

Assessment of Shannon Wiener Index of Birds in various regions of Indore City, Indore, Madhya Pradesh

¹Priya Gaur, ²C. S. Shrivastava and ¹*S. Gaherwal

¹ Department of Zoology, Government Holkar (Model, Autonomous) Science College, Indore (M.P.), India

² Department of Zoology, Government College Mundi, Khandawa (M.P.), India

(Received 21 January, 2020; Accepted 14 April, 2020)

ABSTRACT

A survey of avian fauna was conducted in Indore to record the avian fauna in all the selected sites of Indore city. The objective of the present study was to calculate the Shannon Wiener index of the recorded avian fauna in the Meghdoot garden, Nehru Park, Lalbagh and Pipliyapala Regional Park. Field guide books, cameras and binoculars were used for the identification of the birds. This study was conducted for a year (2018). Seasonal checklists were made and individuals were counted and this diversity index was evaluated. The results of the present study showed that Highest Species Diversity with $H' = 3.2585$ was recorded in Pipliyapala Regional park in the Summer Season. Lowest Species Diversity with $H' = 2.7656$ in Rainy season at Nehru Park. Indore city has rich avian diversity and must be preserved for conservation point of view. Creation of more green spaces should be promoted to enhance this diversity.

Key words : Diversity index, Indore, Avian fauna, Meghdoot garden, Regional park.

Introduction

The most general measure of diversity is simply the number of species per unit area as represented in some kind of standard sample. The environment of a species, as characterized primarily by physical and chemical qualities rather than position within a community, is the species habitat. The habitats occupied by species in a given landscape integrate along environmental gradients, and we can use these gradients as axes of a quite different kind of abstract space, a habitat hyperspace (Whittaker, 1972). Green Spaces in cities have been formally identified as areas with notable avian biodiversity. However, the urban environment is not appraised areas of conservation importance (Vallejo *et al.*, 2009).

Bird species richness is probable to be enhanced by increasing site area and imparting rough grass and water bodies in urban green spaces (Chamberlain *et al.*, 2007). Green spaces and trees confer to a number of environmental functions in urban environments, such as the endurance of urban dwelling species (e.g., bird species). There is a correlation between green space quality (structural and spatial attributes) and the diversity of avian fauna (Sharma and Shukla, 2015). Indian subcontinent is very rich in biodiversity. It is a part of the vast Oriental biogeographic region. There are approximately more than 9,990 bird species recorded on our planet, out of which, the Indian subcontinent is home to more than 1,300 bird species (over 13%) (Grimmett *et al.*, 1999). The population of bird is a very sensitive in-

indicator of pollution in both terrestrial and aquatic ecosystem (Gaston, 1975). Indore city has rich avian diversity and it must be preserved for conservation point of view. Creation of more green spaces should be promoted to enhance this diversity. Therefore, the present study aims at preparing the seasonal checklist of avian fauna and then evaluating the Shannon Wiener Index so that we can estimate the avian diversity in Pipliyapala regional park, Meghdoot Garden, Nehru Park and Lalbagh.

Materials and Methods

Materials

Study area

The study area of Indore city was divided into following zones based on the cardinal directions:

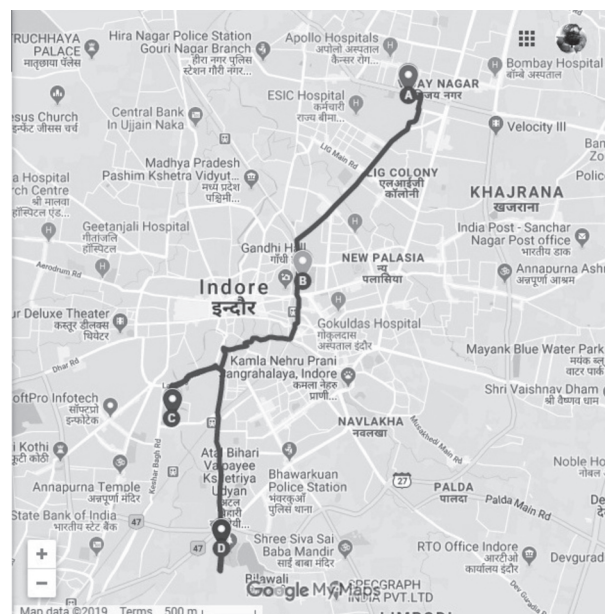


Fig. 1. Map showing location of selected sites of Indore city (Google satellite images).

Zone- I (North): Meghdoot Garden (A)

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. Dominant trees in the place includes *Polyalthia longifolia*, *Ficus benghalensis* var. *krishnae*, *Mangifera indica* and *Ficus bengalensis*.

Zone-II (East): Nehru Park (B)

It the most crowded park of Indore city and is situ-



Fig. 2. Satellite view of Meghdoot Garden (Google satellite images).

ated 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. *Polyalthia longifolia*, *Ficus religiosa*, *Ficus benghalensis* var. *krishnae*, *Mangifera indica*, *Sapodilla plum* and *Ficus bengalensis* are the indigenous trees in the park.



Fig. 3. Satellite view of Nehru Park (Google satellite images).

Zone- III (West): Lal Bagh (C)

It was built in 1886-1921 by Maharaja Shivaji Rao Holkar. It is situated in the periphery of Indore city.

Zone- IV (South): Pipliyapala Regional Park (D)

Study Duration: The present study was conducted for one year (2018) (Gaur *et al.*, 2019^a, Gaur *et al.*, 2019^b, Gaur *et al.*, 2019^c) and it was divided into following season. i.e. Winter season –(November to February); Summer season- (March to June) and Rainy season- (July to October).

Methods

Method 1: 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. This is better than adopting any other methods. Large number of individuals of avian fauna can be observed efficiently. Detectability of avian fauna is also altered by some habitats (e.g. a bird may be found in dense canopy trees area), so, they will be uncommon to other habitats. This problem arises to specific and particular birds. When primary data is collected from large open areas, this line transect method is adopted. Efficiency of line transect method is greater than the point count method. One observer can count more avian fauna per unit time, so, it is more preferred by researchers. In general, line transects are considered more precise than point count methods. Birds are very dynamic, so, data collected by using the line transect method is less prone to bias.

There can be various ways of making transect routes. But this also depends on the total area (selected study area and its landscape) and clear path for walking. An observer should not be halted by a ditch or any other obstruction, to overcome this, the observer should follow the transect line on the periphery of the survey area. At times, when observer has a very large area and limited time to survey; then, multiple small transects within the area should be avoided. So that the data can be recorded in available time and same path is to be followed on every visit to avoid biasness (Bibby *et al.*, 2000).

Method 2: Point Count Method

This is the second method in which an observer sit or stand at a particular location of the study site and records all the birds seen around him/her by focusing on the bird call and keenly listening to every movement around him/her. This method is also adopted over the line transect method because study of a particular habitat can be done in this way only. Specifically less mobile bird and their tree preference, nesting and their breeding pattern study are the main agenda of the observer. Furthermore, line transect methods can pass through different habitats at the same time.

Point count method allows us to study the amalgamation between habits and birds. Here we can study presence or the absence of one species in a particular habitat. Study station within the confined area is determined by stratified random technique covering each terrain. Each point count site should be equidistant to each other to remove biasness or double counting. Generally this distance should be at least 200 meter apart. For these study sites there are 5 stations of these point count due to less area on whole. The count period in all the sites is of six minutes to collect unbiased data (Bibby *et al.*, 2000).

All the recorded data is formulated in tabular form in excel and the following diversity index was calculated: Shannon Index (H') (Spellerberg, 1991): It is a nonparametric measure of diversity. This diversity index is used to assort species diversity among the community of a specific site. Shannon index (or Shannon Wiener index) accounts for understanding species evenness and species abundance both.

$$H' = \sum_{i=1}^S -P_i \ln P_i$$

Where,

"S" indicates total number of species in the given sample (or site).

"Pi" denotes the relative abundance of each species. The value of Pi can be obtained by

$$P_i = \frac{\text{The proportion of individuals of a given species}(n)}{\text{Total number of individuals in the community (N)}}$$

Here,

"n" is the number of individuals of a species.

"N" is the total number of individuals of the sample in whole study site.

Results

The Species diversity in Meghdoot Garden, Nehru Park, Lalbagh and Pipliyapala Regional Park was calculated in winter, summer and rainy season from January 2018 to December 2018. The recorded values of Shannon Index data was represented in Table 1.

Species Diversity of Meghdoot Garden in Winter Season was $H' = 2.9385$; Species Diversity of Meghdoot Garden in Summer Season was $H' = 2.9380$ and Species Diversity of Meghdoot Garden in Rainy Season was $H' = 2.9050$.

Species Diversity of Nehru Park in Winter Season was $H' = 2.7994$; Species Diversity of Nehru Park in Summer Season was $H' = 2.8542$ and Species Diversity of Nehru Park in Rainy Season was $H' = 2.7656$.

Species Diversity of Lalbagh in Winter Season was $H' = 2.9767$; Species Diversity of Lalbagh in Summer Season was $H' = 3.0254$ and Species Diversity of Lalbagh in Rainy Season was $H' = 2.9167$.

Species Diversity of Pipliyapala Regional Park in Winter Season was $H' = 3.1192$; Species Diversity of Pipliyapala Regional Park in Summer Season was $H' = 3.2585$ and Species Diversity of Pipliyapala Regional Park in Rainy Season was $H' = 3.1366$.

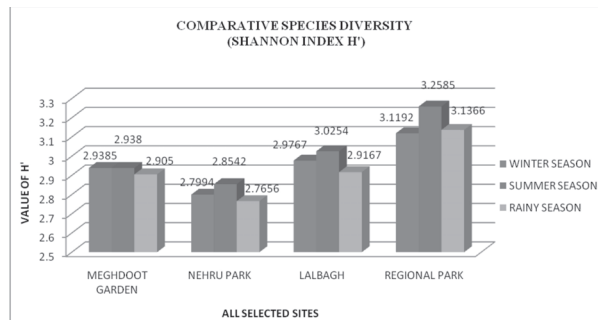
Highest Species Diversity with $H' = 3.2585$ was recorded in Pipliyapala Regional park in Summer Season. Lowest Species Diversity with $H' = 2.7656$ in Rainy season at Nehru Park.

Discussion

In the present study Species Diversity in the avian species was recorded at Meghdoot Garden, Nehru Park, Lalbagh and Pipliyapala Regional Park. Furthermore, this data was represented by Shannon Index with its variation in different seasons (winter,

Table 1. Comparative values of Species diversity through Shannon Index (H') with respect to different seasons in each site.

Study Sites	Winter Season	Summer Season	Rainy Season
Meghdoot Garden	$H' = 2.9385$	$H' = 2.938$	$H' = 2.905$
Nehru Park	$H' = 2.7994$	$H' = 2.8542$	$H' = 2.7656$
Lalbagh	$H' = 2.9767$	$H' = 3.0254$	$H' = 2.9167$
Regional Park	$H' = 3.1192$	$H' = 3.2585$	$H' = 3.1366$

**Graph 1.** Comparative values of Species diversity through Shannon Index (H') with respect to different seasons of each site.

summer and rainy season). Table 1 exhibits that Highest Species Diversity with $H' = 3.2585$ was recorded in Pipliyapala Regional park in Summer Season followed by rainy season with $H' = 3.1366$. Lowest Species Diversity with $H' = 2.7656$ rainy season at Nehru Park. Moreover, Joshi (2015) adopted similar methodology to estimate Shannon-Wiener index in their 120 species of recorded avian fauna at college campus. They recorded a value of 4.43 (highest). This was more than our index because of our less species number. Thus, the results of the present study corroborates with the study of other workers. Other scientists have determined the avifaunal diversity and reported species richness of 56 species and $H' = 1.337664$ at Chicha-pipariya (Highest) and lowest was $H' = 1.335499$ with species richness of 58 (Joshi and Shrivastava, 2012).

Species Diversity of Meghdoot Garden in Winter Season was $H' = 2.9385$; Species Diversity of Meghdoot Garden in Summer Season was $H' = 2.9380$ and Species Diversity of Meghdoot Garden in Rainy Season was $H' = 2.9050$. Similarly, $H' = 2.813$ with richness of 50 species and $H' = 3.098$ with richness of 44 species was recorded by workers (Palita *et al.*, 2011). Shannon Wiener Diversity Index with values of 3.86, 2.84 and 3.64 were reported by workers (Roy *et al.*, 2012) at three study sites of North Bengal. They also emphasized on the correlation between Species Richness and values of Diver-

sity index.

Species Diversity of Lalbagh in Winter Season was $H' = 2.9767$; Species Diversity of Lalbagh in Summer Season was $H' = 3.0254$ and Species Diversity of Lalbagh in Rainy Season was $H' = 2.9167$. Biodiversity can be defined as heterogeneity of life, that too at all the levels of organization. Though this is also explained by Issa (2019) that the value of Shannon Wiener index correlates with the number of species recorded. Species Diversity of Nehru Park in Winter Season was $H' = 2.7994$; Species Diversity of Nehru Park in Summer Season was $H' = 2.8542$ and Species Diversity of Nehru Park in Rainy Season was $H' = 2.7656$. Nagendra (2002) did similar evaluation in two different landscapes and values recorded were 1.611 and 1.622 respectively. Interestingly, the relation between physical parameters of urban lake and water birds were keenly studied. The results showed the Shannon Diversity of fifteen lakes with 3.36 (Highest) and 2.47 (Lowest) respectively (Rajashekhara *et al.*, 2010). Thus, the results of the present study corroborates with the above mentioned authors.

Conclusion

The above study showed that the above mentioned study sites are rich in avian diversity and has various patches which is very dense in avian fauna. All the four study sites have slight dissimilarity in avian fauna composition of Indore city because they have different vegetation and different ratio of indigenous and exotic trees.

Acknowledgement

Authors acknowledge the immense help received from the scholars whose articles are cited and included in references of this manuscript. The authors are also grateful to authors / editors / publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed.

References

- Bibby, C., Burgess, N. D., Hill, D. A. and Mustoe, S. 2000. *Bird Census Techniques*. Academic Press. pp. 200-331.
- Chamberlain, D. E., Gough, S., Vaughan, H., Vickery, H. and Appleton, G. F. 2007. Determinants of bird species richness in public green spaces. *Bird Study*. 54(1): 87-97.
- Gaston, A. J. 1975. Methods of estimating bird populations. *Journal Bombay History National History Society*. 72:271-283.
- Gaur, P., Shrivastava, C. S. and Gaherwal, S. 2019_a. Spatial variation in avifaunal diversity from various green spaces of Indore city, Madhya Pradesh. *International Journal of Current Research and Review*. 11(14): 06-15. DOI: <http://dx.doi.org/10.31782/IJCRR.2019.111412>.
- Gaur, P., Shrivastava, C. S. and Gaherwal, S. 2019_b. Study and Estimation of Species Richness of Avian Fauna in Selected Sites of Indore City (M.P.). *International Journal of Current Advanced Research*. 8(9D): 20001-20003.
- Gaur, P., Shrivastava, C. S. and Gaherwal, S. 2019_c. A study of avian diversity and its temporal variation in various green spaces of Indore city. *International Journal of Recent Scientific Research*. 10{07(01)}: 33889-33893.
- Google satellite images. Accessed on 24/10/2018. <https://www.google.co.in/maps/@22.9734229,78.6568942,6z?hl=en>
- Grimmett, R., Inskipp, C. and Inskipp, T. 1999. *Pocket guide to the birds of the Indian subcontinent*. Oxford University Press, New Delhi, India.
- Grimmett, R., Inskipp, C. and Inskipp, T. 2014. *Birds of Indian Subcontinent, India*. Om Books International, New Delhi, India.
- Issa, A.A.A. 2019. Diversity and abundance of wild birds species in two different habitats at Sharkia Governate, Egypt. *Journal of Applied Zoology*. 80 (34): 1-7.
- Joshi, P. and Shrivastava, V.K. 2012. Ecological study and bird diversity of Tawa Reservoir and its surrounding areas of Hoshangabad district (Madhya Pradesh). *The Bioscan: An International Quarterly Journal of Life Sciences*. 7(1): 129-133.
- Joshi, P.P. 2015. Assessment of Avian Population in Different Habitats around Amolakchand Mahavidyalaya Campus, Yavatmal, Maharashtra, India. *Journal of Global Sciences*. 4(5) : 2244-2250.
- Nagendra, H. 2002. opposite trends in response for the Shannon and Simpson indices of landscape diversity. *Applied Geography*. 22 : 175-186.
- Palita, S.K., Ponkshe, A.V. and Dhar, U. 2011. Habitat enrichment and its impact on avian diversity: a study at GBPIHED, Kosi Katarmal, Uttarakhand, India. *Current Science*. 100 : 1681-1689.
- Rajashekhar, S. and Venkatesha, M. G. 2010: The diversity and abundance of water birds in the lakes of Bangalore city. *Biosystematica*. 4(2) : 63-73.
- Roy, U. S., Banerjee, P. and Mukhopadhyay, S. K. 2012. Study on avifaunal diversity from three different regions of North Bengal, India. *Asian Journal of Conservation Biology*. 1(2) : 120-129.
- Sharma, S. and Shukla, A. 2015. Preliminary study on avian faunal diversity of Polipathar area in Jabalpur (M.P.). *International Journal of Current Advanced Research*. 4(9) : 364-367.
- Spellerberg, I.F. 1991. *Monitoring Ecological Health*. Cambridge University Press, Cambridge.
- Vallejo, B. M., Aloy, A. B. and Ong, P. O. 2009. The distribution, abundance and diversity of birds in Manila's last greenspaces. *Landscape and Urban Planning*. 89 (3-4): 75-85.
- Whittaker, R. H. 1972. Evolution and Measurement of Species Diversity. *Taxon*. 21 : 213-251.