



Avifaunal Diversity of Cantonment Area, Lucknow, Uttar Pradesh, India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Birds have always fascinated mankind with their naturally attractive plumage, harmonious songs and creative behavior. Avifaunal Diversity is one of the most important ecological indicators, displays the environmental quality of an area, its pollution level, safety and accessibility of food and habitat. Cantonment area is one of the distinctive locations represents a sub-urban area of Lucknow. Cantonment area is an abundant green area around 23.43 square kilometer, preferred by number of bird species at its different types of habitat like shaded trees, bushes, grasses, grounds some parks and buildings etc. They provide food and shelter for the urban terrestrial bird's community. The study was performed in Cantonment area for six months from February, 2022 to July, 2022. Bird surveys were carried out using the Line transect method across four different transects at this area. As a result of six months observation, 55 bird species were recorded belonging to 15 orders and 29 families. Majority of species were observed in the order Passeriformes and family Muscicapidae. Data analysis showed that 29 avian species were Common, 12 were Fairly Common, 6 were Uncommon and 8 were Rare, whereas 52 avian species were residents and 3 avian species were migrants.

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Keywords: Avifaunal diversity; cantonment area; Lucknow district; avian species.

1. INTRODUCTION

Birds are one of the most prominent groups of animals throughout the world because of their remarkable splendor, melodious calls, easy recognition and liveliness [1,2]. "Birds are found everywhere from grasslands, forests and wetlands to crop fields and city gardens. They have always fascinated us for their capability of flight and wonderful colouration. Due to these characteristics, birds are sought-after by the wildlife watchers. The beauty of birds has made bird watching a very useful way of spending leisure and gathering revenue from both local and international tourists because the distribution and occurrence of avifauna correlate well with the vegetation patterns of the area, which is of great significance. Activities of birds are considered as indicator of superiority of ecosystem and they also form the incurable links in many food chains, hence they imitate changes originating in several different ecosystem components" [3]. Most avian species remain active during the day, while some species such as owls are found to be active during the evening hours and few feed either during day or night. They are one of the biological pest management tools to control pests in gardens, on farms, and other places. Birds play a major role in pollination and seed dispersal of various flowering plants [4,5]. Depending on their environment, different water birds' adaptations will vary. For example, wading birds are more terrestrial whereas waterfowl are more aquatic [6].

As per State of India's Bird Report 2020 [7], there is a decline in bird population in India, as more than 50% of Indian bird species (out of total 867 species) assessed have registered a decline during the last few decades. The total bird species found in Uttar Pradesh are nearly 550 [8]. A number of studies have documented avifaunal diversity at various university campuses in India Amita et al [9]; Tandon et al. [10]; Snehal et al. [11]; Vinay et al. [12]; Manoj et al. [13]; Kaushal et al. [14]; Singh et al. [15]; Pragasam and Madesh [16]; Alok and Dhuria [17]; Iqram et al. [18], where bird species were observed in different habitats.

"Urban birds differ from wild populations in several ways, besides just being easier to observe. The aim of this study was to assess the avifauna diversity in an urban setting (Cantonment) of Lucknow, this would be

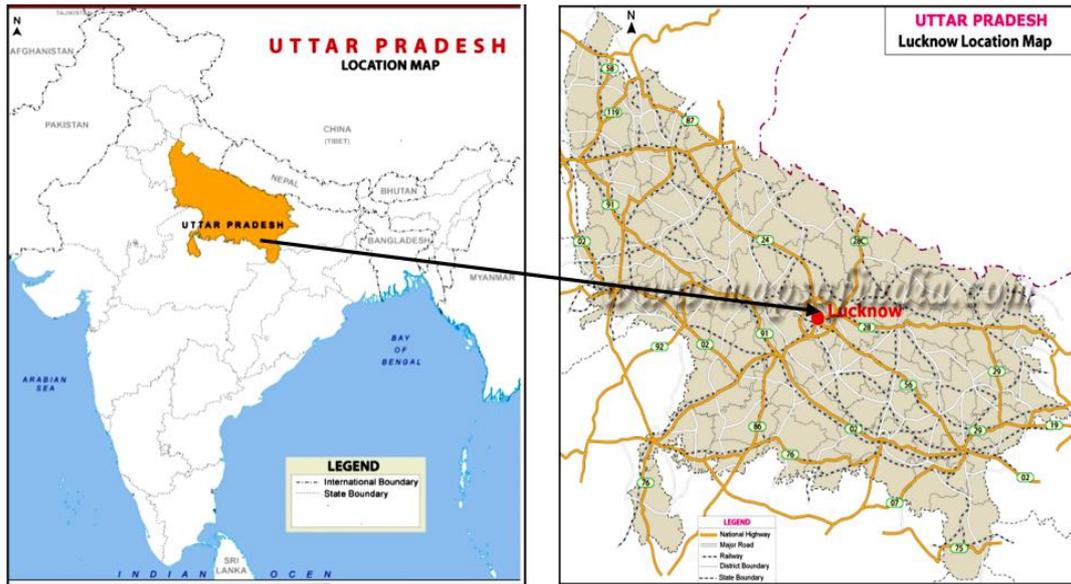
important for the conservation of terrestrial biodiversity and for assessing population status of terrestrial birds in urban ecosystems. Diversity of birds in urbanized areas depends on two basic factors: I) the proximity of the centre to natural forest and, II) the extent of tree cover within the centre itself" [19].

There are numerous studies that have previously been conducted on bird diversity in urban habitats viz. city parks, field remnants, community, private gardens etc. by many research works Newton [20]; Navarro and Benítez [21]; Blair [22]; Hobson and Rempel [23]; Turner [24]. Though, few studies have been done in Indian context in urban habitats Sonika Kushwaha et al. [25]; Ramitha & Vijayalaxmi [26]; Dookia [27]; Praveen & Joseph [28]; Tanveer et al. [29]; Sidra et al. [30].

2. MATERIALS and METHODS

2.1 Study Area

Lucknow Cantonment is situated southeast part of Lucknow (Map 1 & 2) [31,32]. The area (Cantonment, Lucknow) for the study was chosen for the convenience to regular and periodic observation as required for the study. The present study was conducted for a period of six months starting from, February, 2022 to July, 2022 in Cantonment area of Lucknow. The location represents a typical sub-urban area of Lucknow with a mix of some parks & gardens of residential area & seasonal water body. Cantonment geographically located at 26°49'13" N and 80°57'9" E in Lucknow district of Uttar Pradesh, India. Cantonment is around 23.43 square kilometer [33]. The average rainfall is about 32.57 inch per annum. The maximum temperature recorded was 45°C and minimum was 3°C. The area is enriched with a diverse flora and avifauna. Rich flora of campus includes trees like *Saraca asoca* (Ashok), *Terminalia arjuna* (Arjun), *Ficus religiosa* (Peepal), *Azadirachta indica* (Neem), *Mangifera indica* (Mango), *Jijiphus spina cristi* (Ber), *Aegle marmelos* (Bel), *Calotropis procera* (Madaar), *Anthocephalus chinensis* (Kadum), *Pithecellobium dulce* (Jungle jalebi), and other herbs and shrubs. In the Cantonment region, several areas were selected for investigation on avian fauna based on the type of landscapes, which primarily includes greenery and vegetation.



Map 1. Location of Study Area



Map 2. Google Map of Cantonment Area in district Lucknow, U. P.



Transact 1. Aquatic & Shrubby Forest habitat of Race Course, 2 Farlong



Transect 2. Shrubby forest & residential area habitat of AMC, primary road



Transect 3. Residential area habitat of Kasturba Marg



Transect 4. Shrubby forest habitat of Sanjog Chhetriye Road photographs showing various habitat types in cantonment area, district Lucknow, Uttar Pradesh

2.2 Methodology

The study was carried out for a period of six months from February, 2022 to July, 2022. The birds survey was conducted every after two days. In the study area, four different transects varying in length and comprising different habitats, were selected for data collection. During each periodic visit; observations were carried twice in a day in the morning (06:00 to 08:30AM) and evening (15:30 to 18:00PM). However data was recorded in the whole day also, using Line Transect method [34]. Birds were observed by taking photographs whenever possible with the help of Smartphone Oppo A37f (camera specification 8MP) were used to observe and record the observation.

Identification of birds was done using field guides by Ali and Ripley [35] and Grimmett et al. [36]. The checklist preparation, classification of birds in different orders and families and the nomenclature were done according to Praveen et al. [37]. Birds sighted during the study period

were categorized according their presence month-wise (the data recorded during periodic visits was computed month wise for the six months of study), habitat status (the study area comprises three different habitats viz., Aquatic (AQ), Scrubby Forest (SF) and Residential Area (RA)), the residential status of the observed avian species was assigned following Grimmett and Inskipp [38] into Resident (R), Winter Migrant (WM) and Summer Migrant (SM) categories, abundance status of the recorded avian species was assigned into Common (C), Fairly Common (FC), Uncommon (UN) and Rare (RA) following Kumar and Gupta [39].

2.3 Transects Selection

To understand the study area, types of habitats and location of paths, preliminary field surveys were carried out at Cantonment. Based on these surveys in the study area, four different transects varying in length were selected for the collection of data. Locations of all four transect T1, T2, T3, and T4 with their length is portraying in Table 1.

Table 1. Length and habitats of transects in the study area

S. No.	Transects	Transect Length	Habitat(s) at transect
1.	T1	2.5 km	Scrubby Forest and Aquatic
2.	T2	2 km	Scrubby Forest and Residential Area
3.	T3	1.5 km	Residential Area, Park and Gardens
4.	T4	2.3 km	Scrubby Forest

3. RESULTS AND DISCUSSION

During the study period, a total of 55 bird species were recorded in different transects of the study area. These 55 avian species belong to 15 orders, 29 families (Table 2). Out of the observed 15 orders, the avian species richness was highest for the order Passeriformes (22 species), followed by Pesecaniformes (6 species), Columbiformes (4 species), Cuculiformes, Accipitriformes & Piciformes (3 species each), Galliformes, Charadriiformes, Strigiformes, Bucerotiformes & Coraciiformes (2 species each); whereas orders with minimum number of species were Anseriformes, Caprimulgiformes, Gruiformes & Psittaciformes (1 species each) (Fig. 1).

Representing 29 families (Fig. 2), the family Muscicapidae was most diverse with 5 species (each forming 9.09% of total avifauna), the second largest family being Columbidae, Ardeidae, Corvidae & Sturnidae with 4 species (each forming 7.27% of total avifauna) and was Accipitridae & Cuculidae the third with 3 species (each forming 5.45% of total avifauna). Family Phasianidae was next with 2 species; followed by Charadriidae, Strigidae & Ramphastidae represented with 2 species each (each forming 3.63% of total avifauna). Furthermore, 16 families – Anatidae, Apodidae, Rallidae, Phalacrocoracidae, Anhingidae, Bucerotidae, Upupidae, Picidae, Meropidae, Alcedinidae,

Psittaculidae, Dicruridae, Passeridae, Cisticolidae, Phylloscopidae, & Leiothrichidae and were poorly represented with single species each (each accounting for 1.81% of the total avifauna).

3.1 Habitat Status

The analysis revealed that the maximum species (44) were observed in scrubby forest, followed by residential area (28 species), and minimum species (15 species) were observed in the aquatic (Fig. 3).

3.2 Residential Status

The analysis revealed that out of the 55 species, 52 species were Resident (R) species, 02 were Winter Migrant (WM) species and 1 were Summer Migrant (SM) species (Fig. 4).

3.3 Abundance Status

The data analysis showed that 29 avian species were Common, 12 were Fairly Common, 6 were Uncommon and 8 were Rare (Fig. 5).

3.4 Monthly Variation

The evaluation of monthly variations in avian diversity showed that, the maximum species richness was recorded in the month of March, 2022 (26 species) and minimum in the month of June, 2022 (15 species).

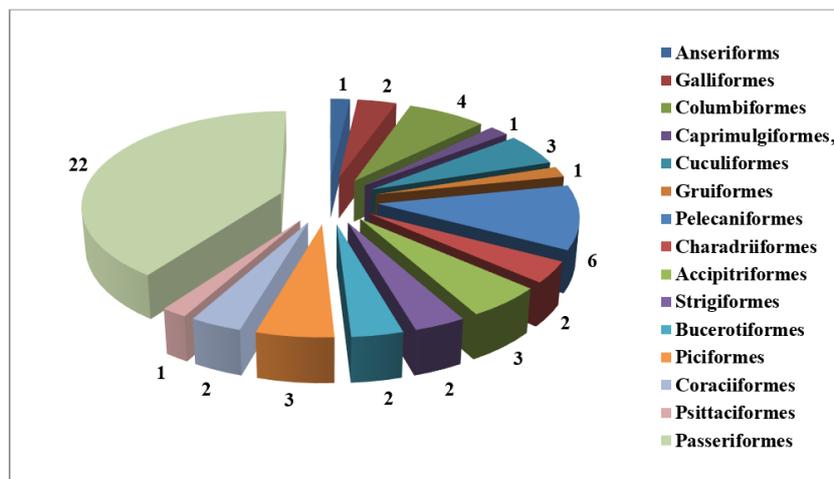


Fig. 1. Avian species richness per order recorded in cantonment Area, Lucknow

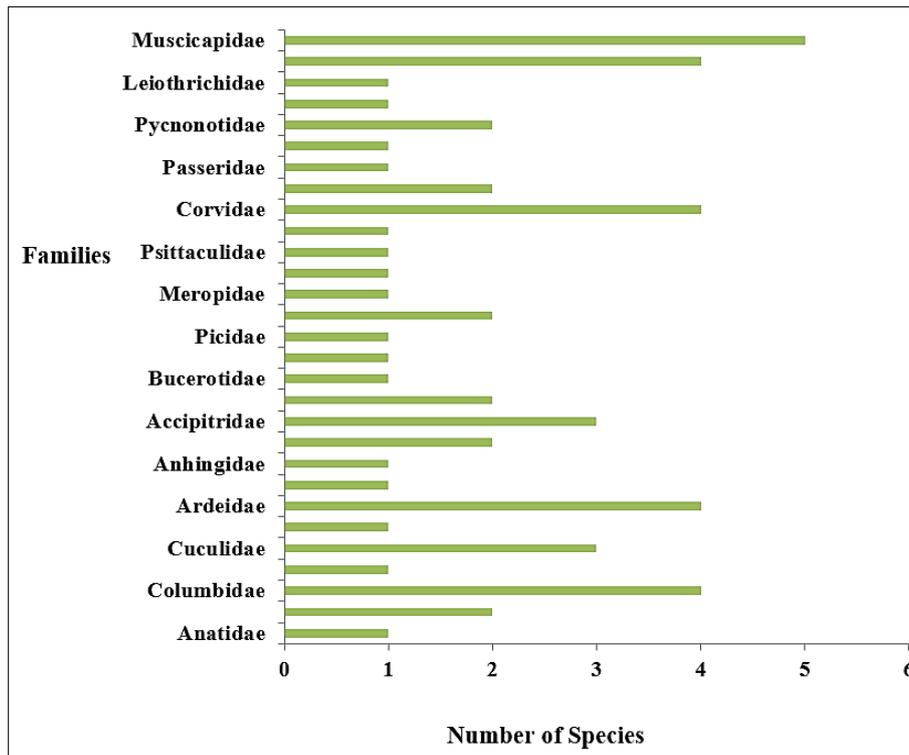


Fig. 2. Family wise avian species species richness observed in Cantonment Area, Lucknow

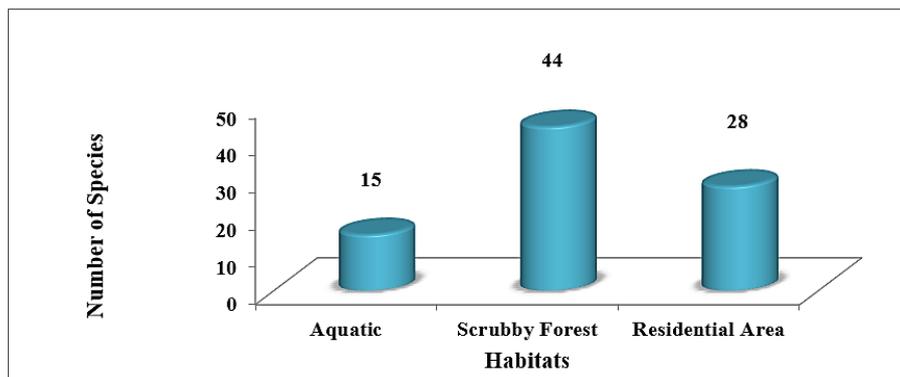


Fig. 3. Habitat wise avian species species richness observed in Cantonment Area, Lucknow

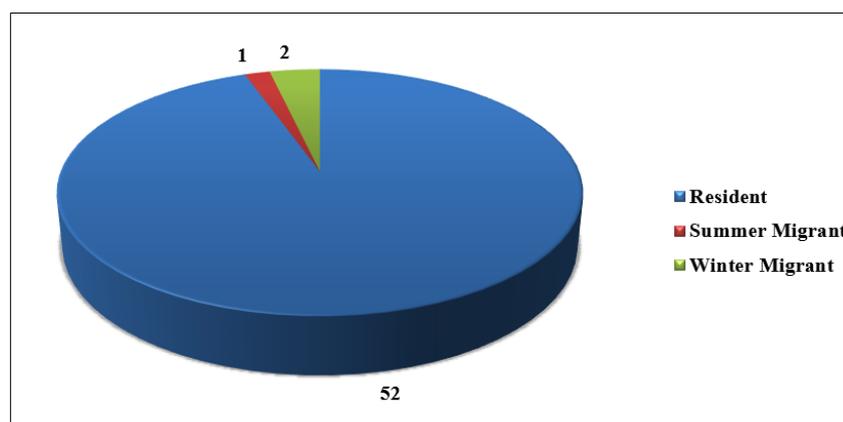


Fig. 4. Residential status of observed avian species in Cantonment Area, Lucknow

Table 2. List of Birds observed during the study period

S. No.	Common Name	Scientific Name	Residential Status	Abundance Status
Order Anseriformes				
Family Anatidae				
1	Mallard	<i>Anas platyrhynchos</i>	WM	C
Order Galliformes				
Family Phasianidae				
2	Indian Peafowl	<i>Pavo cristatus</i> (Linnaeus, 1758)	R	FC
3	Red Junglefowl	<i>Gallus domesticus</i>	R	C
Order Columbiformes				
Family Columbidae				
4	Rock Pigeon	<i>Columba livia</i> (J.F. Gmelin, 1789)	R	C
5	Eurasian Collared Dove	<i>Streptopelia decaocto</i> (Frisvaldszky, 1838)	R	C
6	Laughing Dove	<i>Streptopelia senegalensis</i> (Linnaeus, 1766)	R	C
7	Spotted Dove	<i>Streptopelia chinensis</i>	R	C
Order Caprimulgiformes				
Family Apodidae				
8	Indian House Swift	<i>Apus affinis</i> (J.E. Gray, 1830)	R	UN
Order Cuculiformes				
Family Cuculidae				
9	Greater Coucal	<i>Centropus sinensis</i> (Stephens, 1815)	R	FC
10	Asian Koel	<i>Eudynamys scolopacea</i> (Linnaeus, 1758)	R	UN
11	Brainfever Bird	<i>Hierococcyx varius</i>	R	C
Order Gruiformes				
Family Rallidae				
12	White-breasted Waterhen	<i>Amaurornis phoenicurus</i> (Pennant, 1769)	R	C
Order Pelecaniformes				
Family Ardeidae				
13	Indian Pond Heron	<i>Ardeola grayii</i> (Sykes, 1832)	R	C
14	Cattle Egret	<i>Bubulcus ibis</i> (Linnaeus, 1758)	R	C
15	Intermediate Egret	<i>Ardea intermedia</i> (Wagler, 1829)	R	C
16	Little Egret	<i>Egretta garzetta</i> (Linnaeus, 1766)	R	FC
Family Phalacrocoracidae				
17	Indian Cormorant	<i>Phalacrocorax carb</i>	R	UN
Family Anhingidae				
18	Oriental Darter	<i>Anhinga melanogaster</i> (Pennant, 1769)	R	RA

S. No.	Common Name	Scientific Name	Residential Status	Abundance Status
Order Charadriiformes				
Family Charadriidae				
19	Little Ringed Plover	<i>Charadrius dubius</i> (Scopoli, 1786)	R	UN
20	Red-wattled Lapwing	<i>Vanellus indicus</i> (Boddaert, 1783)	R	C
Order Accipitriformes				
Family Accipitridae				
21	Lesser Spotted Eagle	<i>Aquila pomarina</i>	R	RA
22	Common Pariah Kite	<i>Milvus migrans</i>	R	C
23	Shikra	<i>Accipiter badius</i> (J.F. Gmelin, 1788)	R	UN
Order Strigiformes				
Family Strigidae				
24	Brown Wood Owl	<i>Strix leptogrammica</i>	R	UN
25	Jungle Owlet	<i>Glaucidium radiatum</i>	R	FC
Order Bucerotiformes				
Family Bucerotidae				
26	Indian Grey Hornbill	<i>Ocyrceros birostris</i> (Scopoli, 1786)	R	RA
Family Upupidae				
27	Common Hoopoe	<i>Upupa epops</i> (Linnaeus, 1758)	R	FC
Order Piciformes				
Family Picidae				
28	Lesser Golden-backed Woodpecker	<i>Dinopium benghalense</i> (Linnaeus, 1758)	R	RA
Family Ramphastidae				
29	Brown-Headed Barbet	<i>Megalaima zeylancia</i>	R	FC
30	Coppersmith Barbet	<i>Megalaima haemacephala</i> (Statius Muller, 1776)	R	RA
Order Coraciiformes				
Family Meropidae				
31	Green Bee-eater	<i>Merops orientalis</i> (Latham, 1801)	R	C
Family Alcedinidae				
32	White-throated Kingfisher	<i>Halcyon smyrnensis</i> (Linnaeus, 1758)	R	C
Order Psittaciformes				
Family Psittaculidae				
33	Rose-ringed Parakeet	<i>Psittacula krameri</i> (Scopoli, 1769)	R	FC
Order Passeriformes				
Family Dicruridae				
34	Black Drongo	<i>Dicrurus macrocercus</i> (Vieillot, 1817)	R	C
Family Corvidae				
35	Indian Tree Pie	<i>Dendrocitta vagabunda</i> (Latham, 1790)	R	FC

S. No.	Common Name	Scientific Name	Residential Status	Abundance Status
36	House Crow	<i>Corvus splendens</i> (Vieillot, 1817)	R	C
37	Jungle Crow	<i>Corvus macrorhynchos</i> (Wagler, 1827)	R	RA
38	Racket-Tailed Drongo	<i>Dicrurus paradiseus</i>	R	C
Family Nectariniidae				
39	Purple Sunbird	<i>Cinnyris asiaticus</i> (Latham, 1790)	R	FC
40	Little Spiderhunter	<i>Arachnothera longirostris</i>	R	FC
Family Passeridae				
41	House Sparrow	<i>Passer domesticus</i> (Linnaeus, 1758)	R	C
Family Cisticolidae				
42	Ashy Prinia	<i>Prinia socialis</i> (Sykes, 1832)	R	C
Family Pycnonotidae				
43	Red-vented Bulbul	<i>Pycnonotus cafer</i> (Linnaeus, 1766)	R	C
44	Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	R	C
Family Phylloscopidae				
45	Dull Green Leaf Warbler	<i>Phylloscopus trochiloides</i>	WM	C
Family Leiothrichidae				
46	Jungle Babbler	<i>Turdoides striata</i> (Dumont, 1823)	R	FC
Family Sturnidae				
47	Pied Myna	<i>Sturuns contra</i> (Linnaeus, 1758)	R	C
48	Brahminy Starling	<i>Sturnia pagodarum</i> (J.F. Gmelin, 1789)	R	UN
49	Common Myna	<i>Acridotheres tristis</i> (Linnaeus, 1766)	R	C
50	Bank Myna	<i>Acridotheres ginginianus</i> (Latham, 1790)	R	C
Family Muscipapidae				
51	Oriental Magpie-Robin	<i>Copsychus saularis</i> (Linnaeus, 1758)	R	UN
52	Brown Rock Chat	<i>Cercomela fusca</i> (Blyth, 1851)	R	FC
53	Pied Bushchat	<i>Saxicola caprata</i> (Linnaeus, 1766)	R	C
54	Ant-eating chat	<i>Myrmecocichla formicivora</i>	R	C
55	Brown Flycatcher	<i>Muscicapa dauurica</i>	SM	C

Legend: R -Resident, WM - Winter Migrant, SM - Summer Migrant, C - Common, FC - Fairly Common, UN - Uncommon, and RA – Rare

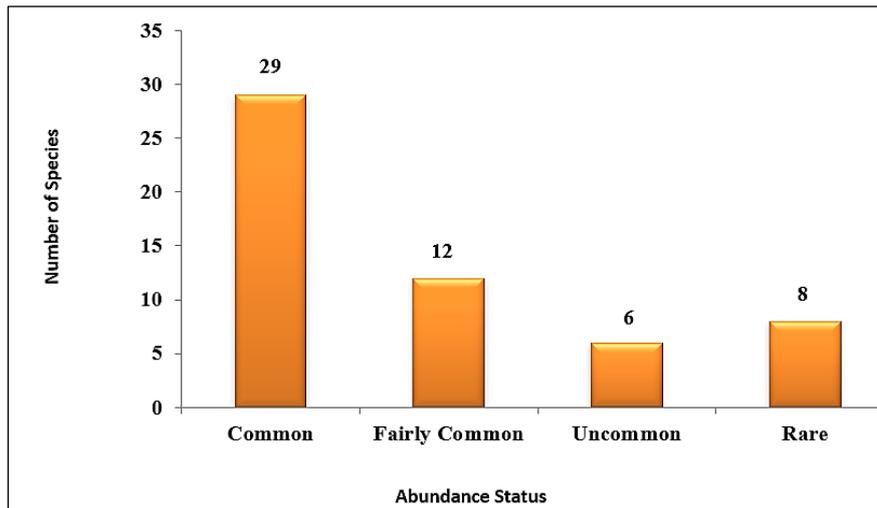


Fig. 5. Abundance status of observed avian species in Cantonment Area, Lucknow

3.5 Threats/Factors and Conservational Strategies in the Study Area

During the study period, various stress factors were observed which are threatening the avian diversity of Cantonment Area. These include several large scale developmental projects such

as residential complexes, road construction through the study areas which have lead to the habitat fragmentation of this site. There is also threat to avifauna due to various anthropogenic activities such as sewage disposal, garbage dumping and burning, grazing of the livestock.



Mallard
Anas platyrhynchos



Indian Peafowl
Pavo cristatus
(Linnaeus, 1758)



Red Junglefowl
Gallus domesticus



Spotted Dove
Streptopelia chinensis



Eurasian Collared Dove
Streptopelia decaocto
(Frivaldszky, 1838)



Laughing Dove
Streptopelia senegalensis
(Linnaeus, 1766)



Rock Pigeon
Columba livia
(J.F. Gmelin, 1789)



Brainfever Bird
Hierococcyx varius



Greater Coucal
Centropus sinensis



White-breasted
Waterhen *Amaurornis
phoenicurus*
(Pennant, 1769)



Indian Pond Heron
Ardeola grayii(Sykes,
1832)



Cattle Egret
Bubulcus ibis
(Linnaeus, 1758)



Intermediate Egret
Ardea intermedia
(Wagler, 1829)



Red-wattled Lapwing
Vanellus indicus
(Boddaert, 1783)



Lesser Spotted Eagle
Aquila pomarina



Common Pariah Kite
Milvus migrans



Shikra
Accipiter badius
(J.F. Gmelin, 1788)



Indian Grey Hornbill
Ocyceros birostris.
(Scopoli, 1786)



Common Hoopoe
Upupa epops
(Linnaeus, 1758)



Green Bee-eater
Merops orientalis
(Latham, 1801)



White-throated Kingfisher
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Rose-ringed Parakeet
Psittacula kramera
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Black Drongo
Dicrurus macrocercus
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House Crow
Corvus splendens
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Racket-Tailed Drongo
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Arachnothera longirostris



Purple Sunbird
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(Latham, 1790)



House Sparrow
Passer domesticus
(Linnaeus, 1758)



Red-whiskered Bulbul
Pycnonotus jocosus



Red-vented Bulbul
Pycnonotus cafer
(Linnaeus, 1766)



Dull Green Leaf Warbler
Phylloscopus trochiloides



Jungle Babbler
Phylloscopus trochiloides(Dumont, 1823)



Brahminy Starling
Sturnia pagodarum(J.F. Gmelin, 1789)



Common Myna
Acridotheres tristis(Linnaeus, 1758)



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Brown Rock Chat
Cercomela fusca (Blyth, 1851)



Ant-eating chat
Myrmecocichla formicivora



Oriental Magpie-Robin
Copsychus saularis (Linnaeus, 1758)



Asian Koel
Eudynamys scolopacea (Linnaeus, 1758)

Picture 1. Photographs of some birds, observed during study

Stress Factors:



Picture 2. Grazing of cattle



Picture 3. Garbage dumping

4. CONCLUSION

Birds play a vital role in keeping the balance of world's ecosystems by providing several ecological services such as pollination, dispersal of seeds, control of pests, scavenging and nutrient cycling etc. [34]. Cantonment Area located in district Lucknow supports resident birds as well as migratory birds but this area is under severe threats due to rapid urbanization. This area showed a rich and diverse presence of nearly 55 species of birds in its varied habitats, belonging to 15 orders and 29 families.

This study is also providing the information about biodiversity of terrestrial bird on this area for the conservation of terrestrial bird population because baseline information is a basic requirement for planning, monitoring and management actions for terrestrial birds and their habitats. This study exhibits the ecological value of terrestrial bird species in Lucknow as a feeding ground for the Migratory and Residential species of birds.

The observational study on avifauna of Cantonment Area, Lucknow is an effort to draw the attention of all selected area. The purpose is to know and improve the avian diversity of this area with little care and concern such as providing bird feed, water, and bird houses for the birds.

On the basis of six months of extensive study, it is suggested that:

1. There should be prohibition on the dumping of garbage and sewage disposal in this area.
2. Long-term monitoring of the biodiversity of this area should be done on regular basis for the development of a sustainable management plan and conservation strategies.
3. The local people should regularly be made aware about the importance of ecosystem services provided by birds through mass contact, awareness programmes and camps as well as installing sign boards, distribution of literature and also by audio-visual documentaries.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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