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Research Article

A STUDY OF AVIAN DIVERSITY AND ITS TEMPORAL VARIATION IN VARIOUS GREEN SPACES OF INDORE CITY

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ABSTRACT

A survey of birds in Indore city (Meghdoot garden, Nehru park, Lalbagh and Pipliyapala Regional Park) was conducted for a year (2018) to study the temporal variation in terrestrial avian fauna. The aim of the present study was to study the fluctuation in the number of species with the change in seasons. Line transect method was adopted to make 10 faunistic surveys in each site in every season. Birds were photographed and identified with the help of their call and field guide books. Interestingly, highest number of birds were recorded in the summer season in Pipliyapala regional park (52) and Lalbagh (39). On the other hand, least number of terrestrial avian diversity was recorded in Lalbagh (35) and Nehru Park (30) in rainy season. Thus, the present study pinnacles the activity of bird watching and tourism in these spaces as it generates revenue, which is further used in the maintenance and development.

INTRODUCTION

Avian diversity is a bioindicator of various habitats. Since, land use pattern have changed over the years, emergence of pastures over the forest covers, farming croplands, botanical gardens and highly urbanized human dominated habitats. So, by calculating the avian diversity, one can estimate ecological health in both the ways qualitatively and quantitatively. Its study functions as an ecological tool. As we know it performs several other functions in the ecosystem for example as a pollinating agent, seed dispersal and disease regulation (luck *et al.,* 2003). As the seasonal changes proceeds there is increase and decrease in food resources respectively. These changes led to the seasonal and temporal variation in avian diversity. Favorable temperature urges birds for local migration and adding of migratory birds in the area (Joshi and Shrivastava, 2012). As the temperature rises, there is decrease in diversity of birds, but there are few exceptions which include birds like egret because their population increases with increase in temperature, as it becomes easier for them to catch fishes in shallow water (Balapure *et al.,* 2012). The central idea of the proposed study is to find out the temporal variation of avian fauna and its diversity in Indore city and to highlight importance of green spaces.

MATERIALS AND METHODS

Study area

Indore city was divided into following study areas:

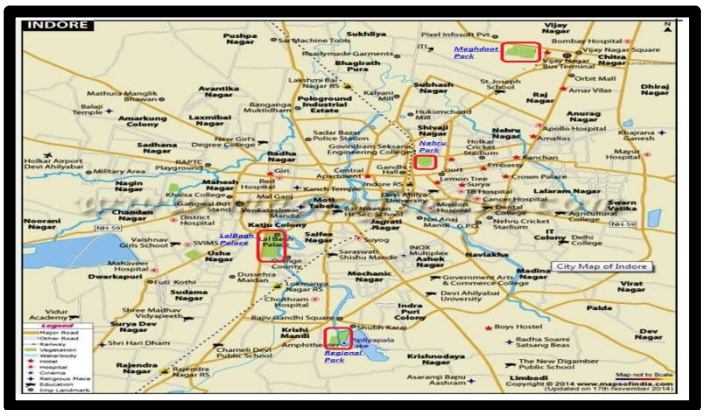

Figure 1 Map showing location of selected sites of Indore city

Site-I (North): Meghdoot Garden: It is one of the voluminous gardens in Vijay Nagar (Indore) and is in periphery of the main city. This place has variety of mini herbal lawns and landscaped gardens.

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Site -II (East): Nehru Park: It the most crowded park of Indore city and is situated near main office of BSNL Indore. Entry in this park is free of cost (no entry fees). Due to easy entry, it is generally crowded by small children and old age people. Generally, roosting of several colonial birds are observed during Night.

Site - III (West): Lalbagh: It was built in 1886-1921 by Maharaja Shivaji Rao Holkar. It is situated in the periphery of Indore city. Visiting hours of this place is 11:00 AM to 4:00 PM. And it is closed on Monday due to maintenance reasons. It is maintained by the Archeological Department of the state. It is also besides the bank of Khan River. It has a rose garden which is one of its kinds in India. With the end of monsoon season there is dense greenery in this 71.63 acre campus. Several flowering plants are grown at the edges of the park.

Site - IV (South): Pipliyapala Regional Park: It is also known as Atal Bihari Vajpayee Regional Park. It is developed by Indore Development Authority (IDA) at a cost of 70 crores in 2003. And now it is maintained by Nagar Nigam Indore (Indore Municipal Corporation). It is spread at an area of 120 acres.

Study period

This study was conducted in a period of 1 year (Jan- Dec, 2018) and it was divided into three seasons, i.e. winter season (November to February), summer season (March to June) and rainy season (July to October).

Identification aids

The book of Indian birds by Salim Ali (13th edition) (2003) and Birds of India by Bikram Grewal and Garima Bhatia (2016) were used for identifications. Nikon binoculars and camera were used to photograph and locate birds at remote locations.

METHOD

Line Transect method

While walking on a continuous pace, it is easy to locate and detect all the avian fauna around the transect line. By adopting line transect method; it is possible to cover a large area in less time.

RESULTS

The Temporal Variation of avian fauna of different study sites (Meghdoot Garden, Nehru Park, Lalbagh and Pipliyapala Regional Park) during January 2018 to December 2018 (winter, summer and rainy season) were represented in Table 1-4.

Temporal variation of birds in Meghdoot Garden

A total thirty five species were recorded in the winter season; thirty six species were found in the summer season and thirty five species were found in the Rainy season. Family Columbidae was found dominating in winter season with 3 species; similarly in summer and winter season Columbidae was dominant with 3 species each (Table: 1).

Temporal variation of birds in Nehru Park

Thirty species of avian fauna was observed in the winter season; in summer season thirty three species were recorded and thirty one species were observed in rainy season. Family Columbidae, Corvidae and Muscicapidae were dominant with 3 species each in winter season; family Muscicapidae was dominant in summer season with 4 species and lastly, Columbidae, Corvidae and Muscicapidae were dominant with 3 species in the rainy season (Table: 2).

Temporal variation of birds in LalBagh

A total thirty five species were recorded in winter season; thirty nine species were observed in summer season and thirty four species were found in rainy season. Only Family Muscicapidae was dominant in winter, summer and rainy season with 5, 5 and 4 species respectively (Table: 3).

Temporal variation of birds in Pipliyapala Regional Park

Forty three species were recorded in winter season; fifty two species were found in summer season and forty six species were observed in rainy season. In winter season family Muscicapidae was dominant with 5 species; then in summer season it was again dominant with 6 species and lastly, Accipitridae and Muscicapidae were dominant with 4 species each in the rainy season (Table: 4).

Table 1 Temporal Variation of birds in Meghdoot Garden during winter, summer and rainy season (2018)

Scientific names of species	Family	Winter	Summer	Rainy
Columba livia	Columbidae	+	+	+
Streptopelia chinensis	Columbidae	+	+	+
Streptopelia senegalensis	Columbidae	+	+	+
Centropus sinensis	Cuculidae	+	+	+
Eudynamys scolopaceus	Cuculidae	+	+	+
Bubulcus ibis	Ardeidae	+	+	+
Vanellus indicus	Charadriidae	+	+	+
Accipiter badius	Accipitridae	+	+	+
Milvus migrans	Accipitridae	+	+	+
Athene brama	Strigidae	+	+	+
Ocyceros birostris	Bucerotidae	+	+	+
Psilopogon haemacephalus	Megalaimidae	+	+	+
Merops orientalis	Meropidae	+	-	-
Halcyon smyrnensis	Alcedinidae	+	+	+
Psittacula eupatria	Psittaculidae	+	-	+
Psittacula krameri	Psittaculidae	+	+	+
Pericrocotus cinnamomeus	Campephagidae	+	+	+
Aegithina tiphia	Aegithinidae	+	+	+
Dicrurus macrocercus	Dicruridae	+	+	+
Rhipidura albicollis	Rhipiduridae	+	+	+
Dendrocitta vagabunda	Corvidae	+	+	+
Corvus splendens	Corvidae	+	+	+
Terpsiphone paradisi	Monarchidae	-	+	-
Dicaeum agile	Dicaeidae	-	+	+
Cinnyris asiaticus	Nectariniidae	+	+	+
Euodice malabarica	Estrildidae	+	+	+
Passer domesticus	Passeridae	+	+	+
Machlolophus xanthogenys	Paridae	-	-	+
Orthotomus sutorius	Cisticolidae	+	+	+
Hirundo rustica	Hirundinidae	-	+	-
Ptyonoprogne concolor	Hirundinidae	+	+	+
Pycnonotus cafer	Pycnonotidae	+	+	+
Phylloscopus trochiloides	Phylloscopidae	+	+	-
Zosterops palpebrosus	Zosteropidae	+	+	+
Turdoides striata	Leiothrichidae	+	+	+
Gracupica contra	Sturnidae	+	+	+
Acridotheres tristis	Sturnidae	+	+	+
Saxicoloides fulicatus	Muscicapidae	+	+	+
Copsychus saularis	Muscicapidae	+	+	+

Keys = (+) indicates presence and (-) indicates absence of species.

Table 2 Temporal Variation of birds in Nehru Park during winter, summer and rainy season (2018)

Scientific names of species	Family	Winter	Summer	Rainy
Columba livia	Columbidae	+	+	+
Streptopelia chinensis	Columbidae	+	+	+
Streptopelia senegalensis	Columbidae	+	+	+
Apus affinis	Apodidae	+	+	+
Eudynamys scolopaceus	Cuculidae	+	+	+
Bubulcus ibis	Ardeidae	+	+	+
Vanellus indicus	Charadriidae	+	+	+
Accipiter badius	Accipitridae	+	+	+
Milvus migrans	Accipitridae	+	+	+
Athene brama	Strigidae	+	+	+
Ocyceros birostris	Bucerotidae	+	+	+
Psilopogon haemacephalus	Megalaimidae	+	+	+
Merops orientalis	Meropidae	+	-	-
Halcyon smyrnensis	Alcedinidae	+	+	+
Psittacula krameri	Psittaculidae	+	+	+
Oriolus kundoo	Oriolidae	-	+	-
Aegithina tiphia	Aegithinidae	+	+	+
Dicrurus macrocercus	Dicruridae	+	+	+
Rhipidura albicollis	Rhipiduridae	+	+	+
Dendrocitta vagabunda	Corvidae	+	+	+
Corvus splendens	Corvidae	+	+	+
Corvus macrorhynchos	Corvidae	+	+	+
Dicaeum agile	Dicaeidae	-	+	+
Leptocoma zeylonica	Nectariniidae	-	+	+
Passer domesticus	Passeridae	+	+	+
Orthotomus sutorius	Cisticolidae	+	+	+
Ptyonoprogne concolor	Hirundinidae	+	+	+
Pycnonotus cafer	Pycnonotidae	+	+	+
Turdoides striata	Leiothrichidae	+	+	+
Acridothere stristis	Sturnidae	+	+	+
Saxicoloides fulicatus	Muscicapidae	+	+	+
Copsychus saularis	Muscicapidae	+	+	+
Ficedula parva	Muscicapidae	+	+	+
Saxicola maurus	Muscicapidae	-	+	-

Keys = (+) indicates presence and (-) indicates absence of species.

Table 3 Temporal Variation of birds in Lalbagh during winter, summer and rainy season (2018)

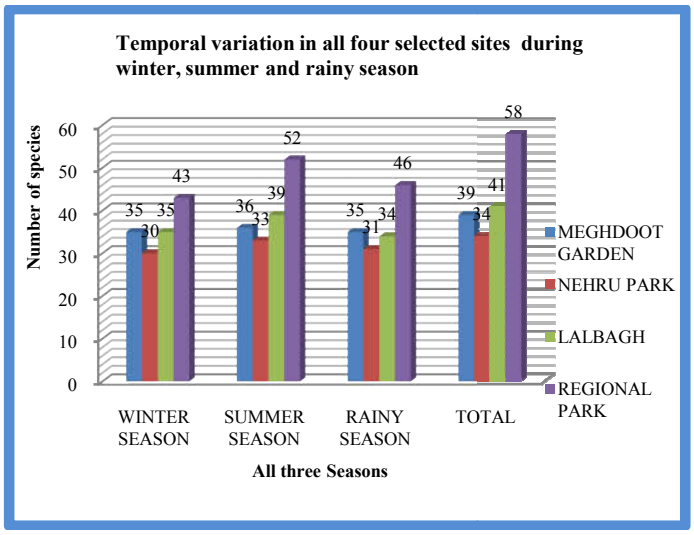
Scientific Names of Species	Family	Winter	Summer	Rainy
Columba livia	Columbidae	+	+	+
Streptopelia chinensis	Columbidae	+	+	+
Streptopelia senegalensis	Columbidae	+	+	+
Apus affinis	Apodidae	+	+	+
Centropus sinensis	Cuculidae	+	+	+
Eudynamys scolopaceus	Cuculidae	+	+	+
Vanellus indicus	Charadriidae	+	+	+
Elanus caeruleus	Accipitridae	-	-	+
Milvus migrans	Accipitridae	+	+	+
Athene brama	Strigidae	+	+	+
Ocyceros birostris	Bucerotidae	+	+	+
Psilopogon haemacephalus	Megalaimidae	+	+	+
Merops orientalis	Meropidae	+	-	-
Halcyon smyrnensis	Alcedinidae	+	+	+
Psittacula krameri	Psittaculidae	+	+	+
Pericrocotus cinnamomeus	Campephagidae	+	+	+
Coracina javensis	Campephagidae	-	+	-
Oriolus kundoo	Oriolidae	-	+	-
Aegithina tiphia	Aegithinidae	+	+	+
Dicrurus macrocercus	Dicruridae	+	+	+
Dendrocitta vagabunda	Corvidae	+	+	+
Corvus splendens	Corvidae	+	+	+
Corvus macrorhynchos	Corvidae	+	+	+
Cinnyri sasiaticus	Nectariniidae	+	+	+
Euodice malabarica	Estrildidae	+	+	+
Passer domesticus	Passeridae	+	+	+
Motacilla maderaspatensis	Motacillidae	-	+	-
Prinia socialis	Cisticolidae	+	+	+
Orthotomus sutorius	Cisticolidae	+	+	+
Hirundo smithii	Hirundinidae	-	+	-
Hirundo rustica	Hirundinidae	-	+	-
Pycnonotus cafer	Pycnonotidae	+	+	+
Zosterops palpebrosus	Zosteropidae	+	+	+
Turdoides striata	Leiothrichidae	+	+	+
Gracupica contra	Sturnidae	+	+	+
Acridotheres tristis	Sturnidae	+	+	+
Saxicoloides fulicatus	Muscicapidae	+	+	+
Copsychus saularis	Muscicapidae	+	+	+
Cyornis tickelliae	Muscicapidae	+	+	+
Ficedula parva	Muscicapidae	+	+	+
Oenanthe fusca	Muscicapidae	+	+	-

Keys = (+) indicates presence and (-) indicates absence of species.

Table 4 Temporal Variation of birds in Pipliyapala Regional Park during winter, summer and rainy season (2018)

Scientific names of species	Family	Winter	Summer	Rainy
Pavo cristatus	Phasianidae	-	-	+
Columba livia	Columbidae	+	+	+
Streptopelia chinensis	Columbidae	+	+	+
Streptopelia senegalensis	Columbidae	+	+	+
Apus affinis	Apodidae	+	+	+
Centropus sinensis	Cuculidae	+	+	+
Clamator jacobinus	Cuculidae	+	+	-
Eudynamys scolopaceus	Cuculidae	+	+	+
Ardeola grayii	Ardeidae	+	+	+
Bubulcus ibis	Ardeidae	+	+	+
Vanellus indicus	Charadriidae	+	+	+
Elanus caeruleus	Accipitridae	-	-	+
Pernis ptilorhynchus	Accipitridae	-	-	+
Accipiter badius	Accipitridae	+	+	+
Milvus migrans	Accipitridae	+	+	+
Athene brama	Strigidae	+	+	+
Ocyceros birostris	Bucerotidae	+	+	+
Psilopogon haemacephalus	Megalaimidae	+	+	+
Merops orientalis	Meropidae	+	-	-
Halcyon smyrnensis	Alcedinidae	+	+	+
Psittacula cyanocephala	Psittaculidae	-	+	+
Psittacula eupatria	Psittaculidae	+	-	+
Psittacula krameri	Psittaculidae	+	+	+
Pericrocotus cinnamomeus	Campephagidae	+	+	+
Coracina javensis	Campephagidae	-	+	-
Oriolus kundoo	Oriolidae	-	+	-
Aegithina tiphia	Aegithinidae	+	+	+
Dicrurus macrocercus	Dicruridae	+	+	+
Rhipidura albicollis	Rhipiduridae	+	+	+
Dendrocitta vagabunda	Corvidae	+	+	+
Corvus splendens	Corvidae	+	+	+
Corvus macrorhynchos	Corvidae	+	+	+
Terpsiphone paradisi	Monarchidae	-	+	-
Dicaeum agile	Dicaeidae	-	+	+
Leptocoma zeylonica	Nectariniidae	-	+	+
Cinnyris asiaticus	Nectariniidae	+	+	+
Euodice malabarica	Estrildidae	+	+	+
Passer domesticus	Passeridae	+	+	+
Motacilla maderaspatensis	Motacillidae	-	+	-
Motacilla alba	Motacillidae	-	+	-
Machlolophus xanthogenys	Paridae	-	-	+
Prinia socialis	Cisticolidae	+	+	+
Orthotomus sutorius	Cisticolidae	+	+	+
Hirundo smithii	Hirundinidae	-	+	-
Hirundo rustica	Hirundinidae	-	+	-
Ptyonoprogne concolor	Hirundinidae	+	+	+
Pycnonotus cafer	Pycnonotidae	+	+	+
Phylloscopus trochiloides	Phylloscopidae	+	+	-
Zosterops palpebrosus	Zosteropidae	+	+	+
Turdoides striata	Leiothrichidae	+	+	+
Gracupica contra	Sturnidae	+	+	+
Acridotheres tristis	Sturnidae	+	+	+
Saxicoloides fulicatus	Muscicapidae	+	+	+
Copsychus saularis	Muscicapidae	+	+	+
Cyornis tickelliae	Muscicapidae	+	+	+
Ficedula parva	Muscicapidae	+	+	+
Saxicola maurus	Muscicapidae	-	+	-
Oenanthe fusca	Muscicapidae	+	+	-

Keys = (+) indicates presence and (-) indicates absence of species.



Graph 1 Graphical representation of temporal variation in all three seasons (Species wise) in Meghdoot garden, Nehru Park, Lalbagh and Regional Park during January 2018-December 2018

DISCUSSIONS

In the present study temporal variation in the avian species richness was studied. There is a continuous change of temperature with change of season. There are few birds which can be noted in summer season (e.g. Golden oriole); similarly, few birds were noted in winters only. Several species were observed in all the seasons (e.g. Common tailorbird). This temporal variation was studied by making a continuous checklist of avian fauna in all the three seasons. Lowest and highest species count with respect to different seasons was also recorded (Graph 1).

All the study sites vary in their area size; they also have distinct kinds of trees, plants and flowers. They also provide different types of food resources for example: fruit bearing trees in Pipliyapala Regional Park are more as compared to other study sites. So, there is disparity in distribution of birds among all the four sites. But on the other hand, larger and older trees are present in Nehru Park; so, hole nesting species are more in number in this site. Interestingly, flowering plants are more in number in Lal Bagh area.

The maximum richness was observed in summer season in Pipliyapala Regional Park (52 species) and lowest count was observed in Nehru park in winter season (30 species). In our study Family Muscicapidae was dominant in Lalbagh and Pipliyapala Regional Park in all the three seasons. Similarly, Muscicapidaewas dominant with 4 species in Nehru Park (summer season).Workers like Gaur *et al.* (2019) studied the spatial variation in Indore city and highlighted the importance of such green spaces in this city. Bagde (2015) studied avian diversity in Chhindwara District of Madhya Pradesh and observed around 124 species and concluded that family Muscicapidae was dominant with 13 species in that area. Moreover, Pejaver *et al.* (2013) published a list of 50 avian species from the Hoshangabad region. Total 262 species and their seasonal sightings were studied by Pasha *et al.* (2004).

In our study Family Accipitridae was dominant with 4 species in rainy season at Regional Park and family Corvidae was dominant with 3 species each at Nehru Park in winter and rainy season. Interestingly, Kushwaha *et al.* (2015) assessed the avian diversity at Tikamgarh district and reported 170 species of 46 families out of which family Accipitridae and Corvidae were dominant with 16 and 13 species respectively. Furthermore, Tiple *et al.* (2010) reported few seasonal species which can be sighted only in winters and summers respectively. These species were 14 in number in their study out of 140 species observed.

Balapure *et al.* (2012) also studied temporal variation in Barna wetland (Narmada basin) and stated reasons for the change in species richness with the change in seasons. Factors like rainfall, humidity and temperature acts as vital role in disrupting and supporting bird population annually. Therefore in the present study showed that with slight change in temperature (seasonal) the birds richness vary. Thus, the results of present study corroborate with above mentioned authors.

CONCLUSION

The aim of the present study was to study the fluctuation in the number of species with the change in seasons. Highest number of birds were recorded in the summer season inPipliyapala regional park (52) and Lalbagh (39). Least number of terrestrial avian diversity was recorded in Lalbagh (35) and Nehru Park (30) in rainy season. Thus, the present study pinnacles the activity of bird watching, conservation, awareness and sustentation of avian diversity especially promoting tourism in these spaces as it generates revenue, which is further used in the maintenance and development.

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