

Avifaunal Diversity and Species Composition in Asan Barrage Wetland and Forest Research Institute, Dehradun, Uttarakhand, India

Heena Parveen¹, Mamta Chaudhary², Surendra Kumar³ and Pradeep Kumar^{4*}

^{1,2,3}Department of Zoology, Maa Shakumbhari University, Punwarka, Saharanpur, Uttar Pradesh - 247120, INDIA

⁴Department of Public Health, Maa Shakumbhari University, Punwarka, Saharanpur, Uttar Pradesh - 247120, INDIA

⁴Corresponding Author: msupkrai@gmail.com



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ABSTRACT

The present study assessed and compared avifaunal diversity and species composition between the wetland ecosystem of Asan Barrage and the forest habitat of Forest Research Institute. Field surveys were conducted using direct observation and photographic documentation during morning hours. A total of 42 bird species comprising 308 individuals were recorded from both study sites. Among these, 26 species with 206 individuals were documented from Asan Barrage, while 16 species with 102 individuals were recorded from the Forest Research Institute campus. The wetland habitat supported greater avifaunal diversity and abundance than the forest ecosystem. Migratory waterbirds such as Northern Pintail (*Anas acuta*), Red-crested Pochard (*Netta rufina*), Bar-headed Goose (*Anser indicus*), and Eurasian Wigeon (*Mareca penelope*) were commonly observed at Asan Barrage, whereas the Forest Research Institute was mainly dominated by resident terrestrial birds including Rock Pigeon (*Columba livia*), Jungle Babbler (*Turdoides striata*), and House Sparrow (*Passer domesticus*). The study indicates that wetlands support higher diversity of migratory and aquatic birds due to the availability of water resources, aquatic vegetation, and food supply, while forest habitats mainly support resident bird communities.

Keywords- Avifaunal diversity, Asan Barrage, Forest Research Institute, wetland ecosystem, migratory birds, Uttarakhand.

I. INTRODUCTION

Birds are among the most diverse and ecologically significant groups of vertebrates and are widely recognized as important indicators of environmental health and ecosystem stability (Ali, 2002; Grimmett et al., 2011). Their diversity, abundance, and distribution patterns provide valuable information regarding habitat quality, climatic conditions, and ecological changes (Porte & Paikra, 2024). Avifauna contributes significantly to ecosystem functioning through pollination, seed dispersal, pest regulation, scavenging, and nutrient cycling, thereby maintaining ecological balance and supporting biodiversity conservation (Bird Life International, 2023). Due to their sensitivity to habitat alteration and environmental disturbances, birds are extensively used in ecological monitoring and biodiversity assessment studies (Patel et al., 2025).

India supports a rich diversity of bird species because of its varied climatic conditions and heterogeneous landscapes, including wetlands, forests, grasslands, and mountainous ecosystems (Grimmett et al., 2011). Ali (2002), in "The Book of Indian Bird", emphasized that habitat diversity plays a major role in determining bird distribution and species richness across the Indian subcontinent. Similarly, Grimmett, Inskipp, and Inskipp (2011) reported that ecological factors such as vegetation structure, water availability, altitude, and climate strongly influence avian community composition and habitat preference.

Wetlands and forests are ecologically important habitats that support a wide variety of resident and migratory bird species (Satheesh et al., 2024). Wetlands are considered among the most productive ecosystems in the world and provide feeding, breeding, nesting, and wintering grounds for numerous migratory and resident water birds (Patel et al., 2025). In contrast, forest

ecosystems support diverse terrestrial bird communities by providing suitable shelter, nesting sites, and food resources (Porte & Paikra, 2024). However, increasing urbanization, habitat fragmentation, deforestation, pollution, and climate change have adversely affected these ecosystems, resulting in a decline in bird populations worldwide (Bird Life International, 2023). Habitat degradation has been identified as one of the major threats to global avian diversity, highlighting the urgent need for habitat conservation and biodiversity monitoring (Bird Life International, 2023).

Recent studies have further demonstrated the ecological importance of wetlands and forest ecosystems in maintaining avian diversity. Satheesh et al. (2024) documented 147 bird species in the Vaduvor Bird Sanctuary and reported that wetland ecosystems support high avian richness due to abundant food availability and favorable breeding conditions. Porte and Paikra (2024), in their integrative review on avian ecology, concluded that habitat heterogeneity, vegetation complexity, elevation, and climatic variables significantly influence bird species composition and community structure. Patel et al. (2025) also reported that wetland ecosystems support exceptionally high avian diversity and play a crucial role in migratory bird conservation.

The present study was conducted in two contrasting habitats of Dehradun, Uttarakhand, namely Asan Barrage and the Forest Research Institute. Asan Barrage is an internationally recognized wetland ecosystem that serves as an important habitat for migratory and resident waterbirds (BirdLife International, 2023), whereas the Forest Research Institute campus represents a semi-natural forest ecosystem supporting diverse terrestrial avifauna (Grimmett et al., 2011). Comparative assessment of bird diversity in these habitats is important for understanding habitat-specific species composition, ecological preferences, and conservation priorities (Porte & Paikra, 2024).

Therefore, the present study aims to assess and compare avifaunal diversity and species composition between Asan Barrage Wetland and the Forest Research Institute, Dehradun. The study also seeks to evaluate the influence of habitat characteristics on bird distribution and diversity patterns, thereby contributing to regional biodiversity documentation and conservation planning in Uttarakhand, India (Patel et al., 2025; BirdLife International, 2023).

II. MATERIALS AND METHODS

2.1 Study Area

The present study was conducted in two ecologically contrasting habitats of Dehradun district, Uttarakhand, India: Asan Barrage and Forest Research Institute. Both sites are known for supporting diverse avifaunal communities due to their distinct habitat characteristics.

2.1.1 Asan Barrage

Asan Barrage is situated near Dakpathar at the confluence of the Asan and Yamuna rivers (30°24'N, 77°40'E). The wetland consists of shallow water bodies, marshy areas, mudflats, aquatic vegetation, and surrounding grasslands that provide suitable habitat for resident and migratory birds. The site supports a variety of waterbirds including ducks, geese, herons, cormorants, and waders, particularly during the winter season.

2.1.2 Forest Research Institute (FRI)

The Forest Research Institute is located on Chakrata Road, Dehradun, Uttarakhand. The campus comprises dense vegetation, ornamental gardens, open grasslands, and mixed forest patches. The habitat supports diverse terrestrial and arboreal bird species by providing food resources, shelter, and nesting sites.

2.1.3 Survey Method

Field surveys were conducted during morning hours, corresponding to peak bird activity periods. Birds were observed using direct visual sighting, binoculars, and digital photography along fixed walking trails and accessible areas of both study sites.

2.1.4 Identification of Bird Species

Bird species were identified based on morphological features such as plumage coloration, body size, beak shape, flight pattern, and behavior. Species identification was confirmed using the standard field guide *Birds of the Indian Subcontinent* by Grimmett, Inskipp, and Inskipp (2011).

2.1.5 Data Collection

Data recorded during field observations included common name, scientific name, habitat type, migratory status, and number of individuals observed for each species. Photographic documentation was also maintained for species verification.

2.1.6 Data Analysis

The collected data were analyzed using descriptive statistical methods to determine species richness and abundance. Comparative analyses between the two habitats were performed using tables, bar diagrams, and pie charts to assess avifaunal diversity and habitat-wise species composition.

III. RESULTS

A total of 42 bird species comprising 308 individuals were recorded from the two study sites during the survey period (**Table 1** and **Table 2**). Among these, 26 species with 206 individuals were documented from Asan Barrage, whereas 16 species with 102 individuals were recorded from Forest Research Institute. Comparative analysis revealed that Asan Barrage supported greater avifaunal diversity and abundance than the Forest Research Institute campus (**Graph 1**).

The avifaunal assemblage observed at Asan Barrage was dominated by wetland-associated and

migratory bird species. Several migratory waterbirds including Northern Pintail (*Anas acuta*), Red-crested Pochard (*Netta rufina*), Bar-headed Goose (*Anser indicus*), Tufted Duck (*Aythya fuligula*), Eurasian Wigeon (*Mareca penelope*), and Ruddy Shelduck (*Tadorna ferruginea*) were commonly recorded during the study period. Among all species observed at this site, Red-crested Pochard showed the highest abundance with 20 individuals, followed by Northern Pintail with 15 individuals. Great Cormorant (*Phalacrocorax carbo*) and Bar-headed Goose were also abundant, each represented by 14 individuals.

In addition to migratory species, several resident wetland birds were observed at Asan Barrage, including Indian Spot-billed Duck (*Anas zonorhyncha*), Grey-headed Swamphen (*Porphyrio poliocephalus*), Indian Pond Heron (*Ardeola grayii*), Little Grebe (*Tachybaptus ruficollis*), and Red-wattled Lapwing (*Vanellus indicus*). Most of the recorded species were associated with aquatic and wetland habitats, indicating the ecological significance of Asan Barrage as an important feeding, breeding, and wintering ground for migratory and resident avifauna.

The avifaunal composition recorded from the Forest Research Institute mainly consisted of resident terrestrial and arboreal bird species associated with forest and urban-edge habitats. Commonly observed species included Rock Pigeon (*Columba livia*), Jungle Babbler (*Turdoides striata*), House Sparrow (*Passer domesticus*), Red-vented Bulbul (*Pycnonotus cafer*), House Crow (*Corvus splendens*), and Rose-ringed Parakeet (*Psittacula krameri*). Rock Pigeon was the most abundant species with 14 individuals, followed by

Jungle Babbler with 12 individuals and House Sparrow with 11 individuals.

Several forest-dependent bird species such as White-throated Fantail (*Rhipidura albicollis*), Ashy Drongo (*Dicrurus leucophaeus*), Himalayan Flameback (*Dinopium shorii*), Indian Grey Hornbill (*Ocyrocus birostris*), and Blue-bearded Bee-eater (*Nyctyornis athertoni*) were also recorded from the FRI campus. Only one migratory species, the Taiga Flycatcher (*Ficedula albicilla*), was observed at this site, suggesting comparatively lower migratory bird diversity in the forest ecosystem.

Habitat-wise comparison demonstrated that the wetland ecosystem supported a greater diversity of migratory and aquatic bird species, whereas the forest ecosystem mainly supported resident terrestrial birds. The higher species richness and abundance recorded at Asan Barrage may be attributed to the availability of water resources, aquatic vegetation, abundant food supply, and suitable resting habitats for migratory birds. In contrast, the relatively lower species diversity observed at the Forest Research Institute may reflect habitat specialization toward woodland and urban-adapted avifaunal communities.

Graph 1 illustrates the comparative avifaunal diversity and abundance recorded at both study sites, while **Graph 2** represents the proportion of bird individuals observed at Asan Barrage and the Forest Research Institute. The graphical analysis further confirms the dominance of bird diversity and abundance at the wetland ecosystem of Asan Barrage compared to the forest habitat of the Forest Research Institute.

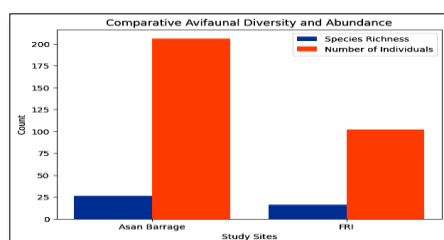
Table: 1 Bird Species Observed at Asan Barrage Wetland, Dehradun, with Number of Individuals, Migratory Status, and Habitat Type

Sr. No.	Bird Species	No. of Individuals	Status	Habitat Type
1	Indian Spot-billed Duck(<i>Anas zonorhyncha</i>)	12	Resident	Wetland
2	Eurasian coot(<i>Fulica atra</i>)	4	Migratory	Wetland
3	Indian Robin(<i>Copsychus fulicatus</i>)	5	Resident	Terrestrial(edge)
4	White Wagtail (<i>Motacilla alba</i>)	8	Migratory	Wetland edge
5	Small Pratincole (<i>Glareola lactea</i>)	10	Resident	Riverine
6	Northern Pintail(<i>Anas acuta</i>)	15	Migratory	Wetland
7	Tufted Duck (<i>Aythya fuligula</i>)	9	Migratory	Wetland
8	Eurasian Moorhen (<i>Gallinula chloropus</i>)	6	Resident	Wetland
9	Grey-headed Swamphen(<i>Porphyrio poliocephalus</i>)	7	Resident	Wetland
10	White-breasted Waterhen (<i>Amaurornis phoenicurus</i>)	4	Resident	Wetland
11	Great Cormorant (<i>Phalacrocorax carbo</i>)	14	Partial migrant	Wetland
12	Purple Heron (<i>Ardea purpurea</i>)	3	Resident	Wetland
13	Steppe Eagle (<i>Aquila nipalensis</i>)	2	Migratory	Open land/scrub
14	Plain Prinia(<i>Prinia inornata</i>)	6	Resident	Terrestrial(edge)
15	Indian Pond Heron (<i>Ardeola grayii</i>)	5	Resident	Wetland

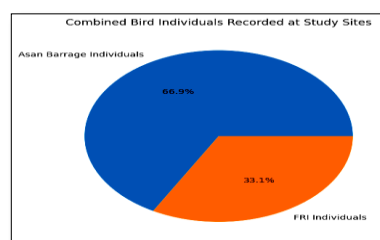
16	Common Sandpiper (<i>Actithypoleucos</i>)	7	Migratory	Wetland
17	Bar-headed Goose (<i>Anserindicus</i>)	14	Migratory	Wetland
18	Red-crested Pochard (<i>Nettarufina</i>)	20	Migratory	Wetland
19	Eurasian Wigeon (<i>Marecapenelope</i>)	10	Migratory	wetland
20	Common Pochard (<i>Aythyaferina</i>)	9	Migratory	wetland
21	Little Grebe (<i>Tachybaptusruficollis</i>)	6	Resident	wetland
22	Ruddy Shelduck (<i>Tadornaferruginea</i>)	8	Migratory	wetland
23	Great Egret (<i>Ardea alba</i>)	5	Partial migrant	wetland
24	Pallas's Gull (<i>Ichthyaetusichthyaetus</i>)	6	Migratory	Wetland
25	Great Crested Grebe (<i>Podiceps cristatus</i>)	4	Migratory	Wetland
26	Red-wattled Lapwing (<i>Vanellusindicus</i>)	7	Resident	wetland

Table: 2 Bird Species Observed at Forest Research Institute (FRI), Dehradun, with Number of Individuals, Migratory Status, and Habitat Type

Sr. No.	Bird Species	No. of Individuals	Status	Habitat Type
1	White-throated Fantail (<i>Rhipidura albicollis</i>)	4	Resident	Forest
2	Great Tit (<i>Parus major</i>)	5	Resident	Forest
3	Taiga Flycatcher (<i>Ficedula albicilla</i>)	3	Migratory (serbia)	Forest
4	Red-vented Bulbul (<i>Pycnonotus cafer</i>)	10	Resident	Forest/Garden
5	Jungle Babbler (<i>Turdoides striata</i>)	12	Resident	Scrub/forest edge
6	Blue-bearded Bee-eater (<i>Nyctyorinasathertoni</i>)	2	Resident	Forest
7	Ashy Drongo (<i>Dicrurus leucophaeus</i>)	4	Resident	Forest
8	Spotted Dove (<i>Spilopeliachinensis</i>)	6	Resident	Open woodland/edge
9	Indian Grey Hornbill (<i>Ocyrocero birostris</i>)	3	Resident	Forest
10	Yellow-bellied Fantail (<i>Chelidorhynchypoxanthus</i>)	2	Resident	Forest
11	Rose-ringed Parakeet (<i>Psittacula krameri</i>)	8	Resident	Forest/urban edge
12	House Crow (<i>Corvus splendens</i>)	9	Resident	Urban
13	Common Myna (<i>Acridotheres fuscus</i>)	7	Resident	Urban open land/urban
14	House Sparrow (<i>Passer domesticus</i>)	11	Resident	Urban
15	Himalayan Flameback (<i>Dinopium shorii</i>)	2	Resident	Forest
16	Rock Pigeon (<i>Columba livia</i>)	14	Resident	Urban



Graph: 1 Comparative Avifaunal Diversity and Abundance at Asan Barrage and Forest Research Institute



Graph: 2 Proportion of Bird Individuals Recorded at Asan Barrage and Forest Research Institute, Dehradun

IV. DISCUSSIONS

The present study revealed considerable variation in avifaunal diversity and species composition between the wetland ecosystem of Asan Barrage and the forest habitat of Forest Research Institute. A total of 42 bird species comprising 308 individuals were recorded during the study period, with comparatively higher species richness and abundance observed at Asan Barrage. The findings indicate that wetland ecosystems support greater avian diversity than terrestrial forest habitats due to the availability of water resources, aquatic vegetation, nesting sites, and abundant food supply (Ali, 2002; Grimmett et al., 2011; Satheesh et al., 2024). Similar observations have been reported by Satheesh et al. (2024), who documented high avian richness in wetland ecosystems because of favorable feeding, breeding, and roosting conditions. Porte and Paikra (2024) also emphasized that habitat heterogeneity and ecological complexity significantly influence bird diversity and distribution.

The dominance of migratory waterbirds at Asan Barrage highlights the ecological importance of wetlands as wintering and stopover habitats for migratory avifauna (BirdLife International, 2023; Patel et al., 2025). Species such as Northern Pintail (*Anas acuta*), Bar-headed Goose (*Anser indicus*), Eurasian Wigeon (*Mareca penelope*), Tufted Duck (*Aythya fuligula*), and Red-crested Pochard (*Netta rufina*) were abundantly recorded during the survey. These findings are consistent with previous studies conducted in northern Indian wetlands, which reported that wetlands provide suitable habitat conditions for migratory birds arriving from Central Asia, Siberia, Mongolia, and Europe during winter seasons (Ali, 2002; Patel et al., 2025). The occurrence of these migratory species suggests that Asan Barrage functions as an ecologically significant wetland supporting regional and international migratory flyways.

Among the recorded species, Red-crested Pochard showed the highest abundance at Asan Barrage, followed by Northern Pintail and Bar-headed Goose. The abundance of these waterbirds may be associated with the presence of shallow water zones, aquatic vegetation, planktonic organisms, fish, and other food resources favorable for feeding activities (Satheesh et al., 2024). Porte and Paikra (2024) reported that habitat heterogeneity, water availability, vegetation structure, and food resources strongly influence avian abundance and community composition. The present findings support these observations by demonstrating greater species richness and abundance in habitats with diverse ecological resources and favorable environmental conditions.

Wetlands are globally recognized as highly productive ecosystems that support a wide range of aquatic and semi-aquatic bird species (BirdLife International, 2023). The presence of species such as Great Cormorant (*Phalacrocorax carbo*), Indian Pond

Heron (*Ardeola grayii*), Grey-headed Swamphen (*Porphyrio poliocephalus*), and Little Grebe (*Tachybaptus ruficollis*) further indicates the ecological health and habitat suitability of Asan Barrage. Similar studies by Grimmett et al. (2011) and Patel et al. (2025) reported that wetlands with stable hydrological conditions and diverse vegetation support higher bird abundance and species richness than many terrestrial habitats.

In contrast, the Forest Research Institute campus supported comparatively lower avifaunal diversity and was dominated mainly by resident terrestrial and arboreal bird species. Commonly observed birds such as Rock Pigeon (*Columba livia*), Jungle Babbler (*Turdoides striata*), House Sparrow (*Passer domesticus*), Red-vented Bulbul (*Pycnonotus cafer*), and House Crow (*Corvus splendens*) are well adapted to forest-edge, semi-urban, and human-modified habitats (Grimmett et al., 2011). Similar observations were reported by Ali (2002), who noted that urban and semi-natural forest habitats generally support resident bird communities adapted to anthropogenic disturbances and fragmented vegetation structures.

The occurrence of forest-associated bird species such as White-throated Fantail (*Rhipidura albicollis*), Ashy Drongo (*Dicrurus leucophaeus*), Himalayan Flameback (*Dinopium shorii*), Indian Grey Hornbill (*Ocyrceros birostris*), and Blue-bearded Bee-eater (*Nyctyornis athertoni*) indicates that the FRI campus still retains important habitat characteristics suitable for woodland bird communities (Grimmett et al., 2011; Porte & Paikra, 2024). However, only one migratory species, the Taiga Flycatcher (*Ficedula albicilla*), was recorded from this site, suggesting comparatively lower habitat suitability for migratory waterbirds than the wetland ecosystem of Asan Barrage.

Habitat-wise comparison clearly demonstrated that wetlands support greater diversity of migratory and aquatic birds, whereas forest habitats mainly support resident terrestrial species. This variation may be attributed to differences in habitat structure, food availability, vegetation composition, hydrological conditions, and ecological productivity (Ali, 2002; Porte & Paikra, 2024). Ali (2002) emphasized that habitat diversity is one of the most important determinants of bird distribution and species richness across ecosystems. Similarly, Grimmett et al. (2011) highlighted that ecological parameters such as water availability, vegetation complexity, and climatic conditions strongly influence avian community structure. The present study strongly supports these findings, as the heterogeneous wetland habitat of Asan Barrage exhibited considerably greater avian diversity than the comparatively homogeneous forest ecosystem of the Forest Research Institute.

Present investigation, the conservation significance of wetland and forest ecosystems in maintaining regional biodiversity. Rapid urbanization,

habitat fragmentation, pollution, deforestation, and climate change are major threats to avifaunal diversity worldwide (BirdLife International, 2023). Several migratory bird species depend on wetlands for feeding, resting, and breeding during migration cycles, making wetland conservation critically important for sustaining global bird populations (Patel et al., 2025). Conservation and sustainable management of wetlands such as Asan Barrage are therefore essential for protecting migratory bird populations and maintaining ecological balance. Similarly, preservation of forest patches and urban green spaces such as the Forest Research Institute campus is important for sustaining terrestrial bird communities and maintaining local biodiversity (Grimmett et al., 2011).

V. CONCLUSION

The present study demonstrated significant variation in avifaunal diversity and species composition between the wetland ecosystem of Asan Barrage and the forest habitat of Forest Research Institute. A total of 42 bird species comprising 308 individuals were recorded during the survey period, of which 26 species with 206 individuals were documented from Asan Barrage and 16 species with 102 individuals were recorded from the Forest Research Institute campus. The findings revealed that Asan Barrage supported comparatively higher avifaunal diversity and abundance than the Forest Research Institute, indicating the ecological importance of wetland ecosystems in sustaining diverse bird communities. The wetland habitat was dominated by migratory and aquatic bird species such as Red-crested Pochard, Northern Pintail, Bar-headed Goose, Eurasian Wigeon, and Ruddy Shelduck, demonstrating the significance of Asan Barrage as an important feeding, breeding, resting, and wintering ground for migratory avifauna.

In contrast, the Forest Research Institute mainly supported resident terrestrial and arboreal bird species including Rock Pigeon, Jungle Babbler, House Sparrow, Red-vented Bulbul, and Rose-ringed Parakeet, reflecting the influence of forest and urban-edge habitats on species composition. The study further indicated that habitat characteristics such as water availability, vegetation structure, ecological heterogeneity, and food resources strongly influence bird diversity and distribution patterns. Wetland ecosystems supported greater species richness and abundance due to favorable ecological conditions, whereas the forest habitat mainly supported woodland and urban-adapted resident species. The findings emphasize the ecological and conservation importance of both wetland and forest ecosystems in maintaining regional biodiversity. Conservation and sustainable management of wetlands such as Asan Barrage are essential for protecting migratory bird populations and maintaining ecological balance, while preservation of forest habitats and urban green spaces

such as the Forest Research Institute campus is equally important for sustaining terrestrial avifaunal diversity.

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PK and MC conceptualized and supervised the study and contributed to data analysis, statistical analysis and interpretation of data. HP carried out field survey, data collection and manuscript preparation. SK assisted in study design and manuscript editing. All authors read and approved the final manuscript.

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