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Study On AQI In Relation To Biodiversity Of Birds Of Moradabad City Of Western Uttar Pradesh, India

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***Abstract**:*
Birds are a unique creature that belongs to class Aves. They are found all over the world and almost in all types of habitats. Their uniqueness in colour, shape, and size and their call differentiates them from other animals. Many birds are known for their social behaviour and others for regular visitors in an area during migration from remote corners. Hey also has important ecological roles like pollination, dispersion, prey and predation in the food chain. Studying birds of an area provides insights into their biodiversity, migratory behaviour and factors related to their feeding, nesting and breeding. Quality of Air in an area is a prime requisite for resident and migratory birds, affecting all their life processes. AQI and its relationship with biodiversity provide insight into the role and status of particular fauna of a particular habitat. Month-wise AQI data for the study areas were analysed, revealing a negative correlation between AQI and avian diversity indices. Specifically, the correlation coefficients between AQI and Simpson's Diversity came out to be -0.3159, which indicates that avian diversity decreases with increasing AQI.

***Keywords:** Avian diversity, Air quality index, Air pollution, Bio-conservation.*

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I. Introduction

Birds, belonging to the class Aves, are a fascinating group of creatures that inhabit diverse habitats worldwide. Their striking variations in colour, shape, size, and vocalizations set them apart from other animals. Many bird species exhibit complex social behaviours, while others are notable for their migratory patterns, visiting specific areas from distant regions. Birds also play vital ecological roles, including pollination, seed dispersal, predation, and serving as prey in food chains.

By studying the avifauna of a region, researchers can gain valuable insights into local biodiversity, migratory patterns, and factors influencing feeding, nesting, and breeding behaviours. Biodiversity is the varied kinds of lifeforms in an area which includes a variety of animals, plants, fungi and microorganisms. Each of these species are interrelated and make up the structural and functional diversity of an ecosystem.

According to ZSI the global Avian Population comprises about approx. 11000 species that are grouped into 36 orders and 247 families. According to ZSI a total of 1358 Species of birds are found in India under 26 orders and 114 families (gopinath1). Bird species respond rapidly to any changes in the environment. They act as bio indicators of their habitat in terms of pollution disease outbreak and other climatic changes, (*Johnson, T.F. et al, 2024*).

Air, Water and Land pollution affects all forms of life including avian fauna. The quality of forage also affects the avian population which is also dependent on the ecosystem where they live. AQI is the Index of the Quality Of Air of an area in terms of major air pollutants like NOx, SOx, CO, Particulate matters etc. These pollutants affect avian population in terms of their physiological stress, bio accumulation of pollutants, Reproductive cycles and mortality also. During Covid period, it was observed that avian population got a chance to freely live in their niche (*Gupta S, 2020*).

Any changes in their atmosphere leads to affect the avian biodiversity and hence to their food chain, food web and overall ecosystem. This paper presents observation and correlation of AQI of Moradabad city of the period of 2023-2024 and biodiversity of avian fauna with the aim of conservation of Avian fauna in urban habitat .

The district of Moradabad lies between 28 °21' to 28 °16' North Latitudes and 78 °4' to 79 ° East Longitude. This district of western Uttar Pradesh occupies a geographical area of 3493 sq. km. and is home to a population of 27, 61,620 (Fig-1).

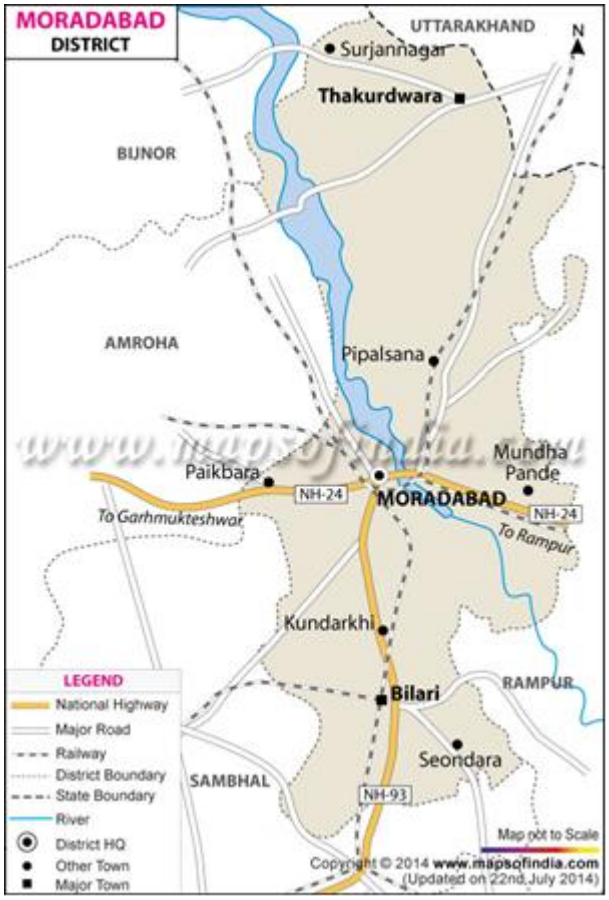

Figure:1-Map of Moradabad City, Uttar Pradesh, India

II. Material And Methods

The AQI data of Moradabad city was recorded monthly from 2023-2024 with the help of the Central Pollution Control Board. Different parameters like SO2, No2, Co, Particulate matters were taken into consideration. The biodiversity of avian fauna of the above said period was also monitored of the Moradabad city (Gupta S. 2025). The field surveys were conducted between 5.30-7.00 AM in summers and 6.30-8.00 AM in winters. Birds were photographed by using DSLR camera and were identified using standard reference books (*Grimmett, R. et. al,, 1998* & *Ali, S 1968*), various apps)

Standard biodiversity indices were applied to calculate the species diversity (*Simpson, E., 1949*). The diversity indices were calculated using software tools of omni. Simpson Index, Simpson Diversity index and Reciprocal Index were calculated and data was recorded. Air Quality Index (AQI) data were collected from the Central Pollution Control Board (CPCB), Moradabad, UP official website monthly during the study period from 2023-2024 (Table-1). The correlation between AQI and diversity indices was statistically analysed using Pearson's correlation coefficient and figures were generated using Microsoft Excel.

III. Results And Discussion

Air pollution has a ubiquitous impact on ecosystems which hampers the acidification and eutrophication of soil and water, deposition of heavy metals and direct (and indirect) effects on flora and fauna.

Sr No	Month	Average AQI
1	April-23	121
2	May-23	120
3	June-23	114
4	July-23	101
5	August-23	99
6	September-23	93
7	October-23	128
8	November-23	153
9	December-23	157
10	January-24	177
11	Februry-24	133

12	March-24	114

Table:1- Average AQI of Moradabad City, Uttar Pradesh, (2023-2024)

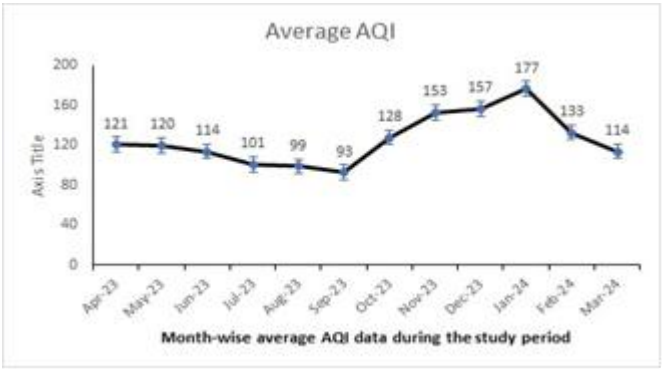

Fig:2-Graph showing Month-wise average AQI data during the study period from 2023-2024

Sr. No.	Common Name	Scientific Name	Order	Family	IUCN Conservation Status
1.	Black-winged kite	*Elanus caeruleus*	Accipitriformes	Accipitridae	Least Concern
2.	Common Shikra	*Accipiter badius*	Accipitriformes	Accipitridae	Least Concern
3.	Black Kite	*Milvus migrans*	Accipitriformes	Accipitridae	Least Concern
4.	White-throated Kingfisher	*Halcyon smyrnensis*	Coraciiformes	Alcedinidae	Least Concern
5.	Little Egret	*Egretta garzetta*	Pelecaniformes	Ardeidae	Least Concern
6.	Cattle Egret	*Bubulcus ibis*	Pelecaniformes	Ardeidae	Least Concern
7.	Indian Grey Hornbill	*Ocyceros birostris*	Bucerotiformes	Bucerotidae	Least Concern
8.	Red-wattled Lapwing	*Vanellus indicus*	Charadriiformes	Charadriidae	Least Concern
9.	Greater Coucal	*Centropus sinensis*	Cuculiformes	Cuculidae	Least Concern
10.	Ashy Prinia	*Prinia socialis*	Passeriformes	Cisticolidae	Least Concern
11.	Rock Pigeon	*Columba livia*	Columbiformes	Columbidae	Least Concern
12.	Spotted Dove	*Spilopelia chinensis*	Columbiformes	Columbidae	Least Concern
13.	Eurasian Collared Dove	*Streptopelia decaocto*	Columbiformes	Columbidae	Least Concern
14.	Laughing Dove	*Spilopelia senegalensis*	Columbiformes	Columbidae	Least Concern
15.	House Crow	*Corvus splendens*	Passeriformes	Corvidae	Least Concern
16.	Large-billed Crow	*Corvus macrorhynchos*	Passeriformes	Corvidae	Least Concern
17.	Rufous Treepie	*Dendrocitta vagabunda*	Passeriformes	Corvidae	Least Concern
18.	Asian Koel	*Eudynamys scolopacea*	Cuculiformes	Cuculidae	Least Concern
19.	Black Drongo	*Dicrurus macrocercus*	Passeriformes	Dicruridae	Least Concern
20.	Indian Silverbill	*Euodice malabarica*	Passeriformes	Estrildidae	Least Concern
21.	Brown-headed Barbet	*Psilopogon zeylanicus*	Piciformes	Megalaimidae	Least Concern
22.	Asian Green Bee-eater	*Merops orientalis*	Coraciiformes	Meropidae	Least Concern
23.	Brown Rock Chat	*Oenanthe fusca*	Passeriformes	Muscicapidae	Least Concern
24.	Oriental Magpie Robin	*Copsychus saularis*	Passeriformes	Muscicapidae	Least Concern
25.	Purple Sunbird	*Cinnyris asiaticus*	Passeriformes	Nectariniidae	Least Concern
26.	Red-whiskered Bulbul	*Pycnonotus jocosus*	Passeriformes	Pycnonotidae	Least Concern
27.	Red-vented Bulbul	*Pycnonotus cafer*	Passeriformes	Pycnonotidae	Least Concern
28.	White-breasted Waterhen	*Amaurornis phoenicurus*	Gruiformes	Rallidae	Least Concern
29.	Asian Pied Starling	*Gracupica contra*	Passeriformes	Sturnidae	Least Concern
30.	Wire-tailed Swallow	*Hirundo smithii*	Passeriformes	Hirundinidae	Least Concern
31.	Jungle Babbler	*Argya striata*	Passeriformes	Leiothrichidae	Least Concern
32.	Large Grey Babbler	*Argya malcolmi*	Passeriformes	Leiothrichidae	Least Concern
33.	Blue-tailed Bee-eater	*Merops philippinus*	Coraciiformes	Meropidae	Least Concern
34.	Pied Wagtail	*Motacilla alba*	Passeriformes	Motacillidae	Least Concern
35.	Tawny Pipit	*Anthus campestris*	Passeriformes	Motacillidae	Least Concern
36.	Taiga Flycatcher	*Ficedula albicilla*	Passeriformes	Muscicapidae	Least Concern
37.	Purple-rumped Sunbird	*Leptocoma zeylonica*	Passeriformes	Nectariniidae	Least Concern
38.	House Sparrow	*Passer domesticus*	Passeriformes	Passeridae	Least Concern
39.	Little Cormorant	*Microcarbo niger*	Suliformes	Phalacrocoracidae	Least Concern
40.	Ring-necked Parakeet	*Psittacula krameri*	Psittaciformes	Psittacidae	Least Concern
41.	Black-winged Stilt	*Himantopus himantopus*	Charadriiformes	Recurvirostridae	Least Concern

42.	Common Sandpiper	*Actitis hypoleucos*	Charadriiformes	Scolopacidae	Least Concern
43.	Bank Myna	*Acridotheres ginginianus*	Passeriformes	Sturnidae	Least Concern
44.	Eurasian Hoopoe	*Upupa epops*	Bucerotiformes	Upupidae	Least Concern
45.	Indian White-eye	*Zosterops palpebrosus*	Passeriformes	Zosteropidae	Least Concern
46.	White-browed Wagtail	*Motacilla maderaspatensis*	Passeriformes	Motacillidae	Least Concern

Table:2- List of Bird Species of different orders and families during the study period 2023-24

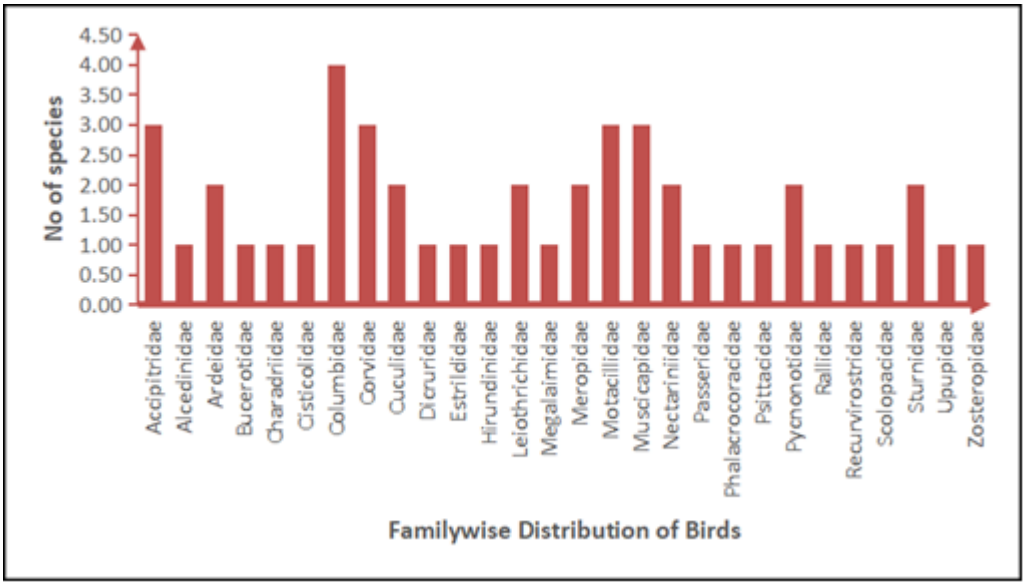

Fig:3- Graph Showing Family-Wise Distribution Of Bird's Species Of Moradabad City Of Uttar Pradesh During Study Period

The impact of fluctuating air quality on avian faunal diversity was investigated throughout the study period from 15.04.2023 to 30.03.2024. Month-wise AQI data for the study areas were analysed (Table-2/Fig-3) revealing a negative correlation between AQI and avian diversity indices. Specifically, the correlation coefficients between AQI and Simpson's Diversity came out to be -0.3159 (Table:2), which indicates that avian diversity decreases with increasing AQI.

Correlation Coefficient value of Average AQI with	r
Simpson Index of Diversity	-0.3159

Table :3- Correlation between AQI with diversity indices during the study period

From the perusal of the graph, it was found that Maximum AQI was found in January 2024 and lowest in September 2023. Notably, the negative correlation coefficients indicate that species diversity declines with increasing AQI levels. In 2023 there was -8 percent fall in AQI and 2024 there was 14 percent rise was recorded. Lowest AQI Of 66 was recorded on 1st May, 2023. Currently, Moradabad is ranking 2115 among the cities with high pollution level in the world (CPCB)

The results of our study, which examined the relationship between pollution levels and bird populations, were consistent with the findings of Tiwari *et al*. (2022) . Their research observed that areas with minimal pollution levels supported a diverse and abundant bird population, whereas sites with high pollution levels had significantly lower bird diversity.

This correlation can be attributed to the fact that many bird species tend to avoid areas with high pollution concentrations, likely due to the adverse effects of pollutants on their survival and reproductive success.

However, our study also revealed an interesting exception. We found that birds belonging to the 'Sturnidae' (starlings) and 'Columbidae' (pigeons and doves) families were surprisingly abundant in polluted sites. This suggests that these bird species have developed adaptations that enable them to thrive in environments with high pollution levels. This finding has important implications for our understanding of the complex relationships between birds, pollution, and urban ecosystems.

Population growth, urbanization, increasing needs, and rapid energy consumption growth are the primary drivers of air pollution in large cities like Moradabad. The consequences of pollution have led to poor

urban air quality in Moradabad. Air pollution in the city can be attributed to various factors, including emissions from transportation, industrial and domestic activities, re-suspension of road dust, construction activities, and the burning of biomass, crop residues, municipal solid waste, garbage, and unapproved fuel. Air pollution affects not only human beings but whole biodiversity and their ecosystem globally. Structure and function alteration of any ecosystem leads to changes in biodiversity statistics, (SR Bhowmick, 2021). Avian species are also affected by air pollution making them even vulnerable to extinction. Birds are more prone to air pollutants as compared to mammalian species, (Olivia V *et al*, ., 2017).

Physiologically, the rate of breathing in birds is higher than humans. Air pollutants affect the lungs of birds as of humans. As per literature surveyed Long-term exposure can lead to inflammation, lung failure, and ruptured blood vessels. Birds can experience respiratory distress, increased stress, immunosuppression, and behavioural changes. Exposure to poly cyclic aromatic hydrocarbons (PAHs), which are toxic chemicals emitted by traffic, can cause reduced egg production and hatching, and DNA mutations. Air pollution can reduce population density, species diversity, and species richness in bird communities, (Madeleine G, *et al*, 2023). Bidri Deepika *et al*, 2023. reported that experimental analysis of pollutants in relation to poultry depicted that AQI OF 150 - 200 causes respiratory or cardiac issues in birds. Area with AQI of 100 & above depicted flock for signs of respiratory distress and dust irritation. Signs of Open mouth breathing, darkening of comb, Gasping, Coughing, increased respiratory rate, Tail bobbing, Lethargy, Weakness, Loss of appetite and thirst, Eye irritation and nasal discharge were closely monitored on AQI above 200.

Furthermore, to reduce the impact of pollution Indian Government along with the Central Pollution Control Board has issued directions under Section 18 (1) (b) of the Air (Prevention & Control of Pollution) Act, 1981, regarding the prevention, control, or abatement of air pollution in various cities of Uttar Pradesh, including Moradabad. A lot of practices are in place to reduce pollution by the government agencies, NGO, Localities.

It is also envisaged that attention should be paid upon bio-conservation of avian fauna rather than destruction of their habitats and more and more green spaces should be built and protected in urban planning framework of which these avian species are also a major part.

IV. Conclusion

The study reveals a significant negative correlation between Air Quality Index (AQI) levels and bird species diversity in Moradabad. The results indicate that as AQI levels increase, bird species diversity declines. This finding is consistent with previous research (Tiwari et al., 2022), which observed a similar relationship between pollution levels and bird populations.

The data also highlights the fluctuating AQI levels in Moradabad, with a notable 8% decrease in 2023 and a 14% increase in 2024. The city's current ranking of 2115 among the most polluted cities worldwide (CPCB) underscores the need for urgent attention to address air pollution concerns.

The study's findings have important implications for conservation efforts and urban planning. To mitigate the negative impacts of air pollution on bird populations, it is essential to:

1. Implement effective air pollution control measures.
2. Promote sustainable urban planning and green infrastructure.
3. Enhance public awareness about the importance of air quality and its impact on biodiversity.

By addressing these concerns, we can work towards creating a healthier environment for both humans and birds, and preserving the rich biodiversity of Moradabad.

V. Future Scope Of Study

- Investigating Specific Pollutants: Future studies could focus on investigating the impact of specific pollutants, such as particulate matter (PM), nitrogen dioxide (NO_2), and ozone (O_3), on bird populations.
- Developing Conservation Strategies: Research could explore developing conservation strategies to mitigate the impact of air pollution on bird populations, such as creating bird-friendly habitats and reducing pollution sources.
- Monitoring and Assessment: Continuous monitoring and assessment of AQI and bird populations could provide valuable insights into the effectiveness of conservation strategies and inform policy decisions.
- Community Engagement and Education: Engaging with local communities and educating them about the importance of air quality and bird conservation could promote collective action to mitigate the impact of air pollution on bird populations.

Conflict Of Intrest

Nil

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