Avifaunal Diversity of Shaheed Ashfaq Ullah Khan PraniUdyan (Zoological Park) in Uttar Pradesh, India

ABSTRACT

Avian taxa are natural indicators of a healthy ecosystem. India has 1332 bird species, about 6% of population. Birds survey was carried out in the winter season from December 2023 to February 2024 at Gorakhpur Zoo (26.713403°N and 83.407705°E, 68m altitude), Uttar Pradesh, following the fixed transects. We recorded 85 avian species belonging to 39 families and 17 orders. Ardeidae was the most diverse family of birds in the study area (RDi value = 8.33).Among the recorded species, 63 species are Resident, 19 species are winter migrant and 3 species are local migrant. During the survey, we recorded one threatened species and winter migrant, the Ferruginous Pochard. There are no studies conducted on birds at the study site despite its abundant avian population. It is essential to conduct further research to monitor the species and population trends of birds, particularly in light of shifting climatic conditions.

Keywords: Avifauna, Species Diversity, Zoological Park, Gorakhpur, Uttar Pradesh, Birds, Winter Migrant, Relative diversity index, Residents

INTRODUCTION

Birds are an ideal taxonomic group for assessing global environmental shifts, given their widespread and longstanding monitoring efforts worldwide (Fraixedas et al., 2020). They play a crucial and indispensable role in maintaining ecological equilibriumby aiding in pollination, regulating agricultural pest populations, and participating in the recycling of nutrients (Wenny et al., 2011). Additionally, the presence of birdlife indicates that the lakes are in good condition, providing sufficient water, secure habitats, and ample food for both adult birds and their young.Having suitable nesting and roosting spots in and around the lakes plays a crucial role in the presence and abundance of aquatic bird populations (Joshi, 2012).

Variations in species diversity are closely linked to changes in a range of biophysical and abiotic factors which play a significant role in shaping biological diversity. These patterns are influenced by both spatial and temporal scales, affecting the interactions between species and the environmental factors that determine species richness (Oindo et al., 2001). In bird communities, composition and species richness are particularly tied to habitat structure and abiotic factors such as temperature and

precipitation, which are directly connected to primary productivity. A theory suggests that number of species is influenced by the diversity of habitats within a given area. Numerous studies, especially those focused on birds, have supported this concept (Brand et al., 2008; Rafe et al., 1985).

The India Checklist recognizes a grand total of 1332 bird species in India, which accounts for approximately 6% of the country's bird population as outlined in Howard and Moore's 4th Edition (Praveen et al., 2020).Uttar Pradesh, the fourth largest state in the Indian subcontinent, is home to diverse avifaunal species. It supports over 550 species of bird species (Uttar Pradesh State Biodiversity Board, 2012).BirdLife International in 2014 identified 17 species in India that are critically endangered, with five of them being present in Uttar Pradesh.

The Shaheed Ashfaq Ullah Khan Prani Udyan Zoological Park in Uttar Pradesh offers a variety of habitats, making it an important site for studying avifaunal diversity. Understanding bird diversity within the zoo's different habitats is critical for developing conservation strategies and ensuring the sustainability of these ecosystems. The zoo serves as a microcosm of the region's broader ecological conditions, essential to monitor the health of bird populations and their response to environmental changes. Furthermore, the role of zoos extends beyond conservation as they act as important centres for education and awareness about biodiversity.

The primary purpose of this study is to understand the bird diversity in the different habitats of the zoological park in Gorakhpur. The findings serve as the baseline for further studies on bird distribution and its abundance, aiding in the long-term monitoring and management of avifaunal population in the region.

MATERIAL AND METHODS

Study Area

The present study was conducted in the Shaheed Ashfaq Ullah Khan Zoological Park, located in Gorakhpur district, north-eastern part of Uttar Pradesh, India, with coordinates at 26.713403°N and 83.407705°Eat an altitude of 68 m (Figure 1). The zoo spans an area of 46.14 hectares, comprising various habitats including wooded areas, grassland and wetland.

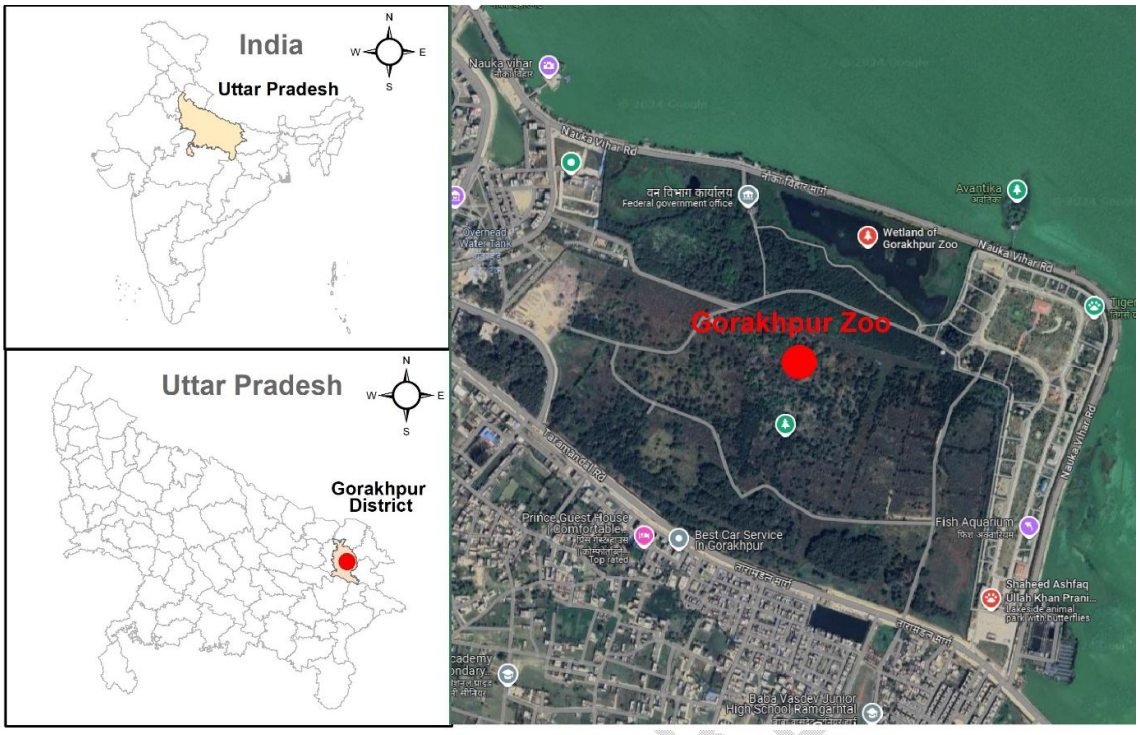

Figure 1: Map of study area showing location of Gorakhpur Zoo of Uttar Pradesh in India

The district shares borders with Nepal to the north and the Bihar state of India to the east. The terrain consists of a diverse mix of human settlements, cultivated lands, pastures, commercial plantations, and wooded areas. The prevailing climate is typically tropical monsoonal, characterized by three distinct seasons: summer (March to mid-June), monsoon (mid-June to mid-October), and winter (mid-October to February). Annual rainfall averages around 1100 to 1800 mm, with the majority (more than 85%) occurring during the monsoon season, while the remainder is sporadically distributed from November to May (Gupta & Singh, 2023; Pandey & Shukla, 2018). Relative humidity levels fluctuate between 74% and 87%. Mean minimum and maximum temperatures during January and June range between 6°C to 27°C and 24°C to 43°C, respectively. The soil composition in the Gorakhpur region falls under the category of Gangetic alluvium, ranging from clayey to sandy loam in texture, with a pH level ranging from 6.5 to 7.5 (CGWB, 2013; Pandey & Shukla, 2018). The major forest found here is Sal (*Shorearobusta*) forests. The primary natural vegetation of the study area is classified as Tropical Moist Deciduous and Tropical Semi-evergreen Forests (Choudhary et al., 2022), as per the classification by Champion and Seth in 1968.

Data collection

Avian surveys were conducted using the point transect method from December 2023 to February 2024 (Buckland et al., 1993). We used point survey method to document the birds in terrestrial and aquatic sites withinthe zoological park(Urfi et al., 2005). The birds were observed using Nikon

Monarch M7 8X42 field binocular during the evening activity hours (1500-1700 h) and were photographed by using Canon 700D camera. Taxonomical nomenclature has been used from the IUCN Red List of Threatened Species (IUCN, 2023).

The identified birds were then categorized according to their residence status as Resident (R), Winter Migrant (WM), Summer Migrant (SM).

Relative Diversity (RDi) denotes ratio of total number of species within a family to total number of species (%) followed by Cottam and Curtis (1956) formula.

$$RDi = \frac{\text{Number of bird species in a Family}}{\text{Total Number of Bird Species}} \times 100$$

RESULTS AND DISCUSSION

A total of 85 species of birds belonging 39 familiesand 17 orders were recorded during the study period in the entire study area (Table 2).

The Passeriforms (35 species) order was the most dominant followed by Pelecaniforms (7 species), Charadriiformes (6 species), Anseriformes (5 species), Columbiformes (5 species), Accipitriformes (4 species), Gruiformes (4 species), Coraciiformes (3 species), Cuculiformes (3 species), Bucerotiformes (2 species), Galliformes (2 species), Piciformes (2 species), Suliformes (2 Species). While Falconiformes, Podicipediformes, Psittaciformes and Strigiformes were the least represented orders with a single species each. Our findings align with earlier reports by Reddy et al. (2024), recorded a diverse population of 92 bird species and their distribution across the university campus farm areas.

Analysis of the relative diversity index in 39 families revealed that Ardeidae was the most diverse family (7 species, RDi= 8.33), followed by Anatidae and Columbidae (5 species, RDi= 5.95), Rallidae, Accipitridae and Phylloscopidae (4 species, RDi= 4.76) (Figure 2). Whereas Podicipedidae, Recurvirostridae, Charadriidae,Falconidae, Dicruridae, Zosteropidae, Leiothrichidae, Nectariniidae, Turdidae, Paridae, Stenostiridae, Passeridae, Psittaculidae, Lanidae, Bucerotidae, Upupidae, Strigidae showed the least diverse (1 species, RDi= 1.19) (Table 1).

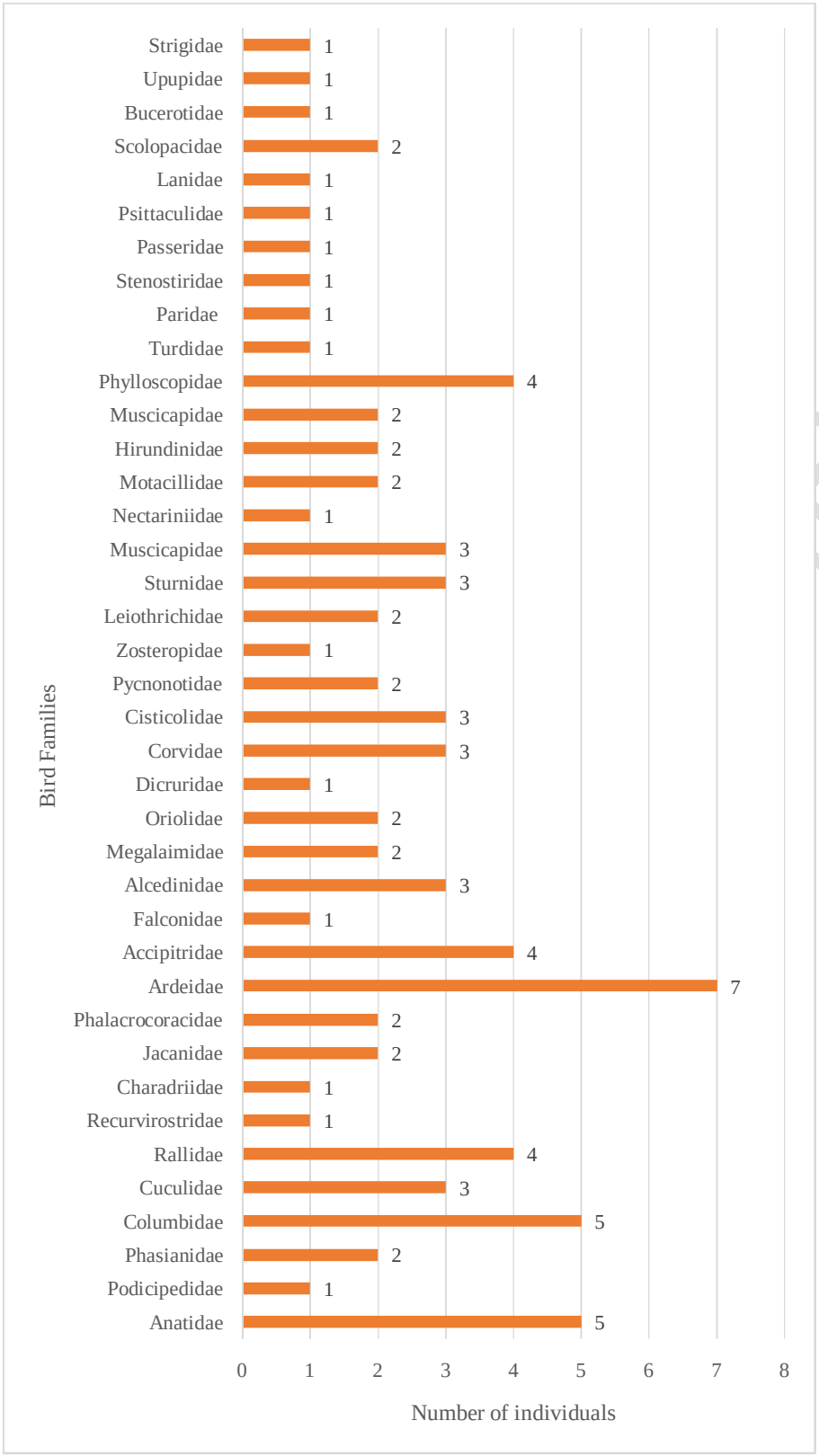

Figure 2: Composition of avian community in Gorakhpur Zoo

Ferruginous Duck *Ayrhyanyroca*is near threatened and the rest of the 84 species are least concern. According to the IWPA (1972), out of 85 recorded species, 5 species such as Indian Peafowl *Pavo cristatus*, Shikra *Accipiter badius*, Booted Eagle *Hieraaetuspennatus*, Crested Serpent Eagle *Spilornischeela* and Peregrine Falcon *Falco peregrinus* were under Schedule I and 80 species were under Schedule II.

Table 1: Relative diversity index (RDi) of various bird families in Gorakhpur Zoo, Uttar Pradesh

Bird Families	Number of Species	RDi Value
Anatidae, Columbidae	5	5.95
Podicipedidae, Recurvirostridae, Charadriidae,Falconidae, Dicruridae, Zosteropidae, Nectariniidae, Turdidae, Paridae, Stenostiridae, Passeridae, Psittaculidae, Lanidae, Bucerotidae, Upupidae, Strigidae	1	1.19
Strigidae, Jacanidae, Leiothrichidae, Phalacrocoracidae, Megalaimidae, Oriolidae, Pycnonotidae, Motacillidae, Hirundinidae, Muscicapidae, Scolopacidae	2	2.38
Cuculidae, Alcedinidae, Corvidae, Cisticolidae, Sturnidae, Muscicapidae	3	3.57
Ardeidae	7	8.33
Rallidae, Accipitridae, Phylloscopidae	4	4.76

It was found that 63 species are Resident, 19 species are winter migrant and 3 species are local migrant (Figure 3).

Table 2: Checklist of recorded bird species

Family	Order	Common Name	Scientific Name	IUCN RED LIST	IWPA	Residential Status
Anatidae	Anseriformes	Lesser Whistling-Duck	*Dendrocygnajavanica*	LC	Schedule II	R
	Anseriformes	Gadwall	*Marecastrepera*	LC	Schedule II	WM
	Anserifor	Green-winged Teal	*Anas crecca*	LC	Sched	WM

	mes	(Common Teal)			ule II	
	Anseriformes	Ferruginous Duck	*Ayrhyanyroca*	NT	Schedule II	WM
	Anseriformes	Garganey	*Spatula querquedula*	LC	Schedule II	WM
Podicipedidae	Podicipediformes	Little Grebe	*Tachybaptusrufi collis*	LC	Schedule II	R
Phasianidae	Galliformes	Indian Peafowl	*Pavo cristatus*	LC	Schedule I	R
	Galliformes	Grey Francolin	*Ortygornispondicerianus*	LC	Schedule II	R
Columbidae	Columbiformes	Rock Pigeon	*Columba livia*	LC	NL	R
	Columbiformes	Eurasian Collared-Dove	*Streptopeliadecaocto*	LC	Schedule II	R
	Columbiformes	Spotted Dove	*Spilopeliachinensis*	LC	Schedule II	R
	Columbiformes	Yellow-footed Green-Pigeon	*Treron Phoenicopterus*	LC	Schedule II	R
	Columbiformes	Laughing Dove	*Spilopelia senegalensis*	LC	Schedule II	R
Cuculidae	Cuculiformes	Greater Coucal	*Centropussinensis*	LC	Schedule II	R
	Cuculiformes	Asian Koel	*Eudynamysscolopaceus*	LC	Schedule II	R
	Cuculiformes	Common Hawk-Cuckoo	*Hierococcyxvarius*	LC	Schedule II	LM
Rallidae	Gruiformes	Eurasian Moorhen	*Gallinula chloropus*	LC	Schedule II	R
	Gruiformes	Eurasian Coot	*Fulicaatra*	LC	Schedule II	R
	Gruiformes	Grey-headed Swamphen	*Porphyriopoliocephalus*	LC	Schedule II	R
	Gruiformes	White-breasted Waterhen	*Amaurornisphoenicurus*	LC	Schedule II	R
Recurvirostridae	Charadriiformes	Black-winged Stilt	*HimantopusHimantopus*	LC	Schedule II	LM
Charadriidae	Charadriiformes	Red-wattled Lapwing	*Vanellus indicus*	LC	Schedule II	R
Jacanidae	Charadriiformes	Bronze-winged Jacana	*Metopidius indicus*	LC	Schedule II	R
	Charadriiformes	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	LC	Schedule II	R
Phalacrocoracidae	Suliformes	Little Cormorant	*Microcarboniger*	LC	Schedule II	R
	Suliformes	Great Cormorant	*Phalacrocorax carbo*	LC	Schedule II	R
Ardeidae	Pelecaniformes	Little Egret	*Egrettagarzetta*	LC	Schedule II	R
	Pelecaniformes	Eastern Cattle Egret	*Bubulcuscoromandus*	LC	Schedule II	R
	Pelecaniformes	Great Egret	*Ardea alba*	LC	Schedule II	R
	Pelecaniformes	Intermediate Egret	*Ardea intermedia*	LC	Schedule II	R
	Pelecaniformes	Indian Pond-Heron	*Ardeolagrayii*	LC	Schedule II	R
	Pelecaniformes	Grey Heron	*Ardea cinerea*	LC	Schedule II	R

	Pelecaniformes	Purple Heron	*Ardea purpurea*	LC	Schedule II	R
Accipitridae	Accipitriformes	Shikra	*Accipiter badius*	LC	Schedule I	R
	Accipitriformes	Black Kite	*Milvus migrans*	LC	Schedule II	R
	Accipitriformes	Crested Serpent-Eagle	*Spilornischeela*	LC	Schedule I	R
	Accipitriformes	Booted Eagle	*Hieraaetuspennatus*	LC	Schedule I	WM
Falconidae	Falconiformes	Peregrine Falcon	*Falco peregrinus*	LC	Schedule I	WM
Alcedinidae	Coraciiformes	White-throated Kingfisher	*Halcyon smyrnensis*	LC	Schedule II	R
	Coraciiformes	Pied Kingfisher	*Cerylerudis*	LC	Schedule II	R
	Coraciiformes	Stork-billed Kingfisher	*Pelargopsiscapensis*	LC	Schedule II	R
Megalaimidae	Piciformes	Brown-headed Barbet	*Psilopogonzeylanicus*	LC	Schedule II	R
	Piciformes	Coppersmith Barbet	*Psilopogonhaemacephalus*	LC	Schedule II	R
Oriolidae	Passeriformes	Indian Golden Oriole	*Orioluskundoo*	LC	Schedule II	R
	Passeriformes	Black-hooded Oriole	*Oriolusxanthornus*	LC	Schedule II	R
Dicruridae	Passeriformes	Black Drongo	*Dicrurusmacrocercus*	LC	Schedule II	R
Corvidae	Passeriformes	Rufous Treepie	*Dendrocittavagabunda*	LC	Schedule II	R
	Passeriformes	House Crow	*Corvus splendens*	LC	NL	R
	Passeriformes	Large-billed Crow	*Corvusmacrorhynchos*	LC	Schedule II	R
Cisticolidae	Passeriformes	Common Tailorbird	*Orthotomussutorius*	LC	Schedule II	R
	Passeriformes	Ashy Prinia	*Priniasocialis*	LC	Schedule II	R
	Passeriformes	Plain Prinia	*Prinia inornate*	LC	Schedule II	R
Pycnonotidae	Passeriformes	Red-vented Bulbul	*Pycnonotuscafer*	LC	Schedule II	R
	Passeriformes	Red-whiskered Bulbul	*Pycnonotusjocosus*	LC	Schedule II	R
Zosteropidae	Passeriformes	Indian White-eye	*Zosteropspalpebrosus*	LC	Schedule II	R
Leiothrichidae	Passeriformes	Jungle Babbler	*Argyastriata*	LC	Schedule II	R
	Passeriformes	Large Grey Babbler	*Argyamalcolmi*	LC	Schedule II	R
Sturnidae	Passeriformes	Indian Pied Starling	*Gracupica contra*	LC	Schedule II	R
	Passeriformes	Common Myna	*Acridotheres tristis*	LC	Schedule II	R
	Passeriformes	Bank Myna	*Acridotheresginginianus*	LC	Schedule II	R
Muscicapidae	Passeriformes	Oriental Magpie-Robin	*Copsychussaularis*	LC	Schedule II	R
	Passerifor	Bluethroat	*Lusciniasvecica*	LC	Sched	WM

	mes				ule II	
	Passeriformes	Indian Robin	*Copsychusfulicatus*	LC	Schedule II	R
Nectariniidae	Passeriformes	Purple Sunbird	*Cinnyrisasiaticus*	LC	Schedule II	R
Motacillidae	Passeriformes	White-browed Wagtail	*Motacillamaderaspatensis*	LC	Schedule II	R
	Passeriformes	White Wagtail	*Motacilla alba*	LC	Schedule II	WM
Hirundinidae	Passeriformes	Barn Swallow	*Hirundo rustica*	LC	Schedule II	WM
	Passeriformes	Grey-throated Martin (Plain Martin)	*Riparia chinensis*	LC	Schedule II	R
Muscicapidae	Passeriformes	Black Redstart	*Phoenicurusochruros*	LC	Schedule II	WM
	Passeriformes	Taiga Flycatcher	*Ficedulaalbicilla*	LC	Schedule II	WM
Phylloscopidae	Passeriformes	Hume's Warbler	*Phylloscopushumei*	LC	Schedule II	WM
	Passeriformes	Common Chiffchaff	*Phylloscopuscollybita*	LC	Schedule II	WM
	Passeriformes	Greenish Warbler	*Phylloscopustrochiloides*	LC	Schedule II	WM
	Passeriformes	Moustached Warbler	*Acrocephalusmelanopogon*	LC	Schedule II	WM
Turdidae	Passeriformes	Orange-headed Thrush	*Geokichlacitrina*	LC	Schedule II	LM
Paridae	Passeriformes	Cinereous Tit	*Parus cinereus*	LC	Schedule II	R
Stenostiridae	Passeriformes	Grey-headed Canary-Flycatcher	*Culicicapaceylonensis*	LC	Schedule II	WM
Passeridae	Passeriformes	House Sparrow	*Passer domesticus*	LC	Schedule II	R
Psittaculidae	Psittaciformes	Rose-ringed Parakeet	*Psittaculakrameria*	LC	Schedule II	R
Lanidae	Passeriformes	Brown Shrike	*Lanius cristatus*	LC	Schedule II	WM
Scolopacidae	Charadriiformes	Green Sandpiper	*Tringaochropus*	LC	Schedule II	WM
	Charadriiformes	Common Sandpiper	*Actitishypoleucos*	LC	Schedule II	WM
Bucerotidae	Bucerotiformes	Indian Grey Hornbill	*Ocycerosbirostris*	LC	Schedule II	R
Upupidae	Bucerotiformes	Eurasian Hoopoe	*Upupa epops*	LC	Schedule II	R
Strigidae	Strigiformes	Spotted Owlet	*Athene brama*	LC	Schedule II	R

*LC- Least Concern, NT- Near Threatened, WM-Winter Migrant, R-Resident,LM- Local Migrant, NL-Not Listed

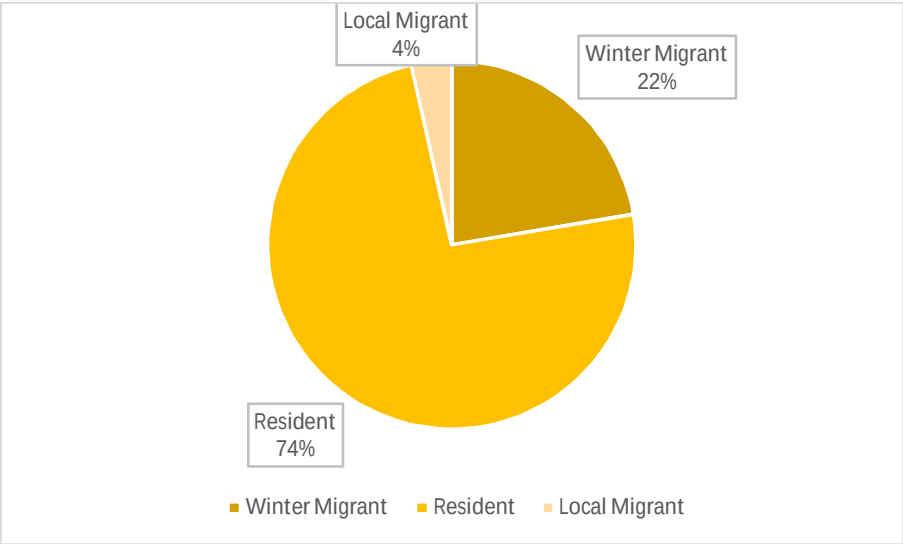

Figure 3: Percentage of avian migrants observed during the study

The presence of near-threatened species Ferruginous Pochard, emphasizes the importance of habitat for both resident and migratory bird species. The dominance of Passeriformes reflects their adaptability to varied habitats, while the high representation of Ardeidae signifies the park's support for wetland-associated species.

CONCLUSION

The study area boasts a rich biodiversity, encompassing various habitats such as wetlands and forested areas. Our observation indicate linkage between habitat type and bird community patterns in an arid city. The presence of a wide variety of bird species highlights the significance of wetlands in urban areas, providing crucial space for migratory birds. However,apart from this study, there is a notable absence of bird studies in this region, making documentation crucial for understanding their distribution within the district.

During early winter, a decrease in the population of migratory ducks has been observed, potentially due to climate change. Climate change, particularly rising temperatures, appears to have a significant impact on birds, might be a reason in delayed arrivals of certain species. The presence of invasive plant species like water hyacinth is another concern, as excessive vegetation in wetlands discourages birds from using them as stopover sites during winter migration.

Conservation efforts should prioritize habitat restoration, water management, and community engagement to enhance the park's role as a biodiversity hotspot. This study serves as a foundation for such initiatives, emphasizing the importance of integrating scientific research into conservation planning.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1.

2.

3.

References

Brand, L. A., White, G. C., & Noon, B. R. (2008). Factors influencing species richness and community composition of breeding birds in a desert riparian corridor. The Condor, 110(2), 199-210.

Buckland, S.T., Anderson, D.R., Burnham, K.P. and Laake, J.L. (1993). Distance Sampling: Estimating Abundance of Biological Populations.

CGWB. (2013). Ground Water Brochure of Gorakhpur District, Uttar Pradesh. Central Ground Water Board, Department of Water Resources, River Development and Ganga Rejuvenation, Ministry of Jal Shakti Government of India.

Champion, H. G., & Seth, S. K. (1968). A revised survey of the forest types of India. Manager of publications.

Chaudhary, D., Singh, P., & Pandey, S. K. (2022). Sal forest diversity and regeneration pattern in stochastic environment: A review. Ecology, Environment & Conservation (pp. S234-S237).

Cottam, G., & Curtis, J. T. (1956). The use of distance measures in phytosociological sampling. Ecology, 37(3), 451-460.

Fraixedas, S., Lindén, A., Piha, M., Cabeza, M., Gregory, R., & Lehikoinen, A. (2020). A state-of-the-art review on birds as indicators of biodiversity: Advances, challenges, and future directions. Ecological Indicators, 118, 106728.

Gordo, O. (2007). Why are bird migration dates shifting? A review of weather and climate effects on avian migratory phenology. Climate research, 35(1-2), 37-58.

Gupta, A., & Singh, A. (2023). Spatio-temporal analysis of land use pattern in a sectoral context: A case study of Gorakhpur district, Uttar Pradesh. International Journal of Humanities and Social Science Research, 9(2), 84-91.

Joshi, K. K., Bhatt, D., & Thapliyal, A. (2012). Avian diversity and its association with vegetation structure in different elevational zones of Nainital district (Western Himalayan) of Uttarakhand. International Journal of Biodiversity and Conservation, 4(11), 364-376.

Oindo, B. O., De By, R. A., & Skidmore, A. K. (2001). Environmental factors influencing bird species diversity in Kenya. African Journal of Ecology, 39(3), 295-302.

Pandey, S. K., & Shukla, R. P. (2018). Plant population structure and species diversity status at two disturbance regimes within mixed forests and sal forests of Gorakhpur, India. International Journal of Ecology and Environmental Sciences, 44(1), 43-58.

Praveen, J., Jayapal, R., & Pittie, A. (2020). Taxonomic updates to the checklists of birds of India, and the South Asian region—2020. Indian Birds, 16(1), 12-19.

Rafe, R. W., Usher, M. B., & Jefferson, R. G. (1985). Birds on reserves: the influence of area and habitat on species richness. Journal of applied ecology, 327-335.

Reddy, V. R., Rajashekhar, M., Sunitha, V., Issai, A. S., Gurumurthy, P., Vaidyula, V. R., & Mounika, G.(2024). Avifaunal diversity in Telangana State: A case study in campus of Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, India. *Journal of Experimental Agriculture International, 46*(5), 672-680.

Shrestha, G., Shrestha, M. B., Byanju, R. M., Reule, S., & Oli, S. (2021). A baseline study on diversity of birds in Sani Bheri River Valley, Nepal. Nepal Journal of Environmental Science, 9(2), 25-33.

Tabur, M. A., & Ayvaz, Y. (2010, June). Ecological importance of birds. In *Second International* Symposium on Sustainable Development Conference (pp. 560-565).

Urfi, A.J., Sen, M., Kalam, A. and Meganathan, T. 2005.Counting birds in India: Methodologies and trends. CurrentScience, 89(12), 1997-2003.

Uttar Pradesh State Biodiversity Board. (2012). Biodiversity: Living treasure of Uttar Pradesh. Uttar Pradesh State Biodiversity Board.

Wenny, D. G., Devault, T. L., Johnson, M. D., Kelly, D., Sekercioglu, C. H., Tomback, D. F., & Whelan, C. J. (2011). The need to quantify ecosystem services provided by birds. The auk, 128(1), 1-14.