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Seasonal Fluctuation of Avifauna Diversity: Study in An Urban Microhabitat, Kolkata, West Bengal, India

Ipsita Chanda

Department of Zoology, Seth Anandram Jaipuria College (Affiliated to University of Kolkata), India

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Abstract Birds are important ecological indicators of an area and provide significant ecosystem service. Natural habitats of birds are destroyed by urbanization, resulting in reduction and alteration of avifaunal diversity. Green coverages of the city have an important impact on urban avifauna diversity, facilitating urban climate, nesting, breeding and migration of birds. Chintamoni Kar Bird Sanctuary (CKBS) spreads over 17.19 acres of land, located at Narendrapur, near Kolkata, West Bengal, India. The plantation type, texture, and resources attract various avifauna, residents as well as migratory to this site. Thus CKBS acts as an attractive survey site for the study of avifauna diversity in urban microhabitat. The survey period of one year (April, 2019 to March, 2020) was categorized into winter, summer and rainy seasons. The inspection was conducted primarily by line transect method and bird census report was prepared for analysis of seasonal fluctuations. The study recorded a total of 618 birds that were categorized into 9 orders, 20 families and 31 species. Among these, birds of order Passeriformes were the most predominant. Birds with omnivorous food habit and resident status were also very common. Winter migrants were more prevalent than the summer one. The richness, abundance and diversity of birds were maximum in winter season compared to other seasons, while bird evenness was high in all seasons. This primary survey at CKBS is an attempt to make people aware of the local avifauna diversity and motivate urban planners to emphasize green cover to conserve the avifauna diversity in urban areas.

Keywords Season, Urban, Species Richness, Diversity, Avifauna

1. Introduction

Birds are one of the most common faunas in all ecological habitats. Owing to their responsiveness to ecological changes, avifauna diversity and distribution are considered as an important indicator to evaluate ecological trends of an area [1,2]. Nonetheless, avifauna contributes significantly to the ecosystem services, providing numerous ecological benefits [3]. These include pollination, seed dispersal [4], forest restoration [5], control of agricultural pests [6], recycling of biomass and reduction of disposable wastes [7], nutrient recycling and soil formation [8]. Few of the services are of particular importance to human population, such as provisioning for food from both wild and domesticated birds and recreation [9]. Therefore, the protection of avifauna is an important criterion to tackle the ecological crisis as well as to protect the environment [9, 10]. Forest is the most significant habitat for birds maintaining the most complex bird community structure. However, this natural habitat of birds has been threatened by human interferences, such as random deforestation for urbanization [11,12]. These anthropogenic activities affect bird population through habitat fragmentation and habitat loss that ultimately restricts the breeding and nesting of avifauna [13,14]. The apparent changes of community structure of avifauna due to anthropogenic activities necessitate the study of avifauna population dynamics in urban areas to protect the species and to sustain ecosystem services provided by them. The complex land use pattern and land cover types,

buildings and vegetation of urban places influence the distribution and abundance of avifauna [15,16]. This correlation between avifauna diversity/ distribution and urban features facilitates urban planning strategy to conserve resident as well as migratory birds within urban landscape [17]. Avifauna diversity is not static. Species richness and species diversity of birds are greatly influenced by seasonal factors such as migration, food supply, feeding habit, foraging behaviour, temperature fluctuation and photoperiodism [18-21]. The metropolitan city Kolkata faces a serious problem of reduction of greenery. However, the green coverages of the city have an important impact on avifauna diversity, facilitating urban climate, nesting and breeding of birds [22, 23]. Chintamoni Kar Bird Sanctuary is an urban microhabitat [24] near the city of Kolkata, West Bengal that comprises a small replica of forestland with rich floral and faunal varieties and attracts resident as well as migratory birds in different seasons throughout the year. This study is an attempt to make primary data of diversity, seasonal variation, ecological status, feeding habit and migratory nature of avifauna in Chintamoni Kar Bird Sanctuary to increase awareness of people to the local avifauna diversity and to motivate urban planner to promote urban greenery to conserve avifauna diversity.

2. Material and Methods

2.1. Study Area

Chintamoni Kar Bird Sanctuary (CKBS) (22°25'45"N and 88°24' 4" E) spreads over 17.19 acres (6.96 hectares) of land. It is also recognized as Narendrapur Wild life Sanctuary and it belongs to the forest department. It is located at Narendrapur, near Kolkata and connected to EM Bypass. The place was formerly called 'Koyeler Bagan' for its avifauna diversity. Presence of dynamic floral diversity including tall trees, such as mango, ficus, palm, jack fruits, coconut tree, bamboo plantation, orchids as well as swamp makes this place a suitable habitat for migratory as well as resident birds. Also, the dense and widespread canopies of tall trees prevent penetration of sunrays even during day time and make the place cool, dark, damp and pleasant during the scorching heat of the summer (Figure 1). The average temperature during daytime is 37°C (summer) and 27°C (winter) and during night 32°C (summer) and 13°C (winter). Humidity is maximum 91% and minimum 57%. Rainfall is high during monsoon and wind blows at 5-10 km/hr.

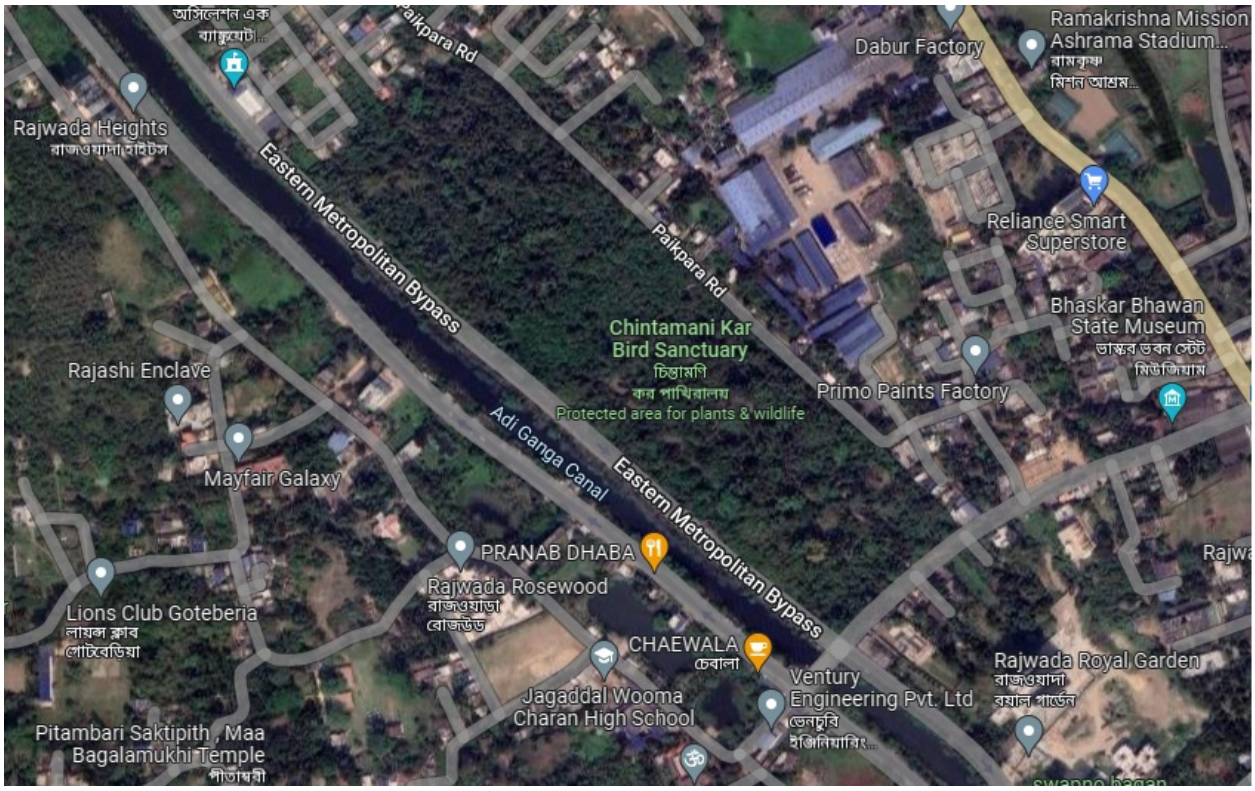

Figure 1. Satellite map of geographical location of study site (CKBS)

2.2. Survey Methods

The survey was carried out from April, 2019 to March, 2020. The whole study period was divided into three seasons: mid-June to mid-October (Rainy),mid-October to mid-February (winter) and mid-February to mid-June (summer) [25]. The study was primarily based on line transect method [26]. Three parallel transect lines of 200m length were used. The maximum visibility on either side of transect line was 50m. The transect lines were placed at a distance of at least 100m to avoid overlap. Bird counts were made by direct visual contact, walking inside the study area. Olympus binocular and a Nikon tele-lens (18mm-55mm, 70mm-300mm) camera were also used for recording of birds. Field guide books were used for identification of birds [27-29]. Survey work was carried out during morning (7:30hr- 11hr) and afternoon (15:00hr-17:00hr). Ten readings were taken per season.

Bird census report was prepared for seasonal fluctuation analysis.

2.3. Data Analysis

The recorded data was analysed by Shannon - Wiener general diversity index formula [30]:

$$H = -\sum_{i=1}^{n} (\text{pix Log (pi)}$$

Where, H stands for Shannon diversity index; pi stands for proportion of individuals of i-th species in a whole community

$$p_i = n/N$$

Where, n stands for individuals of a given species and N stands for total number of individuals in a community.

$$H_{max} = \log (s)$$

Where H_{max} stands for maximum diversity and s stands for total number of species in a community.

$$J = H/ H_{max}$$

where, J stands for equitability or evenness

3. Results and Discussion

The study identified a total of 31 species of birds that belonged to 20 families and 9 orders (Table 1). Among this, the highest number of bird species (n =19) was recorded under order Passeriformes. This abundance might be due to their ability to explore diverse foraging niches of the study site in all seasons [31]. Of all the recorded bird species, about 74% birds (n =23) were categorized as resident birds, which do not perform any annual or seasonal migration. Among the other, 23% (n =7) birds were winter-migrants and the rest 3% (n=1) were summer-migrants. Higher percentage of resident birds might be due to the optimum climate conditions, favorable nesting and breeding habitats, and availability of food in all seasons in the study area. Among migratory birds, the higher count of winter migrants might also be related to the favourable climate and plenty of available food in the winter. Among the total number of birds, species richness was highest (97%, n=30) in winter season. The summer and rainy seasons had species richness about 77% (n=24) and 74% (n=23), respectively (Fig 2). The higher richness of birds in winter season is probably correlated to the factors like the suitable climate, resource availability and less predation pressure in the study area [32]. Out of the recorded 31 species of birds, 29% (n=9) belonged to insectivorous, 35% (n=35) to omnivorous, 10% (n=3) to frugivorous, 13% (n=4) to carnivorous, 6% (n=2) to nectarivorous and the rest 6% (n=2) to granivorous/ herbivorous types. CKBS is an ideal foraging site for birds and rich in various types of food that include fruits, nectar, grains, herbs, insects, animals etc. It has various floral diversities that include tall plantations such as mango, ficus, palm, jack fruits, coconut tree, bamboo plantation, shrubs, herbs, orchids etc. These provide resources like fruit, flowers, grains and nectar. The faunal diversities include different invertebrate and vertebrate species that provide food for insectivorous and carnivorous birds. The higher percentage of omnivorous birds in the study area might be correlated to the ecological behaviour of the birds to utilize maximum available resources to avoid competition within the limited space of habitat [33]. Omnivorous birds are mostly fed upon invertebrate fauna like insects, molluscs, crustaceans, grains, weeds, fruits etc. Thus, the feeding habit is the type of adaptive strategy for the best utilization of minimum ecological resources [34]. According to International Union for Conservation of Nature and Natural resources (IUCN) protection status, all the recorded birds were categorized as least concern (LC) [35]. According to Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), only spotted owlet (*Athene brama*) was listed under APP-II. Others were included to the category, 'not yet known' (NY) [36]. Among the total of 618 birds recorded in three seasons, the maximum number of birds (abundance) was found in winter (44%, n=273). The numbers of birds in summer and rainy seasons were 199 (32%) and 146 (24%), respectively (Figure 2).

The data collected in three different seasons was analysed by using formula of Shannon diversity index (H) [30]. It was found that winter season had maximum diversity (H_{max}= 3.40; H=3.34), followed by summer (H_{max}= 3.17; H= 3.21) and rainy season (H_{max}= 3.13; H= 2.99) (Figure 2). Diversity index is determined by species richness and evenness [37]. The higher abundance and diversity of birds in winter season might be due to favourable temperature and plenty of available food. On the contrary, the summer and rainy seasons are predominated by hot temperature and heavy downpour that impede the movement of birds.

However, equitability/ evenness (J) was high in all three seasons. It was highest in summer (J= 1.01), followed by winter (J= 0.98) and rainy (J= 0.95) seasons. High species evenness of the birds in all seasons might be correlated to the stability of ecosystem in the study area and high degree of interspecific interaction.

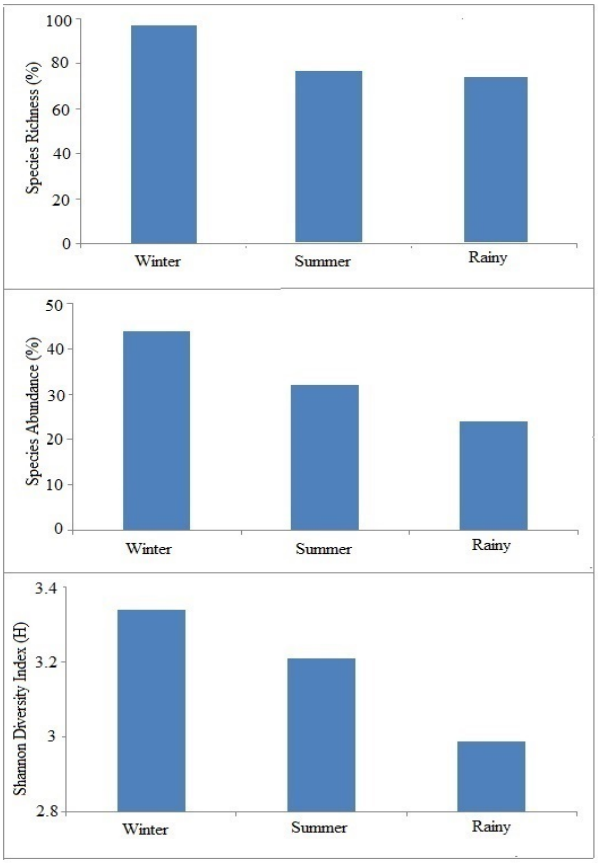

Figure 2. Seasonal variation of species richness, abundance and diversity of avifauna

This is to be noted that the dense canopy of the study site sometimes obstructed the visual contact of birds. However, it is expected that the survey with longer time span might increase the avifauna diversity more than the observed.

4. Conclusions

- A survey of avifauna diversity was conducted at Chintamoni Kar Bird Sanctuary, Kolkata in winter, summer and rainy seasons to prepare a primary report of variation of birds in different seasons in the urban microhabitat.
- The survey report recorded a total of 31 species of birds that were categorized into 20 families and 9 orders. Of these, the Passerine birds were the most common in occurrence.
- Among various feeding habits, omnivorous birds were highest in number.
- Resident birds were more frequent than the migratory birds.
- Among migratory birds, winter migrants were prevalent.
- Species richness, abundance and diversity of birds were maximum in winter season.
- Species evenness of birds was high in all seasons.
- The megacity Kolkata suffocates from the loss of greenery and pollution due to advancement of urbanization that results in loss of avifaunal diversity.
- This census report at CKBS would motivate urban planner to take a proper ~~a~~ management decision to find an innovative way to promote green cover of the city to conserve local and overall avifauna diversity.

Table 1. List of bird populations in different seasons

Sl No	Common Name	Scientific Name	Order	Family	* Status	*Food habit	Conservation status	Abundance		
								Winter	Summer	Rainy
1	Spotted dove	*Spilopelia chinensis*	Columbiformes	Columbidae	R	G	LC/ NY	15	13	07
2	Green bea-eater	*Merops orientalis*	Coraciformis	Meropidae	R	I	LC/ NY	09	07	05
3	Asian Koel	*Eudynamys scolopaceus*	Cuculiformes	Cuculidae	R	F	LC/ NY	08	07	04
4	Jungle Myna	*Acridotheres fuscus*	Passeriformes	Sturnidae	R	O	LC/ NY	07	04	05
5	Black Drongo	*Dicrurus macrocercus*	Passeriformes	Dicruridae	R	I	LC/ NY	16	15	11

Table 1 continued.

6	Greater flameback	*Chrysocolaptes guttacristatus*	Piciformes	Picidae	R	I	LC/ NY	07	06	03
7	Red-whisker Bulbul	*Pycnonotus jocosus*	Passeriformes	Pycnonotidae	R	F	LC/ NY	13	11	08
8	Rose-ringed Parakeet	*Psittacula krameri*	Psittaciformes	Psittacidae	R	H	LC/ NY	14	10	09
9	Black-hooded oriole	*Oriolus xanthornus*	Passeriformes	Oriolidae	R	O	LC/ NY	13	14	07
10	Oriental Magpie Robin	*Copsychus saularis*	Passeriformes	Muscicapidae	R	I	LC/ NY	16	15	11
11	Jungle Babbler	*Turdoides striata*	Passeriformes	Leiothrichidae	R	O	LC/ NY	27	21	19
12	Greater Coucal	*Centropus sinensis*	Cuculiformes	Cuculidae	R	C	LC/ NY	06	04	03
13 13	Red-vented Bulbul	*Pycnonotus cafer*	Passeriformes	Pycnonotidae	R	F	LC/ NY	18	14	10
14	Ashy Drongo	*Dicrurus leucophaeus*	Passeriformes	Dicruridae	WM	I	LC/ NY	03	00	00
15	Western-crowned warbler	*Phylloscopus occipitalis*	Passeriformes	Phylloscopidae	WM	O	LC/ NY	07	00	00
16	Orange-headed Thrush	*Geokichla citrina*	Passeriformes	Turdidae	R	O	LC/ NY	08	05	03
17	Spangled Drongo	*Dicrurus hottenttus*	Passeriformes	Dicruridae	WM	O	LC/ NY	06	00	00
18	Scaly-breasted Munia	*Lonchura punctulata*	Passeriformes	Estrildidae	R	O	LC/ NY	11	07	05
19	Purple- rumped Sunbird	*Leptocoma zeylonica*	Passeriformes	Nectariniidae	R	N	LC/ NY	08	05	06
20	Grey-backed Shrike	*Lanius tephronotus*	Passeriformes	Laniidae	WM	I	LC/ NY	06	00	00
21	Loten's Sunbird	*Cinnyris lotenius*	Passeriformes	Nectariniidae	WM	N	LC/ NY	03	00	00
22	Rufous Treepie	*Dendrocitta vagabunda*	Passeriformes	Corvidae	R	O	LC/ NY	05	04	03
23	Spotted Owlet	*Athene brama*	Strigiformes	Strigidae	R	C	LC/A PII	03	02	01
24	Indian Nightjar	*Caprimulgus asiaticus*	Caprimulgiformes	Caprimulgdae	SM	I	LC/ NY	00	01	00
25	Grey Wagtail	*Motacilla cinerea*	Passeriformes	Motacillidae	WM	I	LC/ NY	03	00	00
26	Indian roller	*Coracias benghalensis*	Coraciiformes	Coraciidae	R	C	LC/ NY	06	05	03
27	White-breasted waterhen	*Amaurornis phoenicurus*	Gruiformes	Rallidae	R	O	LC/ NY	08	07	05
28	Asian palm swift	*Cypsiurus balasiensis*	Caprimulgiformes	Apodidae	WM	I	LC/ NY	03	00	00
29	Golden-fronted leafbird	*Chloropsis aurifrons*	Passeriformes	Chloropseidae	R	O	LC/ NY	05	03	03
30	Little egret	*Egretta garzetta*	Pelecaniformes	Ardeidae	R	C	LC/ NY	07	06	06
31	House crow	*Corvus macrorhynchos*	Passeriformes	Corvidae	R	O	LC/ NY	12	13	09

*Abbreviation denotes R=Resident bird; WM=Winter Migratory bird; SM=Summer Migratory bird; I= Insectivorous; O= Omnivorous; F= Frugivorous; C= Carnivorous; N= Nectarivotous; G=Grainivorous, H= Herbivorous

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