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Avian Diversity Evaluation of Bilawali Lake Through Walking Transect Survey

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Abstract

A systematic avifaunal assessment was conducted at Bilawali Lake on January 3, 2026, using the walking transect method to document bird diversity and abundance. Approximately 1.58 miles were surveyed over a duration of 3 h 12 min with the aid of binoculars and digital photography for precise species identification. A total of 67 bird species representing multiple taxonomic families were recorded, indicating the substantial ecological richness of the lake ecosystem. The rose-ringed parakeet (Psittacula krameri) emerged as the most dominant species, with 377 individuals observed. Both resident and migratory bird species were documented, highlighting the seasonal importance of Bilawali Lake as an urban wetland habitat. The Shannon diversity index (H′ = 3.23) revealed high species heterogeneity, reflecting favorable environmental conditions. These findings emphasize the ecological significance of Bilawali Lake and recommend conservation-oriented management strategies.

Keywords: Avian diversity, Urban lake ecosystem, Walking transect method, Species richness, Shannon diversity index, and Bilawali Lake.

1.INTRODUCTION

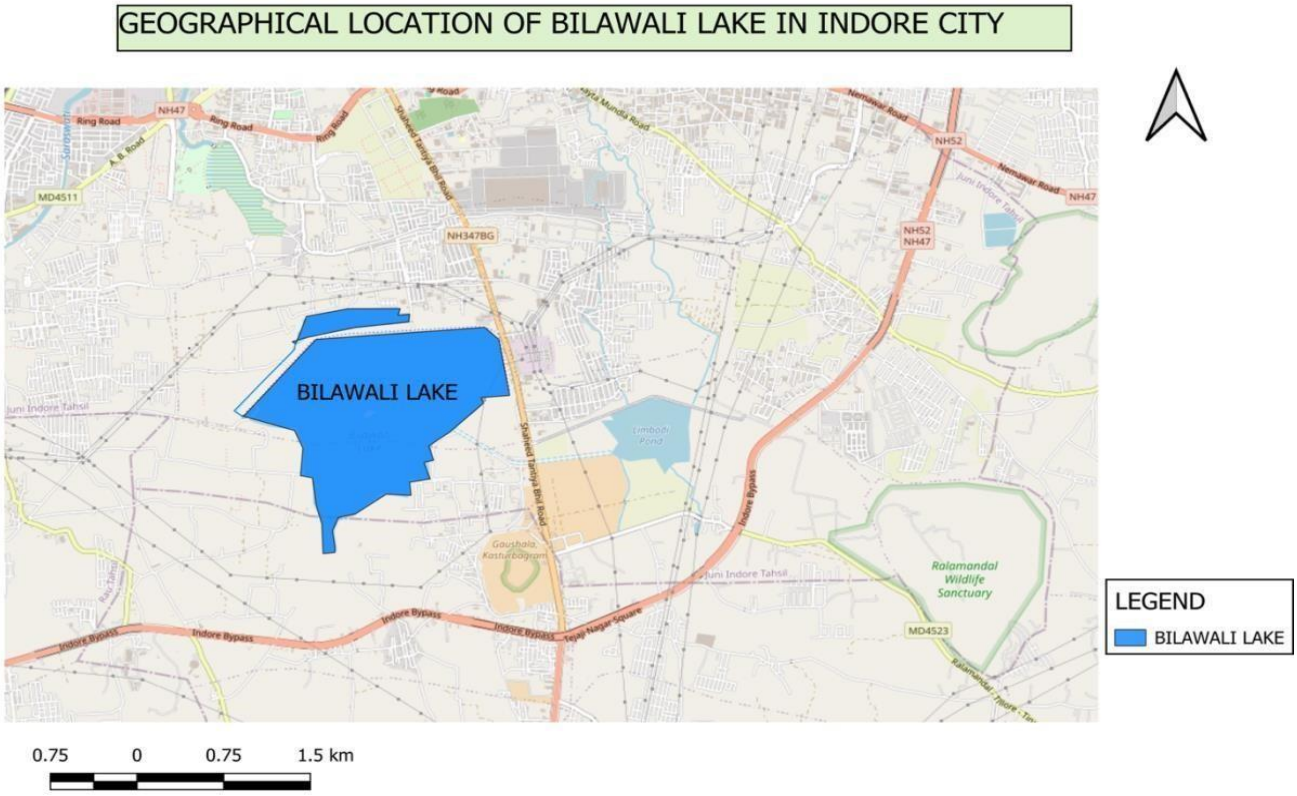
Wetlands are ecologically significant ecosystems that support a wide range of plant and animal life. Birds, in particular, are considered reliable indicators of environmental health because changes in their diversity and abundance often reflect alterations in habitat conditions. Therefore, assessing avian diversity is an important step in understanding the ecological status of any wetland area.

Bilawali Lake, located in Indore, serves as an important urban wetland that provides feeding, nesting, and resting grounds for several resident and migratory bird species. Rapid urban expansion and increasing human activities around the lake may influence its biodiversity, making systematic ecological assessment necessary.

The Walking Transect Survey method is a practical field technique used to record bird species along a fixed route within a defined area. It helps in estimating species richness and relative abundance efficiently. The present study focuses on evaluating the avian diversity of Bilawali Lake through this method to understand its ecological importance and to provide baseline information for conservation planning.

2. STUDY AREA -

The present study was conducted at Bilawali Lake, an important urban wetland situated in the southern part of Indore. The lake is geographically located at approximately 22.65° North latitude and 75.78° East longitude. It lies at an average elevation of about 550 meters above



sea level. Bilawali Lake is surrounded by semi-urban and developing residential areas, along with patches of open land and vegetation. The region experiences a tropical climate characterized by hot summers, moderate monsoon rainfall, and mild winters. The average annual rainfall of the area is mainly received during the southwest monsoon season (June to September).

The lake provides suitable habitat conditions such as open water surface, marginal vegetation, shallow zones, and feeding grounds, which attract a variety of resident and migratory bird species. However, increasing urban expansion and human activities around the lake may influence its ecological stability. Due to its ecological importance and accessibility for field surveys, Bilawali Lake was selected as the study area for evaluating avian diversity through the Walking Transect Survey method.

3. METHODOLOGY

(A) Research Design

The study is based on a field-oriented ecological survey aimed at assessing bird diversity at Bilawali Lake. A quantitative approach was adopted to record species richness and abundance using standard biodiversity indices.

(B) Survey Method: Walking Transect Method-

- Predetermined transect lines were selected along the periphery of the lake.
- Each transect was approximately 1.58 miles in length.
- Observations were made by walking slowly along the transect at a constant pace.
- Birds seen or heard within a fixed width (e.g., 20–30 meters on both sides) were recorded.
- Surveys were conducted during early morning hours (6:00–9:00 AM), when bird activity is maximum.

(C) Data Collection-

For each species, the following data were recorded:

- Species name
- Number of individuals (ni)
- Habitat type (open water / vegetation / shoreline) • Residential status (resident / migratory) **Field tools used:**
- Binoculars
- Field notebook / data sheet
- Camera
- GPS device for location marking

(D) Ecological Indices Used -

The collected data were analyzed using the following indices:

(a) Species Richness (S)

Total number of species recorded.

(b) Shannon–Wiener Diversity Index (H′)

Recorded species were categorized into resident and migratory groups based on regional ornithological literature. Biodiversity was quantified using the Shannon–Wiener Diversity Index:

$$H' = \sum(p_i \ln p_i)$$

Where,

H′ = Shannon diversity index

p_i = proportion of individuals of the i^{th} species

$p_i = n_i / N$

n_i = number of individuals of a particular species

N = total number of individuals of all species

ln = natural logarithm

H'< 1 Very low species diversity

H'= 1 – 2 Low diversity

H' = 2 – 3 Moderate diversity

H'> 3 High diversity

(c) Simpson's Diversity Index

Simpson's Diversity Index is commonly used in ecological studies to measure species diversity and dominance within a community. The value of the index generally ranges between 0 and 1.

$D = \Sigma\, n(n-1) / N(N-1)$

Value (1–D)	Interpretation
0 – 0.25	Very low diversity
0.25 – 0.50	Low diversity
0.50 – 0.75	Moderate diversity
0.75 – 1.00	High diversity

(d) Evenness Index (J)

The Evenness Index measures how evenly individuals are distributed among species. A higher value indicates equal distribution, while a lower value shows dominance by a few species.

$J = H' / \ln S$

Where:

J = Evenness Index

H′ = Shannon–Wiener Diversity Index

S = Total number of species

ln = Natural logarithm

The value of Evenness ranges from 0 to 1.

$E \approx 1$ (high evenness)

$E \approx 0$ (low evenness)

4. ANALYSIS

(A) Species Richness

A total of 67 bird species (S = 67) were recorded during the field survey.

(B) Shannon–Wiener Diversity Index (H′)

The Shannon–Wiener Index was used to assess species diversity by incorporating both species richness and relative abundance.

$$H' = \sum(p_i \ln p_i)$$

Based on the calculated values, the Shannon diversity index was found to be:

H'=3.23

(C) Simpson's Diversity Index

Simpson's index was applied to measure species dominance within the community.

$$D = \Sigma\, n(n-1) / N(N-1)$$

The calculated value of dominance (D) is approximately:

D = 0.066

Simpson's diversity value is expressed as:

1 - D = 0.934

(D) Evenness (J)

Species evenness was calculated to understand how uniformly individuals are distributed across the recorded species.

J = H' / ln(S)

J = Evenness
H' = Shannon Diversity Index = 3.23
S = Total species = 67

J = 0.77

5. RESULTS AND DESCRIPTION

(A) Key Findings-

- Species richness: 67 species
- Total individuals recorded: 377
- Shannon-Wiener Diversity Index(H'): 3.23
- Simpson's Diversity Index(1–D): 0.934
- Evenness Index (J): 0.77

(B) Description-

i. **Species Richness -** During the field survey at Bilawali Lake, a total of 67 bird species were identified. This number reflects the presence of a diverse avian community within the study area.

ii. **Total Individuals -** The observations recorded 377 individual birds belonging to different species. This indicates that the lake environment supports a considerable bird population.

iii. **Shannon–Wiener Diversity Index (H' = 3.23) -** The calculated Shannon diversity value shows that the study area has high bird diversity. The value suggests that many species occur in the habitat with a reasonably balanced number of individuals.

iv. **Simpson's Diversity Index (1–D = 0.934) -** The Simpson diversity result is very close to 1, which indicates a high level of species diversity. It means that individuals observed in the survey are likely to belong to different species rather than being dominated by a single species.

v. **Evenness (J = 0.77) -** The evenness value shows that individuals are relatively well distributed among the recorded species. However, some species were observed more frequently than others.

6. DISCUSSION AND FUTURE PROSPECTS

The considerable species richness observed within a limited survey duration reflects the availability of diverse ecological niches within Bilawali Lake. The presence of migratory waders and passerines highlights its importance along regional migratory routes. Dominance of urban-adapted species suggests accessibility to anthropogenic food resources, whereas occurrence of sensitive wetland birds indicates relatively stable habitat conditions.
Urban expansion, pollution, and habitat modification may pose future threats to the lake ecosystem. Therefore, continuous ecological monitoring is essential for sustainable biodiversity management.

The findings of this study provide useful baseline information about the avian diversity of Bilawali Lake. Future research can focus on long-term monitoring of bird populations to understand seasonal variations and migration patterns. Detailed studies on habitat characteristics, vegetation, and water quality may help in understanding the factors influencing bird diversity in the area.
Further studies may also explore the impact of human activities, urban development, and environmental changes on bird populations. Conservation measures and proper management of the lake ecosystem will be important to maintain and protect its biodiversity. Promoting awareness and encouraging sustainable practices around the lake may help in preserving the habitat for birds in the future.

7. CONCLUSION

Bilawali Lake supports a rich assemblage of avifauna and functions as an important urban freshwater ecosystem. The study provides baseline information for long-term ecological assessment and emphasizes the need for habitat protection. Conservation measures and community participation are vital to maintaining biodiversity and ecosystem services.The findings also indicate potential suitability of Bilawali Lake for recognition under wetland conservation frameworks such as Local Urban Biodiversity Park and Community Reserve.

8. RECOMMENDATIONS

- Regular bird monitoring programs
- Habitat restoration and shoreline vegetation management
- Control of pollution and solid waste dumping
- Public awareness initiatives
- Integration of Bilawali Lake into urban biodiversity planning

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