

Diversity and Abundance of Winter Migratory Birds at Shivnala Lake, Tehsil Paoni, District Bhandara (M.S.) India.

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Abstract

The present study evaluated the diversity and abundance of winter migratory birds at Shivnala Lake, Paoni Tehsil, Bhandara District, Maharashtra, India, from October 2022 to March 2024. Employing line transect and point count methodologies, we recorded 40 species across 08 orders and 16 families, totaling 1,384 individual birds. The order Anseriformes (ducks and geese) was predominant, comprising 11 species, followed by Passeriformes and Charadriiformes. The Northern Pintail (*Anas acuta*) recorded with the largest number of individuals, accounting for 25.32% of the relative abundance, followed by the Greylag Goose (*Anser anser*). Diversity indices revealed moderate diversity (Shannon-Wiener index $H' = 2.33$), high heterogeneity (Simpson's index $1-D = 0.85$), and low evenness ($J = 0.63$), indicating dominance by a limited number of species. Habitat analysis demonstrated that freshwater ecosystems supported 95% of the overall abundance, with herbivores predominating in the feeding guilds. Site-specific analysis indicated that the Agri-Forest habitat supported the highest abundance, underscoring the significance of mosaic landscapes in sustaining the migratory bird populations. The presence of the vulnerable species, the Common Pochard (*Aythya ferina*), underscores the conservation importance of Shivnala Lake as a critical wetland along the Central Asian Flyway. These findings highlight the ecological value of small- and medium-sized wetlands in central India and their role in maintaining avian diversity in the face of increasing anthropogenic and climatic pressures.

Keywords: Avifauna, Migratory, Diversity, Shivnala Lake, Wetland, Habitat

Introduction

Birds are a key element in the biodiversity of Earth (Kiros et al., 2018). The Indian subcontinent boasts an impressive array of biodiversity, with India being home to 1,340 bird species, representing 13% of the global total of 9,000 bird species. As noted by Ali and Ripley (1987), 176 of these species are unique to the Indian subcontinent. Grasslands, wetlands, and wetland-associated habitats offer perfect conditions for these creatures. Additionally, the Indian state of Maharashtra is home to over 577 bird species. India's variable climate and geography account for its high biodiversity. Avifauna have a significant role in ecosystems (Kushwaha & Kulkarni, 2013; Abie et al., 2019; Vala et al., 2020; Dendup et al., 2021). Wetland ecosystems, which can be seen in numerous topographical and environmental contexts, provide a variety of distinct habitats. Wetlands provide all the necessities and services and act as a key habitat to a large part of the biological diversity (Davidson N. C., D'Cruz R., Finlayson C. M, 2010). India serves as a wintering ground for migratory birds at present. Natural and manmade wetlands in India host many migratory birds comprising local and altitudinal species (Mishra et al., 2019). Migration is subject to effects and changes in environment such as temperature fluctuations, breeding condition and edibility of food. Wetlands provide key habitats to these species, meeting basic requirements such as foods and resting places suited to migration (Buriro et al.

2016). These migratory flyways play a crucial role in biodiversity conservation since they aid species dispersal, nutrient transfer and numerous ecological processes (Cid et al., 2022). Estimating seasonal abundance and diversity of migratory species in these locations can facilitate drawing inferences regarding overall migration patterns in birds and wetland ecosystems (Shah & Sharma, 2022). Measured effects of climate change, habitat fragmentation, aridity, and improper weather have been realized as the most intense and consistent threats hindering declining bird population size, having both direct and indirect effects across the entire community of birds (Janzen 1986; Murphy 1988; Lubchenco et al. 1991; Hannah et al. 1994; Sintayehu 2018). Therefore, monitoring avian diversity, distribution patterns, and ecological relationships is imperative while understanding overall habitat conservation and species diversity. Wetlands represent pivotal ecosystems with intense biological productiveness that provide central habitats to migratory and resident species of birds. Wetlands yield supplies, habitat for roosting places, and breeding habitats, creating ecological connectivity within landscapes (Kumar et al., 2022). India falls within the Central Asian Flyway (CAF) across Arctic Siberia and the Indian subcontinent that constitutes an important migratory flyway covering about 250 migratory species of waterbirds (Sundar et al., 2021). Maharashtra state, especially districts in the east such as Bhandara and Gondia districts, is represented by many natural and manmade wetlands that serve as a critical wintering ground for these species of birds (Jha & Pal, 2020). Located in the Paoni Taluka of the Bhandara District, Shivnala Lake is a moderately sized wetland nestled within an agricultural setting. This aquatic environment features diverse habitats, such as open water, littoral zones, muddy flats, and nearby rice fields, which attract migratory birds in winter. Studies in nearby wetlands in eastern Maharashtra, such as Padav Talav (Nagbhid) and the Navegaon–Nagzira wetland complexes, have recorded notable species diversity among Anatidae, Ardeidae, Charadriidae, and Scolopacidae in winter (Bhowmik et al., 2019; Sharma et al., 2023). However, recent observations have highlighted troubling trends in the arrival of migratory birds throughout central India due to climate change. Reports from Nagpur and Gondia have noted a decrease in winter migrants, such as bar-headed geese (*Anser indicus*), northern pintails (*Anas acuta*), and red-crested pochards (*Netta rufina*), due to fluctuating hydrological conditions, wetland degradation, and human disturbance. Given this ecological and conservation backdrop, a thorough investigation of the diversity and abundance of winter migratory birds at Shivnala Lake is both timely and crucial. This study aimed to (i) assess species richness and abundance patterns, (ii) examine habitat preferences among different foraging guilds, and (iii) identify local conservation challenges and opportunities. The findings of this study will further inform broader wetland management strategies within the Central Indian landscape, ensuring that small- and medium-sized wetlands, such as Shivnala Lake, continue to support avian diversity along the Central Asian Flyway.

“Material and methods”

“Study Area”:

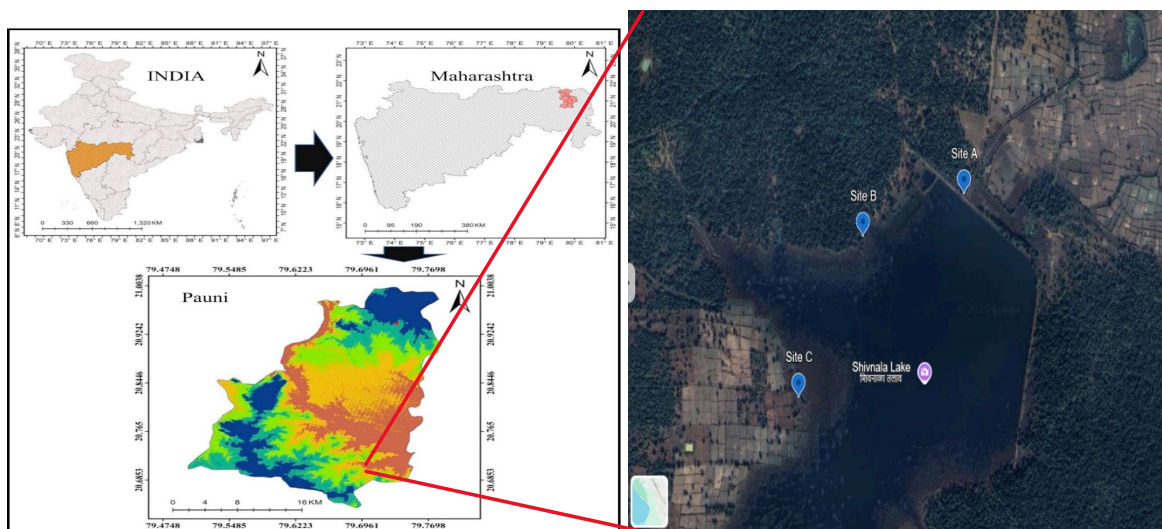


Fig1. Map Paoni Taluka and Shivanala Lake of the District. Bhandara.

The state of Maharashtra falls under a tropical wet and dry climate with three distinct weather conditions: hot, rainy, and cold. March marks the beginning of the summer, and the temperature rises continuously until June. In Bhandara dist., summer temperatures usually rise to between 40 °C and 45 °C. May is the warmest month of the year, with the number of days exceeding 40 °C, and January is the coldest month. The winter season continues until the month of February, with lower temperatures occurring in December and January. Some parts of the inland areas have a hot semi-arid kind of weather due to the rain shadow effect presented by the Western Ghats

Shivnala Lake is a natural perennial water body near Shivnala (Gondi) village in Paoni, Bhandara district, Maharashtra. The study was carried out in Shivnala Lake (20°41'20.9"N 79°41'26.0"E), from October 2022 to March 2024.

Methods:

Observations were taken between 07:30 am and 10:30 am, and from 02:30 pm to 06:00 pm. To document bird diversity, line transect and point count methods were employed. Observations were made using a binocular (Olympus 10x50 S), and photography was done with Canon SX 70HS Bridge Camera and a Nikon 5300 D DSLR. The birds recorded were identified by referring to Ali & Ripley (1981). Field guide Grimmett et al.(2016) was also used to identify the birds, and they were further classified into Resident, Resident Migrant, and Migrant categories using the IUCN Red List database and the eBird web portal.

Data Analysis:

The evenness and diversity calculations were done using different indices of diversity. These encompass the Shannon-Wiener index of diversity, which depicts the diversity of a community by considering the species richness and evenness. The Simpson index of diversity also represents a measure of biodiversity by taking into consideration of the number of species existing and the individual's distribution in the different species. Evenness is also measured as a parameter showing the similarity in the abundance of different species in a given environment. In addition, relative abundance is a term showing how abundant or rare a species exists in comparison to different species in a given community. The relative abundance for the different bird species was calculated by the number of individuals of the species divided by total no. of individuals of all species multiplied by 100.

Results:

The Shivnala Lake data gives a quantitative assessment of avian community structure, with especial emphasis on winter migratory birds. Being a wetland ecosystem of forested and agricultural land use, it is probably the prime seasonal habitat for many species of migratory birds. There were 40 species of winter migrating birds belonging to 08 orders and 16 families documented. (Table 1). Most species were in the order Anseriformes (waterfowls: ducks, geese) with 11 species, while Charadriiformes (waders: plovers, sandpipers) with 7 species and Passeriformes (perching birds: wagtails, shrikes, warblers) with 15 species followed next. High richness indicates that the lake provides diverse ecological niches—open water, muddy shores, and its adjacent terrestrial surroundings—appropriate for a variety of species. (Fig-2,3,4 and 5).

The total number of all birds that migrate was 1384 birds.

The Northern Pintail (*Anas acuta*) was most dominant with 350 birds, creating a Relative Abundance (RA) of 25.32%. It was followed by Greylag -Goose (*Anser anser*, RA=14.80%), Bar headed Goose (*Anser indicus*, RA=6.86%), and Wood Sandpiper (*Tringa glareola*, RA=21.25%). High level of abundance of these species suggests that Shivnala Lake is of utmost importance for foraging and resting for certain waterfowls and waders.

Western Marsh Harrier, Black Stork, Temminck's Stint, and several passerines like warblers and wagtails. These species all exhibit a very low RA (<0.2%), indicating that either they are rare visitors or their habitat is suboptimal for them (Fig.2).

Site A (Forest-Agri): Had the intermediate abundance (363 individuals, 26.22%). This can be explained by the presence of optimal habitat features like the interference of agricultural and forested land.

Site B (Forest): Recorded 156 birds (11.27%). The forested site can host birds that prefer quiet, vegetative shores

Site C (Agri-Forest): The maximum total abundance was recorded at this site (865 individuals, 62.5% of total). This was probably because of a combination of abundant water source and neighboring agricultural fields offering rich foraging opportunities.

“Diversity indices”

‘Shannon-Wiener Diversity Index (H')’: 2.33. Value shows a moderate level of species diversity. It confirms that many species are present, but it is not extremely high, indicating that some species do have substantial dominance (e.g., Northern Pintail).

‘Simpson's Diversity Index (1-D)’: 0.85. This value shows that two randomly selected individuals from the community would most likely (85% probability) be of different species. This reinforces the result of large diversity with predominance of few species.

Pielou's Evenness Index (J): 0.63. This number is below 1, which reflects that the number of individuals dispersed over species is uneven. This data indicates that few species are extremely abundant, while most of the species are quite rare. (Fig.6)

Analysis of Habitat and Feeding Guilds

Habitat Preference: Freshwater species of habitat predominated overwhelmingly with 95.2% of overall abundance, thus underscoring the endemic importance of the lake itself. Terrestrial species, while diverse (15 species), were considerably less abundant (4.8%).

Feeding Guilds: Herbivores made up the largest guild (61.2%), largely due to flocks of geese and ducks. Second were the Omnivores (25.1%), followed by Insectivores (13.2%). Carnivores and Piscivores were few

but occurred in numbers.

Table 1: Diversity of Migratory Avifauna At Shivanala Lake Paoni

“Order”	“Family”	“Species”	“Common Name”	“Migratory Status”	“IUCN Status”
“Accipitriformes”	Accipitridae	<i>Circus aeruginosus</i>	Western Marsh Harrier	‘WV’	‘LC’
“Anseriformes”	Anatidae	<i>Anas acuta</i>	Northern Pintail	‘WV’	‘LC’
		<i>Anser anser</i>	Greylag Goose	‘WV’	‘LC’
		<i>Anser indicus</i>	Bar headed Goose	‘WV’	‘LC’
		<i>Netta rufina</i>	Red crested Pochard	‘WV’	‘LC’
		<i>Aythya ferina</i>	Common -Pochard	‘WV’	VU
		<i>Aythya fuligula</i>	Tufted -Duck	‘WV’	‘LC’
		<i>Mareca strepera</i>	Gadwall	‘WV’	‘LC’
		<i>Anas crecca</i>	Common Teal	‘WV’	‘LC’
		<i>Spatula querquedula</i>	Garganey	‘WV’	‘LC’
		<i>Tadorna ferruginea</i>	Ruddy Shelduck	‘WV’	‘LC’
		<i>Spatula clypeata</i>	Northern Shoveler	‘WV’	‘LC’
Charadriiformes	Burhinidae	<i>Charadrius alexandrinus</i>	kentish Plover	WV	LC
		<i>Charadrius dubius</i>	Little Ringed Plover	WV	LC
Charadriiformes	Scolopacidae	“ <i>Tringa glareola</i> ”	Wood Sandpiper	WV	LC
		“ <i>Tringa ochropus</i> ”	Green Sandpiper	WV	LC
		“ <i>Tringa stagnatilis</i> ”	Marsh Sandpiper	WV	LC
		“ <i>Actitis hypoleucos</i> ”	Common Sandpiper	WV	LC
		<i>Calidris temminckii</i>	Temminck' Stint	WV	LC
Ciconiiformes	Ciconiidae	<i>Ciconia nigra</i>	Black Stork	WV	‘LC’
	“Meropidae”	“ <i>Merops philippinus</i> ”	Blue tailed Bee eater	‘WV’	‘LC’
Passeriformes	Acrocephalidae	“ <i>Acrocephalus Agricola</i> ”	“Paddyfield Warbler”	WV	LC
		“ <i>Acrocephalus dumetorum</i> ”	“Blyth's Reed Warbler”	WV	LC
		“ <i>Acrocephalus stentoreus</i> ”	“Clamorous Reed Warbler”	WV	LC
	Emberizidae	<i>Emberiza melanocephala</i>	Black-headed Bunting	WV	‘LC’
	“Laniidae”	“ <i>Lanius cristatus</i> ”	“Brown Shrike”	‘WV’	‘LC’
		<i>Lanius excubitor</i>	Great Grey Shrike	WV	LC

	Motacillidae	<i>Motacilla cinerea</i>	Grey Wagtail	WV	LC
		<i>Motacilla Flava</i>	Western yellow Wagtail	WV	LC
		<i>Motacilla citreola</i>	Citrine Wagtail	WV	LC
		<i>Antus campestris</i>	Tawny Pipit	WV	‘LC’
		<i>Antus trivialis</i>	Tree Pipit	‘WV’	‘LC’
	“Muscicapidae”	<i>Saxicola maurus</i>	Siberian Stonechat	WV	‘LC’
		<i>“Muscicapa dauurica”</i>	“Asian Brown Flycatcher”	WV	LC
	“Phylloscopidae”	<i>“Phylloscopus collybita”</i>	“Common Chiffchaff”	WV	‘LC’
	“Sturnidae”	<i>“Pastor roseus”</i>	“Rosy Starling”	PM	‘LC’
	Hirundinidae	<i>Petrochelidon fluvicola</i>	Streak-throated Swallow	LM	LC
Podicipediformes	Podicipedidae	<i>Mareca penelope</i>	Eurasian wigeon	WV	LC
Suliformes	Anhingidae	<i>Phalacrocorax carbo</i>	Great Cormorant	LM	LC

‘WV’- “Winter Visitor”, ‘PM’- “Passage Migrant”, LM- Local Migrant, ‘LC’- “Least concern”, ‘VU’- “Vulnerable”

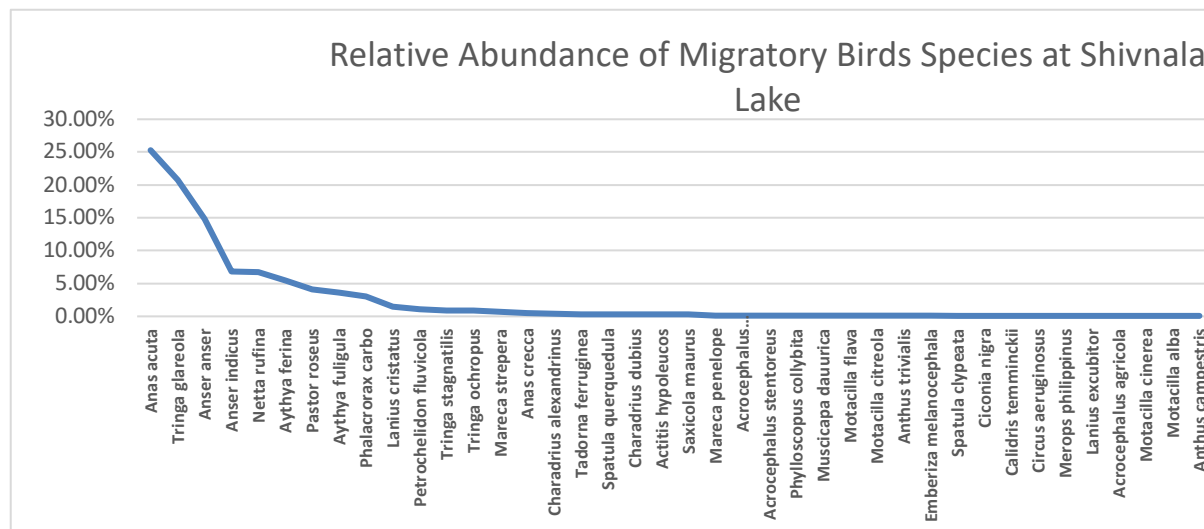


Fig. 2- Species abundance of Migratory Avifauna of Shivnala Lake

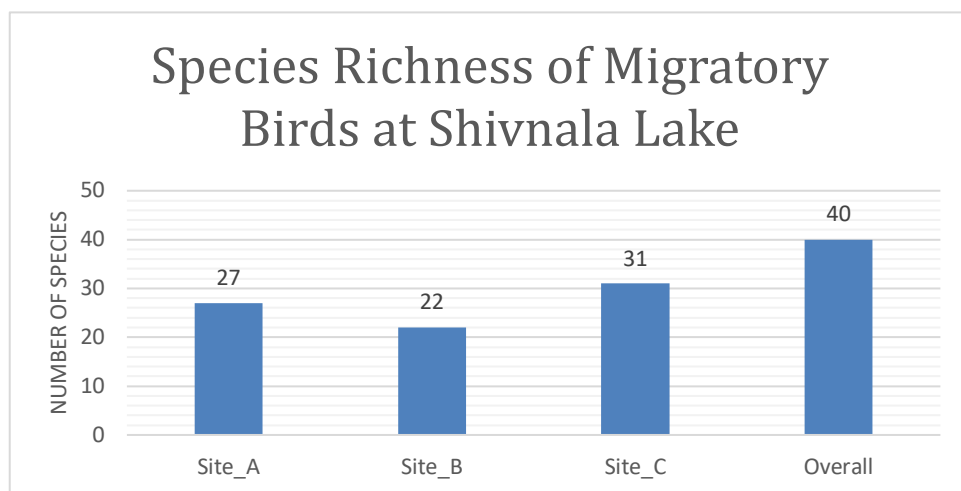


Fig. 3- Sitewise and Overall species richness of Shivnala Lake

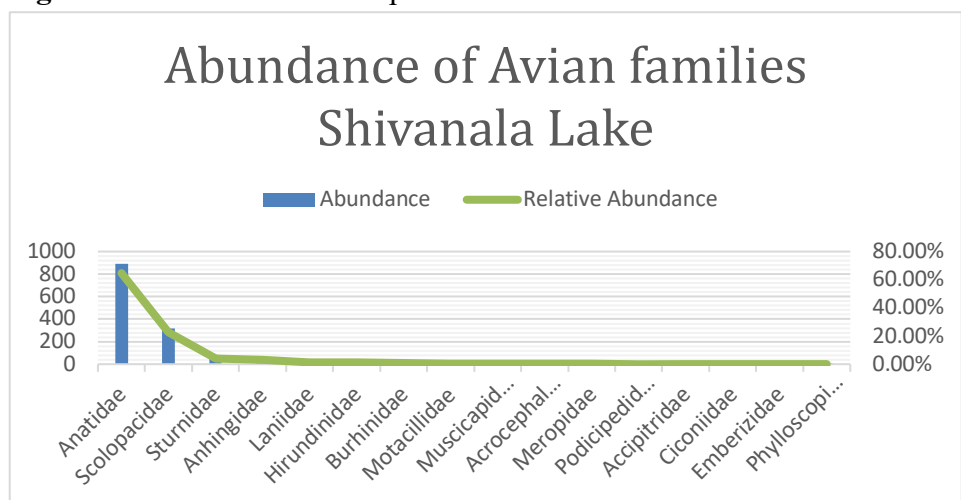


Fig.4- Abundance of Avian Families of Migratory Birds at Shivanala Lake

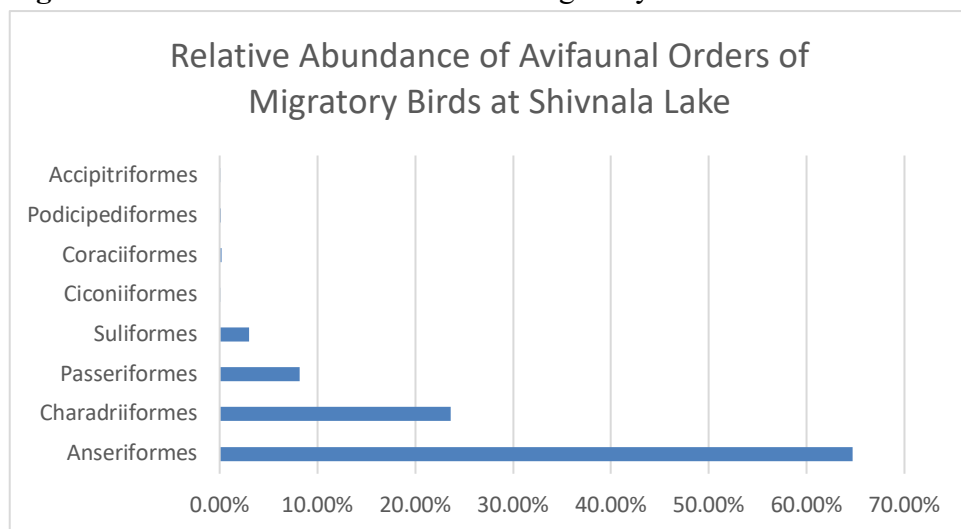


Fig.5- Relative abundance of Avifaunal Orders of migratory Species at Shivnala Lake

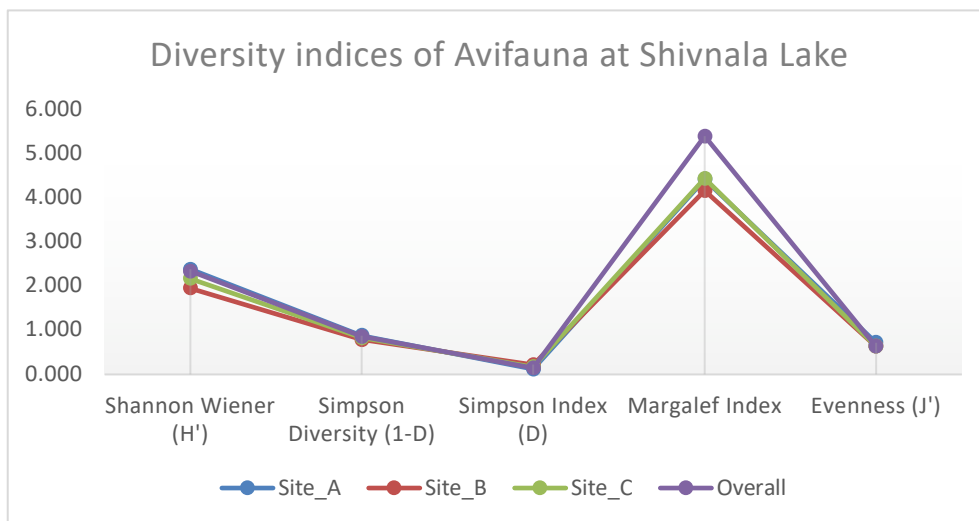


Fig.6 -Diversity Indices of Migratory Avifaunal Diversity of Shivnala Lake

Discussion:

The findings verify that Shivnala Lake represents a regionally important winter migratory bird wetland, especially for waterfowls (Anseriformes) and waders (Charadriiformes). The extremely high species richness of species such as Northern Pintail and Greylag Goose is a unifying characteristic of fertile inland wetlands throughout India that are seasonal stopping-over sites for the Central Asian Flyway race (Grewal et al., 2020; Urfi, 2011). A likely facilitating factor in the excellent roosting and foraging conditions of the lake is a set of lush aquatic vegetation, a major foraging source for herb-eating waterfowls (Batzer & Sharitz, 2006), and proximate crop refuse providing supplemental foraging sites within a landscape mosaic, a process that has been documented in other agro-wetlands of India (Sundar & Kittur, 2013).

The moderate diversity ($H'=2.33$) with low evenness ($J=0.63$) is typical of most Indian wetlands that harbor large, mono-specific or oligo-specific flocks of waterbirds with a complement of less frequent species (Ali & Ripley, 1987; Nameer, 2015). The dominance of a few guilds is typical of productive wetlands that present rich but specific resources (Weller, 1999). The high species richness of passerines, though with low number of birds, is consistent with other studies from other Indian locations, wherein coterminus terrestrial habitats contribute considerably to overall diversity of a wetland complex (Praveen et al., 2020).

High richness at Site C (Agri-Forest) highlights mosaic landscape value for conservation (wetland + farmland) for India. Human-altered landscapes like these can serve as substitute habitats for numerous species, as evidenced from different regions of India (Sundar & Subramanya, 2010). The agricultural fields must supply essential granivorous and herbivorous species with spilled grain and other edibles (Ma et al., 2010) that these species can survive on. It is, however, a double-edged sword that creates a threat to these species' populations, because alterations of farming practices, such as expansion of pesticides or change of cropping patterns, can affect these populations negatively, a risk recorded by (Nameer et al., 2001).

The presence of the Common Pochard (*Aythya ferina*) which is a “vulnerable” species as per ‘IUCN’ adds to the Shivnala Lake's importance for its conservation further. Being documented in Maharashtra's wetlands is of importance, with its population being monitored in the area being of broader implications for its overall conservation (Praveen et al., 2020). This makes it necessary for specific action to safeguard its very specific

requirements for its habitation, most likely involving open water with abundant benthic fauna for foraging purposes (Fox et al., 2016).

Conclusion:

Shivnala Lake is recognized as an ecologically vital wetland that sustains a varied assemblage of winter migratory avifauna, particularly including waterfowl and wading birds. The prevalence of plant-eating guilds, along with the robust populations of species like the Northern Pintail and Greylag Goose, underscores the critical importance of this location for foraging and resting. Despite exhibiting moderate species diversity, the heterogeneous landscape composed of wetland and agricultural zones markedly elevates overall avian abundance, thereby illustrating the significance of anthropogenically altered habitats in the realm of avian conservation. The insights into the Vulnerable Common Pochard elevate the conservation relevance of this area, requiring specialized monitoring and intervention efforts. The implementation of effective wetland management, habitat restoration initiatives, and sustainable agricultural methodologies will be imperative to ensure the preservation of migratory bird populations at Shivnala Lake and throughout the wider Central Asian Flyway.

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