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Avian Ecology And Conservation Challenges In Keoladeo Bird Sanctuary, Bharatpur, Rajasthan, India

Divyanshu[1*], Jay Kumar Jay[2], Chahat Kumari[3]

[1,2,3]University Department of Zoology, T. M. Bhagalpur University, Bhagalpur, Bihar, India*

***Corresponding Author**: Mr. Divyanshu*
**University Department of Zoology, T. M. Bhagalpur University, Bhagalpur, Bihar, India-812007*
Email address: scholardivyanshu@gmail.com

Abstract

Keoladeo National Park, a UNESCO World Heritage Site located in Bharatpur, Rajasthan, India is long known for its rich avian biodiversity, including globally threatened and migratory bird species. The present study investigates the avian diversity and conservation challenges through multiple field surveys conducted during November and December 2024. A total of 3488 individuals representing 73 species across 34 families were recorded using the point-count method. Remarkably, 2176 individuals from eight globally threatened and near-threatened species were observed including two endangered species (*Aquila nipalensis* and *Neophron percnopterus*), two vulnerable species (*Clanga hastata* and *Ciconia episcopus*) and four near-threatened species. Diversity analysis revealed a Richness Index of 8.83, indicating high species richness, while Simpson's Index (0.62) and Shannon's Index (1.89) suggest moderate species diversity. Ciconiidae appeared to be the most dominant family, accounting for 62.1% of the total avian population, with *Mycteria leucocephala* being the most abundant species. Furthermore, a decline in migratory bird populations was observed compared to previous years and Eurasian spoonbills (*Platalea leucorodia*) were found nesting outside the boundaries of park suggesting a shift in breeding habitats potentially due to habitat degradation. The study highlights habitat loss, fragmentation, water scarcity and human interference are significant threats to avian diversity. These findings also suggest an urgent need for conservation strategies including sustainable habitat management and regular ecological monitoring to preserve wildlife biodiversity.

Keywords: Diversity, Richness, Migration, Habitat, Birds, Wildlife

1. INTRODUCTION

Biological diversity refers to the range of ecological resources that are present in an area as well as the existence of a wide range of organisms (Shekhawat and Bhatnagar, 2014). Accessibility to open fields (Wuczynski et al. 2011, Zuria and Gates 2012, Morelli 2013) and forest boundaries (Batary et al. 2014), habitat fragmentation (Bhatt and Joshi 2011), habitat quality (Caprio et al. 2011), changes in the landscape (Wretenberg et al. 2010, Fischer et al. 2011, Morelli 2013), vegetation types (Kissling et al. 2010), and climate (Wuczynski et al. 2011, Zuria and Gates 2012, Morelli 2013) are all factors contributing to bird diversity and richness.

In many regions of the world, anthropogenic activities have led to extensive habitat degradation, fragmentation, and destruction. A thorough assessment of the consequences of such actions on the ecosystem is essential due to the detrimental effects on bird diversity (Wiens 1995, O'Connell et al. 2000, Chettri et al. 2001, McLaughlin 2011, Bregman et al. 2014).

In Bharatpur, Rajasthan (India) resides the internationally recognized bird habitat known as Keoladeo National Park (KNP). This UNESCO World Heritage Site, which covers an area of around 29 square kilometres, is a paradise for nature lovers, bird watchers and ornithologists. More than 370 bird species can be found there, including endangered and uncommon species like the Siberian crane. In 1981, India become a member of the Ramsar Convention and two wetlands viz., Keoladeo National Park and Lake Chilika were declared as Ramsar sites. The existence of near-threatened and endangered species in wetlands highlights the necessity of efficient conservation strategies to guarantee the preservation and longevity of the sanctuary's diverse birdlife (Divyanshu and Kumari 2025).

Therefore, the present study aimed to answer the following questions: (1) What are the different types of avian species present in the National Park; (2) What are the status of endangered and rare bird species; and (3) What are present-day threats to bird conservation?

2. MATERIALS AND METHODS

2.1 Study area

KNP lies between latitudes 27° 07' 06'' N and 27° 12' 02'' N and longitudes 77° 29' 05'' E and 77° 33' 09'' E (Figure – 1) and is a low-lying area in the floodplains of river Banganga and Gambhir which are the tributaries of the river Yamuna. KNP is characterised by woodland, scrub woodland, savanna woodland, low grasslands with scattered trees and scrub, plantations and wetlands. More than 90 species of flowering plants are found in the wetlands of KNP (Mathur et al. 2009).

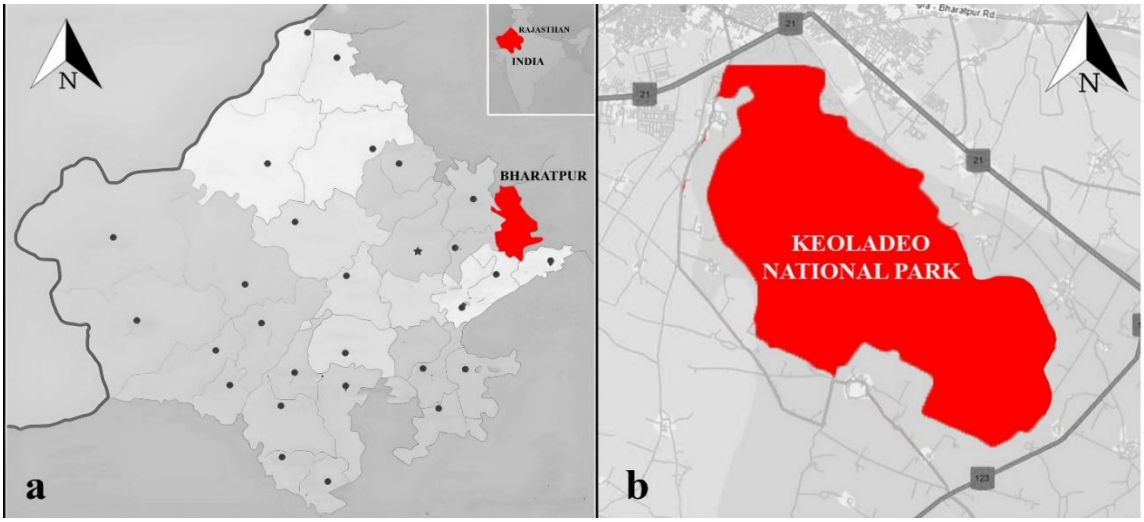

Figure – 1 Study area. (a) Map of India, Rajasthan and Bharatpur (b) Map of Keoladeo National Park, Bharatpur where survey was conducted.

2.2 Field data collection

The study was conducted in November 2024 and December 2024 on the trails and transects of KNP (Figure – 1b). Regular surveys were conducted in the morning (07.00 to 11.30) and in the evening (15:00 to 17:00). The survey team used binoculars (Olympus 10x50) for bird scanning and photographs were recorded using DSLR camera (Nikon D750 and Nikon D5600) on the telephoto lenses (Sigma 150-600 mm and Nikkor 70-300 mm). Avian population was estimated using point-count method (Bibby et al. 2000). Species identification, migration and conservation-status of the birds were based on a field-guide book to the Birds of Indian Sub-continent (Grimmett et al. 2011) and other relevant literatures (Ali 2002).

2.3 Data analysis

Data obtained by survey were evaluated to determine Species Richness Index (R), Simpson's Diversity Index (D) and Shannon Diversity Index (H) in KNP. Statistical analysis was carried out in Microsoft Excel (2021).

2.4 Species Richness Index (R)

The total number of species in a community is known as the "richness index". The Richness index (R) is calculated using Margalef equation (Margalef 1958).

$R = (S - 1) / Ln (N)$

Where:

R: index of species richness.

S: number of species observed.

N: total number of individuals.

Ln: natural logarithm value.

Margalef richness index is classified into three categories viz., low species richness ($R < 2.5$), medium species richness ($2.5 > R < 4$) and high species richness ($R > 4$). Therefore, the species richness is an approximate number of different avian species present in an ecosystem during the survey period.

Simpson's Diversity Index (D): A diversity index is a quantitative measure that reflects the diversity of a community including evenness and dominance (Simpson 1949).

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

Where:

D: index of diversity.

n: number of individuals in a single species.

N: total number of individuals.

Simpson's diversity index ranges from 0 to 1, where 0 represents no diversity and 1 represents infinite diversity.

Shannon Diversity Index (H): The Shannon Diversity index is commonly used to characterise species diversity in a community (Shannon and Weaver 1963).

$H = - \Sigma\, (Pi \times Ln (Pi))$

Where:

Pi: the proportion (n/N) of individuals of one particular species found (n) divided by the total number of individuals found (N).

Ln: Natural logarithm value.

3. RESULTS

The present study at Keoladeo National Park (KNP) recorded a total of 3,488 individuals belonging to 73 species and 34 different families (Table – 1). Among them, 2,176 individuals were from globally threatened and near-threatened species, representing eight species across six families. These included: Endangered species: *Aquila nipalensis* and *Neophron percnopterus*, Vulnerable species: *Clanga hastata* and *Ciconia episcopus*, Near-threatened species: *Mycteria leucocephala*, *Anhinga melanogaster*, *Threskiornis melanocephalus*, and *Psittacula eupatria*.

Table – 1 List of species observed at Keoladeo National Park

FAMILY	COMMON NAME	SCIENTIFIC NAME	IUCN STATUS
ANATIDAE	Cotton Pygmy-Goose	*Nettapus coromandelianus*	LC
	Gadwall	*Mareca strepera*	LC
	Indian Spot-billed Duck	*Anas poecilorhyncha*	LC
PHASIANIDAE	Indian Peafowl	*Pavo cristatus*	LC
COLUMBIDAE	Rock Pigeon	*Columba livia*	LC
	Eurasian Collared-Dove	*Streptopelia decaocto*	LC
	Laughing Dove	*Spilopelia senegalensis*	LC
CUCULIDAE	Greater Coucal	*Centropus sinensis*	LC
RALLIDAE	Eurasian Moorhen	*Gallinula chloropus*	LC
	Eurasian Coot	*Fulica atra*	LC
	Gray-headed Swamphen	*Porphyrio poliocephalus*	LC
	White-breasted Waterhen	*Amaurornis phoenicurus*	LC
CHARADRIIDAE	Red-wattled Lapwing	*Vanellus indicus*	LC
SCOLOPACIDAE	Common Sandpiper	*Actitis hypoleucos*	LC
CICONIIDAE	Asian Openbill	*Anastomus oscitans*	LC
	Asian Woolly-necked Stork	*Ciconia episcopus*	VU
	Painted Stork	*Mycteria leucocephala*	NT
ANHINGIDAE	Oriental Darter	*Anhinga melanogaster*	NT
PHALACROCORACIDAE	Little Cormorant	*Microcarbo niger*	LC

	Great Cormorant	*Phalacrocorax carbo*	LC
THRESKIORNITHIDAE	Black-headed Ibis	*Threskiornis melanocephalus*	NT
	Eurasian Spoonbill	*Platalea leucorodia*	LC
ARDEIDAE	Black Bittern	*Botaurus flavicollis*	LC
	Yellow Bittern	*Botaurus sinensis*	LC
	Little Egret	*Egretta garzetta*	LC
	Indian Pond-Heron	*Ardeola grayii*	LC
	Great Egret	*Ardea alba*	LC
	Gray Heron	*Ardea cinerea*	LC
	Purple Heron	*Ardea purpurea*	LC
ACCIPITRIDAE	Egyptian Vulture	*Neophron percnopterus*	EN
	Indian Spotted Eagle	*Clanga hastata*	VU
	Steppe Eagle	*Aquila nipalensis*	EN
	Shikra	*Tachyspiza badia*	LC
	Black Kite	*Milvus migrans*	LC
STRIGIDAE	Indian Scops-Owl	*Otus bakkamoena*	LC
	Spotted Owlet	*Athene brama*	LC
BUCEROTIDAE	Indian Gray Hornbill	*Ocyceros birostris*	LC
MEROPIDAE	Asian Green Bee-eater	*Merops orientalis*	LC
ALCEDINIDAE	Common Kingfisher	*Alcedo atthis*	LC
	White-throated Kingfisher	*Halcyon smyrnensis*	LC
PICIDAE	Black-rumped Flameback	*Dinopium benghalense*	LC
PSITTACULIDAE	Alexandrine Parakeet	*Psittacula eupatria*	NT
	Rose-ringed Parakeet	*Psittacula krameri*	LC
DICRURIDAE	Black Drongo	*Dicrurus macrocercus*	LC
CORVIDAE	Rufous Treepie	*Dendrocitta vagabunda*	LC
	House Crow	*Corvus splendens*	LC
	Large-billed Crow	*Corvus macrorhynchos*	LC
CISTICOLIDAE	Common Tailorbird	*Orthotomus sutorius*	LC
	Ashy Prinia	*Prinia socialis*	LC
	Plain Prinia	*Prinia inornata*	LC
PYCNONOTIDAE	Red-vented Bulbul	*Pycnonotus cafer*	LC
	White-eared Bulbul	*Pycnonotus leucotis*	LC
PHYLLOSCOPIDAE	Greenish Warbler	*Phylloscopus trochiloides*	LC
SYLVIIDAE	Lesser Whitethroat	*Curruca curruca*	LC
LEIOTHRICHIDAE	Jungle Babbler	*Argya striata*	LC
STURNIDAE	Brahminy Starling	*Sturnia pagodarum*	LC
	Common Myna	*Acridotheres tristis*	LC
	Bank Myna	*Acridotheres ginginianus*	LC
TURDIDAE	Orange-headed Thrush	*Geokichla citrina*	LC
MUSCICAPIDAE	Indian Robin	*Copsychus fulicatus*	LC
	Oriental Magpie-Robin	*Copsychus saularis*	LC
	Bluethroat	*Luscinia svecica*	LC
	Red-breasted Flycatcher	*Ficedula parva*	LC
	Black Redstart	*Phoenicurus ochruros*	LC
	Pied Bushchat	*Saxicola caprata*	LC
	Brown Rock Chat	*Oenanthe fusca*	LC
NECTARINIIDAE	Purple Sunbird	*Cinnyris asiaticus*	LC
PASSERIDAE	House Sparrow	*Passer domesticus*	LC
MOTACILLIDAE	Citrine Wagtail	*Motacilla citreola*	LC
	White Wagtail	*Motacilla alba*	LC
ESTRILDIDAE	Indian Silverbill	*Euodice malabarica*	LC
	Scaly-breasted Munia	*Lonchura punctulata*	LC
ACROCEPHALIDAE	Blyth's Reed Warbler	*Acrocephalus dumetorum*	LC

LC – Least concern, EN – Endangered, VU – Vulnerable, NT – Near-threatened

The Margalef Richness Index value of 8.83 supports the high species richness of KNP. The most abundant species recorded was *Mycteria leucocephala*, which accounted for 60.21% of the total avian population (Figure – 4). The next three most abundant species—*Microcarbo niger*, *Sturnia pagodarum*, and *Platalea leucorodia*—had observed populations ranging between 100–400 individuals, collectively comprising 18.69% of the total

bird abundance. Fourteen species were observed in numbers ranging between 20–100 individuals, including: *Mareca strepera, Spilopelia senegalensis, Gallinula chloropus, Fulica atra, Vanellus indicus, Anastomus oscitans, Anhinga melanogaster, Phalacrocorax carbo, Threskiornis melanocephalus, Egretta garzetta, Ardeola grayii, Halcyon smyrnensis, Passer domesticus,* and *Psittacula krameri*, collectively accounting for 13.25% of the total avian population. Additionally, several rare species (fewer than 10 individuals) were recorded, including: *Nettapus coromandelianus, Porphyrio poliocephalus, Actitis hypoleucos, Ciconia episcopus, Botaurus flavicollis, Botaurus sinensis, Neophron percnopterus, Clanga hastata, Aquila nipalensis, Acrocephalus dumetorum, Lonchura punctulata, Euodice malabarica, Pycnonotus leucotis, Athene brama, Motacilla alba, Motacilla citreola, Saxicola caprata, Phoenicurus ochruros, Ficedula parva,* and *Luscinia svecica*. The Simpson Diversity Index (D) of 0.62 and the Shannon Diversity Index (H) of 1.89 suggest a moderate species diversity during the study period.

Figure – 4 Nesting of Painted Stork (*Mycteria leucocephala*), the most abundant species observed at KNP.

4. DISCUSSION

A significantly smaller number of migratory birds were observed at KNP during this survey compared to previous years, indicating a potential shift in the migration patterns of various waterbirds. Several factors, including climate change, habitat degradation, water availability fluctuations, and increased human disturbances, may be responsible for this decline. Among the recorded families, Ardeidae and Muscicapidae exhibited the highest species diversity, with seven species each (Figure – 2). However, the most abundant family was Ciconiidae, accounting for 62.1% of the total observed avian population (Figure – 3). This dominance aligns with previous studies, which reported a high prevalence of painted stork (*Mycteria leucocephala*) at KNP (Naoroji, 1990). While the high abundance of Ciconiidae indicates favorable wetland conditions for this group, it may also suggest an imbalance in species representation, possibly influenced by hydrological changes, habitat specialization, or human impact on other species.

Notably, Eurasian Spoonbills (*Platalea leucorodia*) were found nesting outside the protected boundaries of KNP (Figure – 5), suggesting a shift in their traditional breeding patterns. This shift may be due to habitat degradation, reduced nesting site availability, or environmental changes affecting their preferred breeding conditions. Despite its national and global significance, KNP faces numerous conservation challenges. The largest threat to bird populations worldwide is habitat loss and fragmentation (Crosby, 1996; Pandit et al., 2007), and KNP is no exception. Increasing development activities, natural resource demands, and urban expansion continue to pose serious threats to the park's ecological integrity. A high species turnover rate across habitats suggests that species coexistence within different habitat types is essential for maintaining overall biodiversity (Jankowski et al., 2009). Interestingly, most threatened species were observed in undisturbed habitats, indicating that roads, human settlements, and other anthropogenic disturbances negatively impact vulnerable bird populations.

These findings highlight the urgent need for comprehensive conservation strategies focused on habitat protection, sustainable management, and ecological monitoring to ensure the long-term survival of avian species in KNP. Future research should explore the specific causes of migratory bird decline and develop effective strategies for mitigating the impact of human disturbances on this UNESCO World Heritage Site.

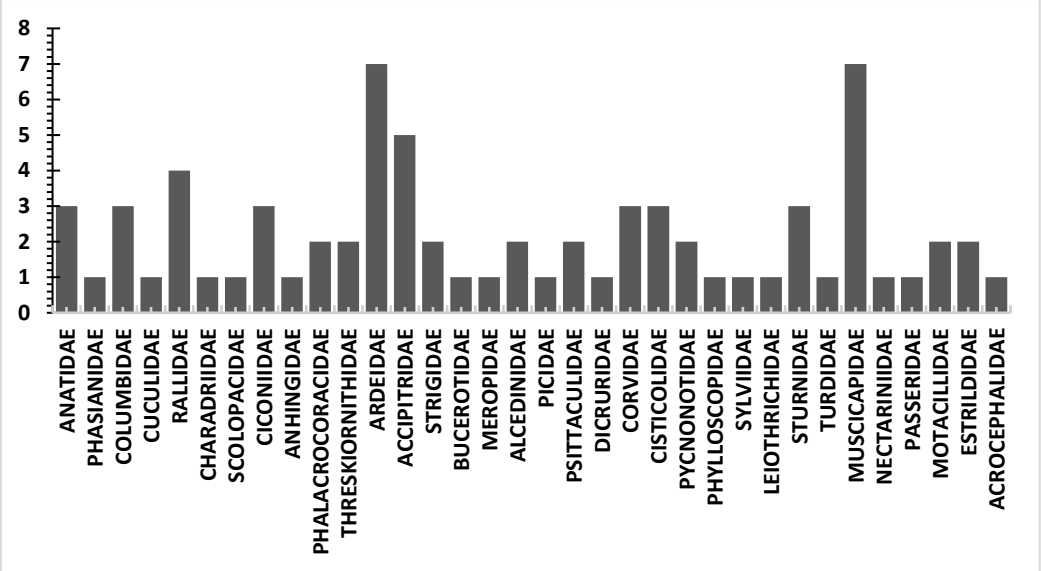

Figure – 2 Number of species within different families observed at Keoladeo National Park

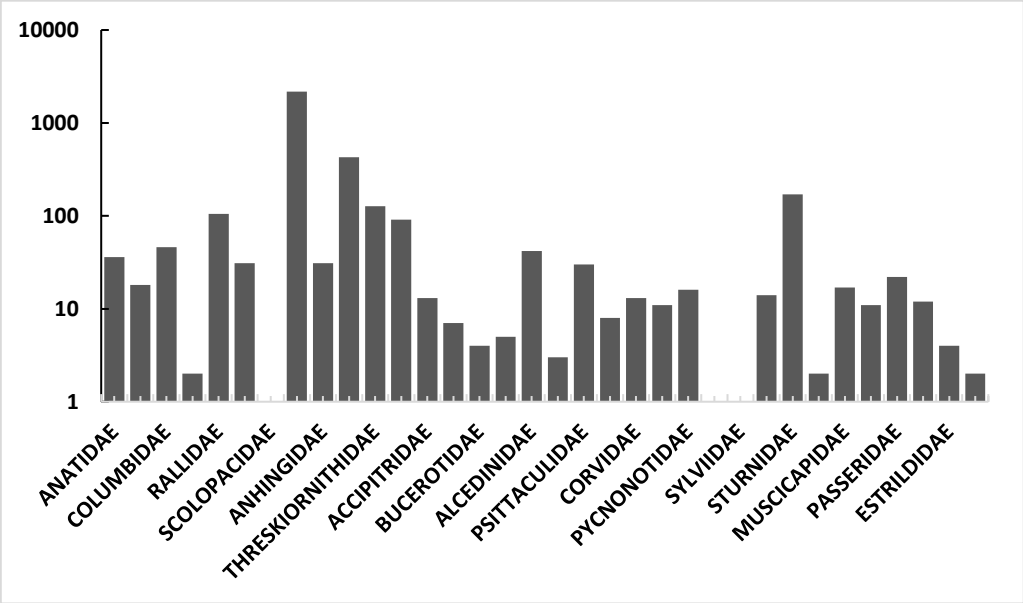

Figure – 3 Number of individuals within different families observed at Keoladeo National Park

Figure – 5 Nesting of Eurasian Spoonbill (*Platalea leucorodia*) outside the premises of KNP. Juveniles with paler bills and adult having dark bills.

5. CONCLUSION

The forest and wetlands of KNP provide an essential habitat for majority of avian species including migratory waterbirds, storks and raptors. However, because of the growing need for natural resources, these forests and wetlands are susceptible to overexploitation. This study recorded 2176 individuals of globally threatened and near threatened species belonging to seven different families which indicates the importance of the wildlife conservation at KNP. The present study also reveals a significant decline in the number of migratory birds arriving at KNP during the month of December. This decrease maybe related to a combination of environmental and anthropogenic factors including habitat degradation, alteration in water availability, change in climate and increase in human disturbances. Remarkably, Eurasian spoonbills were observed nesting outside the premises of KNP indicating a possible shift in their habitat preferences and breeding patterns due to changing ecological conditions. The predominance of Ciconiidae suggests that wetland health is crucial for maintaining avian diversity at KNP. However, the concentration of a single family at such high percentage (62.1%) may indicate an imbalance in species representation potentially caused by habitat specialization, hydrological changes and human impact. This observation highlights the need to extend conservation efforts beyond protected areas and address environmental changes affecting surrounding regions.

The findings suggest the urgent need for comprehensive conservation strategies to protect and restore KNP's ecological balance. Conservation strategies should also focus on maintaining the wetland's integrity, ensuring adequate water flow, food availability and protecting key breeding areas. Regular monitoring, habitat management and implementation of sustainable policies are essential to ensure the long-term survival of globally threatened avian species. Further studies are required to identify the possible causes and developing ecological strategies to mitigate the decline in migratory bird populations and restoring the ecological balance of this UNESCO World Heritage Site.

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CONFLICT OF INTEREST

The author declares no conflict of interest regarding the publication of this research.

REFERENCES

1. Ali, S., 2002. The book of Indian birds. Oxford University press.
2. Batary, P., Fronczek, S., Normann, C., Scherber, C., Tscharntke, T., 2014. How do edge effect and tree species diversity change bird diversity and avian nest survival in Germany's largest deciduous forest? For. Ecol. Manag. 319, 44–50.
3. Bhatt, D., Joshi, K.K., 2011. Bird assemblages in natural and urbanized habitats along elevational gradient in Nainital district (western Himalaya) of Uttarakhand state, India. Curr. Zool. 57, 318–329.
4. Bibby, C.J., Burgess, N.D., Hill, D.A., Mustoe, S., 2000. Bird census techniques. Elsevier.
5. Caprio, E., Chamberlain, D.E., Isaia, M., Rolando, A., 2011. Landscape changes caused by high altitude skipistes affect bird species richness and distribution in the Alps. Biol. Conserv. 144, 2958–2967.
6. Crosby, M., 1996. Threatened birds in the eastern Himalayas. OBC Bull. 23, 21–23.
7. Divyanshu., Kumari, C., 2025. Migratory wings over wetlands: Avian diversity at Vikramshila Gangetic dolphin sanctuary, Bhagalpur, Bihar, India. International Journal for Multidisciplinary Research, 7(1). https://doi.org/10.36948/ijfmr.2025.v07i01.34641
8. Jankowski, J.E., Ciecka, A.L., Meyer, N.Y., Rabenold, K.N., 2009. Beta diversity along environmental gradients: implications of habitat specialization in tropical montane landscapes. Journal of Animal Ecology, 78: 315-327. https://doi.org/10.1111/j.1365-2656.2008.01487.x
9. Kissling, W.D., Field, R., Korntheuer, H., Heyder, U., Bohning-Gaese, K., 2010. Woody plants and the prediction of climate-change impacts on bird diversity. Philos. Trans. R. Soc. B Biol. Sci. 365, 2035–2045.

10. Margalef, R., 1958. Information theory in ecology. Gen. Syst. 3, 36–71.
11. Mathur, V.B., K. Sivakumar, Singh, B., Anoop, K.R., 2009. A bibliographical review for identifying research gap areas: Keoladeo Ghana National Park – A World Heritage site. Wildlife Institute of India, Dehradun. 54p.
12. Morelli, F., 2013., Relative importance of marginal vegetation (shrubs, hedgerows, isolated trees) surrogate of HNV farmland for bird species distribution in Central Italy. Ecol. Eng. 57, 261–266.
13. Naoroji, R., 1990. Predation by (Aquila) eagles on nestling storks and herons in Keoladeo National Park, Bharatpur. Journal of the Bombay Natural History Society. 87(1):37-46.
14. Pandit, M.K., Sodhi, N.S., Koh, L.P., Bhaskar, A., Brook, B.W., 2007. Unreported yet massive deforestation driving loss of endemic biodiversity in Indian Himalaya. Biodivers. Conserv. 16, 153–163.
15. Shannon, C.E., Weaver, W., 1963. The mathematical theory of communication. The University of Illinois Press, Illinois.
16. Shekhawat, D.S., Bhatnagar, C., 2014. Guild, status, and diversity of avian fauna in the Jhunjhunu district, Rajasthan, India. Journal of Asia-Pacific Biodiversity 7: 262-267. https://doi.org/10.1016/j.japb.2014.06.001
17. Simpson, E.H., 1949. Measurement of diversity. Nature 163: 688. https://doi.org/10.1038/163688a0
18. Wretenberg, J., Part, T., Berg, Å., 2010. Changes in local species richness of farmland birds in relation to landuse changes and landscape structure. Biol. Conserv. 143, 375–381.
19. Wuczynski, ´ A., Kujawa, K., Dajdok, Z., Grzesiak, W., 2011. Species richness and composition of bird communities in various field margins of Poland. Agric., Ecosyst. Environ. 141, 202–209.
20. Zuria, I., Gates, J.E., 2012. Community composition, species richness, and abundance of birds in field margins of central Mexico: local and landscape-scale effects. Agrofor. Syst. 87, 377–393.