66.292%), then in Jogodishpur (65.168%), then in Asranga (59.55%). The lowest diversity was observed in Shree Rampur Bill and Kastogaree Bill (32.584%).

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AUTHOR CONTRIBUTIONS

AA and KH were involved in conception and design of the experiments. AA, KH, SM, MA, SS and SA contributed to perform the experiments. AA, KH and SM analyzed data. SS contributed to drafting the article. KH and MA contributed to revising it critically for important intellectual content. AA made the final approval of the version to be published.

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CONFLICTS OF INTEREST

Authors declared that they have no conflict of interest.

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