International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Study of Bird Diversity during Monsoon Season Related to Air Quality at Asansol, West Bengal

Debdyuti Sengupta[1], Soumendra Nath Talapatra[2]

[1] Ph.D Scholar, Department of Environmental Science, Secom Skills University, Kendradangal, Birbhum, West Bengal, India

[2]Department of Bio-Science, Secom Skills University, Kendradangal, Birbhum, West Bengal, India

Corresponding author Email: *debdyutisenguptaindia[at]gmail.com*
Phone: +91-7550856044

Abstract: ***Qualitative and quantitative assessment of bird diversity as during monsoon season and correlated with available air quality parameters of Asansol, West Bengal. For bird diversity assessment, a total500-meter line transects was done randomly weekly twice a day (2hrs. duration in each day) and call count methods in industrial and urban area compared to suburban area for the period of three months (June 2021 – August 2021). Different biodiversity indices were compared between the sites. Overall air quality data were correlated with the value of bird diversity. In the present findings, qualitative and quantitative assessment indicated that the variety of bird species were observed less numbers (11 types and 118 organisms) in site A1 compared to site A2 (20 types and 202 organisms). Different indices such as Shannon diversity index, Index of Dominance, and Margalef's species richness index values were higher in site B (2.40, 0.87 and 3.60) when compared to site A (2.00, 0.81 and 2.10) while Berger-Parker Dominance Index value was observed lower in site A2 (0.30) when compared to site A1 (0.36). The values (Mean ± SD) of different air quality parameters (µg/m³) viz. $PM_{2.5}$, PM_{10}, SO_2 and NO_2 were 56.66±2.13, 114.32±5.64, 11.22±0.64 and 29.01±1.90, respectively. Different diversity indices were lower in the site A1 may be due to the combinations of air pollutants or PM_{10} itself when compared to site A2. In future, it is suggested to study avifaunal diversity in dry seasons viz. winter and summer related to the air quality status.***

Keywords: Bird diversity; Air quality; Industrial area; Urban area; Suburban area; Air quality bioindicator

1. Introduction

The study of bird diversity is very important because this indicates air quality of particular area. Several air pollutants viz. particulates and gaseous pollutants have an impact on bird species due to inhalation exposure.[1-2]A recent international study emphasized that decreasing of bird population in USA due to air pollutants especially ozone increasing rate.[3]Beside these, urbanization is also the causative reason for the declining of bird species.[4-5]Abnormal air quality due to industrial and automobile emissions that lead to air pollution. But present regulation of air pollution is based on human health hazards and no standards of pollutants have been proposed for avifauna or other chordates.

High diversity of avifauna indicates a healthy ecosystem and bird species fulfil several ecological functions in their habitats.[5-6] Moreover, insect feeder and raptors regulate disease vectors viz. mosquitoes and rodents. Scavenger birds, especially Pied Crow (*Corvus albus*) an important contributor for recycling of biomass and reducing disposable wastes.[5] Fruit eating birds help in seed dispersal of fleshy fruit.[7]Birds also participate in plant pollination.[8]

Several earlier studies have been reported bird diversity in different parts of West Bengal [9-13] but not related to air quality of urban and/or industrial area compared to suburban area. Chowdhury et al. [4]studied bird diversity related to traffic load near roadside parks without air quality assessment. Some international studies have been reported that air pollution causes the declining of the bird diversity [1-2,14]and it was observed a close relation between bird diversity in two parks of Kolkata and air pollution [15]but the correlation between air quality parameters and bird diversity in Asansol urbanized area near industry, West Bengal is lacking.

The present study was attempted the bird diversity as qualitative and quantitative assessment during monsoon season and corelated with available air quality parameters of Asansol, West Bengal.

2. Materials and Methods

Selection of study area

The study sites were selected as per heavily populated neighbourhoods, nearby residential buildings, nearby roads and continuous vehicular movements and nearby industries designated as site A1(latitude = 23° 40´ N and longitude = 86° 55´ E) and suburban area comparatively lower vehicular movements, far from industrial vicinity designated as site A2(latitude = 23° 67´ N and longitude = 87° 22´ E), Asansol, West Bengal. The study was carried out in these two habitats as per downwind direction for qualitative and quantitative assessment.

Study design

A total500-meter line transects was done randomly weekly twice a day (2hrs. duration in each day) and call count methods in industrial and urban area compared to suburban area for the period of three months (June 2021 – August 2021). The photographs of birds were taken during survey by using camera and was identified with the help of research articles.[16-18] Some unassuming bird species were identified based on their calls.[19]

Air quality data

All the secondary data of ambient air pollutants such as SO_2, NO_2, $PM_{2.5}$ and PM_{10} related to Asansol air quality monitoring station, West Bengal were retrieved from Air Quality Information System of West Bengal Pollution Control Board, Kolkata to know the present status of air quality during monsoon season (June 2021 – August 2021).

Qualitative and quantitative assessment of avifauna

Bird diversity indices such as total specimens (N), Shannon diversity index (H'), Index of Dominance (C), Berger-Parker

Dominance Index, and Margalef's species richness index (S) were calculated.[20-24] The formulae are as follows:

Shannon-Wiener diversity index (H') = - [$\sum$ Pi ln Pi] … (1)

where, Pi is proportion of species i relative to the total number of species, and lnPi is natural logarithm of this proportion.

Index of Dominance (C) = $\sum (ni/N)^2$…… (2)

where, ni = importance value for each species (number of individuals), N = total number of importance value

Berger-Parker Dominance Index= N_{max} / N …… (3)

where, N_{max} is the number of Individuals of a species, and N is total population of birds.

Margalef's species richness = S–1 ÷ ln N …… (4)

where, S = number of species, ln N = natural logarithm of the total number of individuals

The values of different biodiversity indices were calculated by using online tool namely Biodiversity calculator developed by AL Young Studio (https://www.alyoung.com/labs/biodiversity_calculator.html ?rand).

Statistical analysis

The Pearson correlation coefficient was analyzed to determine significant association between different air quality parameters and number of bird species during monsoon. All the data were considered the significance level at $P<0.05$ by using statistical software, PAST (PAleontological STatistics) software (version 3.26) developed by Hammer et al. [25]

3. Results

In the present findings, qualitative and quantitative assessment indicated that the variety of bird species were observed few in numbers in site A compared to site B (Table 1). The comparison revealed bird varieties of about 11 types in site A than varieties of about 20 types in site B. Common species of birds were *Corvus splendens*, *Columba livia*, *Acridotheres tristis*, *Acridotheres ginginianus*, *Spilopelia chinensis*, *Turdoides striata*, *Anas platyrhynchos domesticus*, *Copsychus saularis*, and *Dicrurus adsimilis*observed in both study sites. Moreover, few species were observed only in site B not in site A.

Table 1: List of avifauna in the study sites

Site A1				Site A2			
S. No.	Common Name	Scientific Name	Total No.	Sl. No.	Common Name	Scientific Name	Total No.
1.	House crow	*Corvus splendens*	15	1.	Indian pigeon	*Columba livia*	60
2.	Indian pigeon	*Columba livia*	42	2.	Spotted dove	*Spilopelia chinensis*	18
3.	Common mayna	*Acridotheres tristis*	12	3.	Jungle babbler	*Turdoides striata*	12
4.	Bank mayna	*Acridotheres ginginianus*	4	4.	Common mayna	*Acridotheres tristis*	8
5.	Spotted dove	*Spilopelia chinensis*	2	5.	Asian koel	*Eudynamys scolopaceus*	1
6.	Jungle babbler	*Turdoides striata*	8	6.	Vulture	*Gyps indicus*	2
7.	Indian little black cormorant	*Phalacrocorax* sp.	1	7.	House crow	*Corvus splendens*	25
8.	Domestic duck	*Anas platyrhynchos domesticus*	12	8.	White breasted water hen	*Amaurornis phoenicurus*	7
9.	Oriental magpie robin	*Copsychus saularis*	2	9.	Indian rose ringed parakeet	*Psittaciformes sp.*	12
10.	Cock	*Gallus gallus domesticus*	15	10.	Red vented bulbul	*Pycnonotus cafer*	2
11.	Bronzed drongo	*Dicrurus adsimilis*	5	11.	Red whiskered bulbul	*Pycnonotus jocosus*	1
				12.	Cattle egret	*Bubulcus ibis*	12
				13.	Bank mayna	*Acridotheres ginginianus*	5
				14.	Domestic duck	*Anas platyrhynchos domesticus*	11
				15.	Cock	*Gallus gallus domesticus*	9
				16.	Purple sunbird	*Cinnyris asiaticus*	4
				17.	Bronzed drongo	*Dicrurus adsimilis*	8
				18.	Oriental magpie robin	*Copsychus saularis*	2
				19.	Greater coucal	*Centropus sinensis*	1
				20.	Woodpecker	*Dinopium benghalense*	2

Table 2 evaluates the comparative diversity indices between the site A1 and A2. Higher value of the number of total organisms of about 202 in site A2 when compared to site A1 (118).Different indices such as Shannon diversity index, Index of Dominance, and Margalef's species richness index values were higher in site A2 (2.40, 0.87 and 3.60) when

compared to site A1 (2.00, 0.81 and 2.10) while Berger-Parker Dominance Index value was observed lower in site A2 (0.30) when compared to site A1 (0.36).

Table 2: Diversity indices compared between the site A1 and A2

Indices	Site A1	Site A2
Total No. of species	11	20
Total No. of organisms	118	202
Shannon-Wiener diversity index	2.00	2.40
Index of Dominance	0.81	0.87
Berger-Parker Dominance Index	0.36	0.30
Margalef's species richness	2.10	3.60

Fig 1 describes the values (Mean ± SD) of different air quality parameters in which all the parameters were observed within the national ambient air quality standards except PM_{10}. The value of $PM_{2.5}$, PM_{10}, SO_2 and NO_2 were 56.66 ±2.13 µg/m³, 114.32 ±5.64 µg/m³, 11.22 ±0.64 µg/m³ and 29.01 ±1.90 µg/m³, respectively.

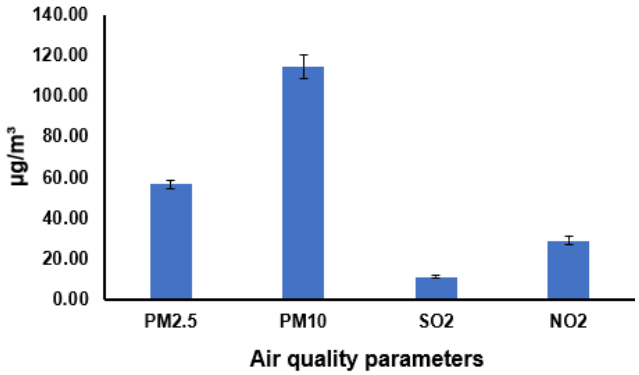

Figure 1: Average value of air quality parameters within the study area (Mean ± SD; n = 27)

Table 3estimates the Pearson correlation coefficient of air quality parameters and bird species availability in the site A1 and A2. In the site A, $PM_{2.5}$and PM_{10} were observed negative correlation (r = -0.024 and r = -0.399) while SO_2 and NO_2 shown positive correlation (r = 0.068 and r = 0.715) with the availability of bird species. In the site B, $PM_{2.5}$,SO_2 and NO_2 were observed negative correlation (r = -0.132, r = -0.234 and r = -0.105) while PM_{10}shown positive correlation (r = 0.103) with the availability of bird species.

Table 3: Correlation coefficient of air quality parameters and bird species availability in the site A1 and A2

Correlation coefficient of	Site A1	Site A2
$PM_{2.5}$ and bird species	r = -0.024	r = -0.132
PM_{10} and bird species	r = -0.399	r = 0.103
SO_2 and bird species	r = 0.068	r = -0.234
NO_2 and bird species	r = 0.715	r = -0.105

4. Discussion

The bird species are highly diverse and easily noticeable in the ecosystem. The diversity of avifauna declines due to environmental stresses especially abnormal air quality.[1-2,4,14-15]

In the present study sites common bird species such as *Corvus splendens*, *Columba livia*, *Acridotheres tristis*, *Acridotheres ginginianus*, *Spilopelia chinensis*, *Turdoides striata*, *Anas platyrhynchos domesticus*, *Copsychus saularis*, and *Dicrurus adsimilis*observed in both study sites. Moreover, few more species such as *Eudynamys scolopaceus*, *Gyps indicus*, *Amaurornis phoenicurus*, *Psittaciformes sp.*, *Pycnonotus cafer*, *Pycnonotus jocosus*, *Bubulcus ibis*, *Cinnyris asiaticus*, *Centropus sinensis*, and *Dinopium benghalense* were recorded only in site B but in site A, one specimen of *Phalacrocorax* sp. was recorded. In the recent study, the variation of bird species due to air pollution has been found in the parks of Kolkata metropolitan area.[15]

Different diversity indices were higher in the site A2due to less exposure of air pollutants compared to site A1 nearer to industrial vicinity and highly human interference as urbanized area. Moreover, all the air pollutants within the national ambient air quality standards except PM_{10}. These pollutants may be safe for human but unsafe for bird's growth, metabolic activity, respiratory rate, etc. for declining diversity in site A1. On the other hand, the diversity wasfound a decreasing trend may be due to elevated average level of PM_{10}, which has evidenced in the previous studies that particulates and other air pollutants decreased the diversity of avifauna.[2-3,14-15]

The negative value of the correlation coefficient, the r value indicates an increasing level of one parameter and decreasing in the other parameter. In the present study, there is a possibly of induction of air pollutants in site A1, which decreased the bird diversity as per decreased values of diversity indices, which is supported by earlier studies.[15,26] The relation between two variables could be established by correlation coefficient in which the parameters of air pollution and biodiversity of birds are interdependent and inversely related to each other.[15,27]

5. Conclusion

The present study was conducted in the monsoon season to know the bird diversity related to air quality parameters in the industrial vicinity and urbanized area (site A) compared to suburban area far away from industries(site B) at Asansol, West Bengal. Different diversity indices were lower in the site A may be due to the combinations of air pollutants or PM_{10} itself when compared to site A. In future, it is suggested to study avifaunal diversity in dry seasons viz. winter and summer related to the air quality status.

Conflict of interest
None

References

[1] Brown RE, Brain JD, Wang N.The avian respiratory system: a unique model for studies of respiratory toxicosis and for monitoring air quality.Environ Health Perspect. 1997;105:188-200.
[2] Sanderfoot OV, Holloway T.Air pollution impacts on avian species via inhalation exposure and associated outcomes.Environ Res Lett. 2017;12:083002.

[3] Liang Y, Rudika I, Zou EY, Johnston A, Amanda D. Rodewald AD, et al. Conservation cobenefits from air pollution regulation: Evidence from birds. Proceedings of the National Academy of Sciences USA. 2020;117(49):30900-6.
[4] Chowdhury R., Sarkar S, Nandy A, Talapatra SN. Assessment of bird diversity as bioindicators in two parks, Kolkata, India. International Letters of Natural Sciences. 2014;16:131-9.
[5] Gatesire T, Nsabimana D, Nyiramana A, Seburanga JL, MirvilleMO.Bird diversity and distribution in relation to urban landscape types in Northern Rwanda.New Scientific World Journal. 2014;2014:157824.
[6] Stevenson T, Fanshawe J. Field Guide to the Birds of East Africa: Kenya, Tanzania, Uganda, Rwanda, Burundi. 1st edition,T&AD Poyser,London,UK,2002.
[7] Judd WS,CampbellCS, KelloggEA, StevensPF, Donoghue MJ. PlantSystematics:Aphylogeneticapproach,Sinauer Associates,Sunderland,Mass,USA,3rdedition,2008.
[8] Singha Roy U, Purbasha Banerjee P, Mukhopadhyay SK.Study on avifaunal diversity from three different regions of North Bengal, India. Asian Journal of Conservation Biology.2012; 1(2):120-9.
[9] Das P, Aditya Bandyopadhyay S. A preliminary assessment of avifaunal diversity in and around Sarojini Naidu College campus, Kolkata, West Bengal, India. International Journal of Fauna and Biological Studies.2016;3(2):56-61.
[10] Mukhopadhyay S, Mazumdar S. Composition, diversity and foraging guilds of avifauna in a suburban area of southern West Bengal, India. The Ring.2017;39:103-20.
[11] Debnath S, Biswas S, Panigrahi AK. Present status and diversity of avian fauna in Purbasthali bird sanctuary, West Bengal, India.Agric Sci Digest. 2018;38(2):95-102.
[12] Chowdhury S. Migratory wetland birds diversity in lower Chota Nagpur plateau with special reference to Purulia district, West Bengal, India. Int J Adv Res.2020;8(10):357-67.
[13] Li Z, Courchamp F, Blumstein DT. Pigeons home faster through polluted air. Sci Rep.2016;6:1-6.
[14] Roy Bhowmick S. Biodiversity assessment of bird species as bioindicators and the impact of air pollution on the ecological community. International Journal of Pure and Applied Zoology. 2021;9(2):18-25.
[15] Ali S, Ripley SD. Handbook of the Birds of India and Pakistan. Oxford University Press. New Delhi, 1987.
[16] Inskipp T, Lindsey N, Duckworth W. An annotated checklist of the birds of the Oriental region. Sandy, Bedfordshire, United Kingdom: Oriental Bird Club, 1996.
[17] Grimmett R, Inskipp C, Inskipp T. Pocket guide to the birds of the Indian subcontinent. Oxford University Press, New Delhi, India, 1999.
[18] Aynalem S, Bekele A. Species composition, relative abundance and distribution of bird fauna of riverine and wetland habitats of Infranz and Yiganda at Southern tip of Lake Tana, Ethiopia.Trop Ecol. 2008;49:199-209.
[19] Shannon CE, Weiner W. The Mathematical Theory of Communication. Urbana, IL: University of Illinois Press, Urbana, 1949; 117 p.
[20] Pielou EC. The Measurement of Diversity in Different Types of Biological Collections.J Theore Biol. 1966;3:131-44.
[21] Margalef, R. Perspectives in Ecological Theory. Chicago II. University of Chicago Press, Chicago, 1968; 111 p.
[22] Berger WH, & Parker FL. Diversity of planktonic foraminifera in deep-sea sediments. Science. 1970;168(3937):1345-7.
[23] Stiling P. Ecology: Theories and Applications (3rd ed), Upper Saddle River, NJ: Prentice-Hall, Inc, 1999.
[24] Hammer Ø, Harper DAT, Ryan PD.PAST: Paleontological statistics software package for education and data analysis Palaeontologia Electronica. 2001;4(1):9.
[25] Marzluff, J M. Worldwide urbanization and its effects on birds. In: Marzluff JM, Bowman R, Donnelly R. (eds) Avian Ecology and Conservation in an Urbanizing World. Springer, Boston, MA, 2001; pp. 19-47.
[26] Tanveer A, Shahzad M, Chaudhry AA. Avian fauna of Punjab University, Lahore. Pak J Zool. 2002;17:35-51.