



# Status, Diversity and Species Composition of Wetland Birds on Vaduvor Bird Sanctuary, Tiruvarur District, Tamil Nadu, India

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

Birds serve as the best indicators of wetland function and as measures of success in wetland management, restoration, and creation. This study was conducted from 2022 to 2024 in the Vaduvor Bird Sanctuary of Tiruvarur district, employing the total count method to estimate the population of wetland birds. Year-wise species diversity, richness, relative diversity, evenness, density, and relative abundance were calculated. A total of 147 bird species belonging to 48 families and 18 orders were recorded. The maximum diversity and evenness were observed in 2024 (3.05 and 0.37), while the minimum values were recorded in 2023 (2.11 and 0.21). The total density was highest in 2023 (162.68/ha) and lowest in 2024 (27.82/ha), and species richness peaked in 2022 (117) and was lowest in 2024 (84). This sanctuary complex supports three IUCN Red-listed, four Near Threatened species: Curlew Sandpiper (*Calidris ferruginea*), Spot-billed Pelican (*Pelecanus*

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*philippensis*), Black-headed Ibis (*Threskiornis melanosephalus*), and Oriental Darter (*Anhinga melanogaster*), two vulnerable species: Yellow-throated Bulbul (*Pycnonotus xantholaemus*) and River Tern (*Sterna hirundo*), and one Endangered species – Lesser Sand Plover (*Charadrius mongolus*). This paper provides an overview of the current status and the IUCN status of wetland birds within the study area.

**Keywords:** Wetland, water birds; Vaduvor Bird Sanctuary; year-wise variations.

## 1. INTRODUCTION

Birds are a diverse group of warm-blooded vertebrates known for their feathers, beaks, ability to lay hard-shelled eggs, and, in many cases, their capacity for flight. They inhabit a wide range of ecosystems worldwide, including forests, grasslands, deserts, oceans, woodlands, gardens, swamps, Lakes and Rivers [1,2]. With a greater number of species spread across nearly the entire Earth than any other class of vertebrates [3], birds exhibit a remarkable variety of sizes, from tiny hummingbirds to towering ostriches. Their physical characteristics also vary greatly, including colours, patterns, and specialized adaptations for different lifestyles. Birds are widely acknowledged as essential for biodiversity conservation [4]. Their diversity within an area fulfils crucial ecological functions such as pollination, seed dispersal, and pest control. Additionally, birds are valuable indicators of biodiversity shifts and ecosystem health, serving as bioindicators [5]. Recognizing the importance of each bird species is vital for maintaining ecological balance and a healthy environment [6,7].

The Indian subcontinent is home to approximately 1,340 bird species, constituting over 13% of the global avian diversity [8]. "Among the 1340 bird species found in India, 302 are water birds, 57 are endemic to the region, 3 are breeding endemics, and 85 are classified as threatened" [9]. The birds that are ecologically dependent on wetlands are called waterfowl or aquatic birds according to Ramsar Convention (1975). Wetland is an "Area of marsh, fen, peatland or water whether natural or artificial, permanent or temporary with water, that is static or flowing, fresh, brackish or salt including areas of marine water, the depth of which does not exceed 6 meters" [10,11]. Wetlands, the second most productive ecosystems after tropical rainforests [12], nurture migratory aquatic avian and resident avian species, enhancing wetland richness and productivity [13,14]. "Conserving wetlands is paramount to safeguard threatened and endangered species" [15]. The discharge of

sewage and agricultural runoff constitutes significant factors introducing various nutrients into wetland ecosystems, leading to their degradation and potential demise [16,17]. The Vaduvor Bird Sanctuary serves as a crucial habitat for numerous wetland birds. Despite its importance, there has been a notable absence of systematic studies focusing on wetland birds in terms of seasonal patterns, diversity, evenness, richness, and density. The Vaduvor Bird Sanctuary holds significance as one of the Ramsar sites, highlighting the importance of wetland conservation. Preserving these wetlands not only aids in conservation efforts but also has the potential to boost tourism for the sanctuary. Therefore, this study was undertaken with the primary objective of conducting an inventory of wetland birds within the Vaduvor Bird Sanctuary.

## 2. MATERIALS AND METHODS

### 2.1 Study Area

Vaduvor bird sanctuary (Sri Kodandaramaswami eri) is located between 10°42'9.39"N latitude and 79°19'4.94"E longitude and covers an area of over 128.10 ha (1.28 sq.km) in Vaduvor Agraharam village of Mannargudi Taluk of Tiruvarur District in Tamil Nadu. "It is comprised of small man-made reservoirs connected by an ancient network of canals and these reservoirs are fed by the Mettur reservoir and are situated in the semi-arid district of Thiruvarur was created in 1999. The tank water is extensively utilized by the villagers for agriculture. As the sanctuary is basically an irrigation tank, there is no forest vegetation within the sanctuary. *Acacia nilotica* plantations raised by Social Forestry Wing stand on the western boundary of the sanctuary. Other species present in the sanctuary include *Azadiracta indica*, *Melia azadirach*, *Pongamia pinnata*, Coconut, Palmyrah, etc. A variety of medicinal plants, mostly in the form of shrubs and climbers, come up annually on the sanctuary bunds. A large portion of the tank on the northern side,

close to the steel watch tower, has been encroached by Water hyacinth and Ipomoea. Likewise, the aquatic submerged and terrestrial vegetation present in and around the wetland serve as essential foraging and breeding grounds for the birds. The interconnected wetland system plays a crucial role as a protective barrier against flooding and also serves as a water source during periods of drought. However, the Sanctuary faces mounting anthropogenic pressures stemming from urbanization, water extraction, unsustainable fishing practices, invasive species, and climate change. Consequently, it has been designated as an area of national significance by the government. To address these challenges, the Tiruvarur Forest Division implemented a management plan spanning from 2016 to 2021" [18].

## 2.2 Methodology

The field survey was conducted last three years from 2022 to 2024 using the total count method. Wherever possible, researchers walked in and around the wetlands or selected specific vantage points to count all the birds (only seen) and the same pathway was used for whole survey [19]. The survey was carried out during dusk and dawn times, from 6:30 am to 10:00 am in the morning and 4:00 pm to 6:30 pm in the evening. Observations were made using binoculars (Nikon 7x50), and photographs of birds were taken using a camera (Nikon P900). Bird identification was confirmed using reference books such as "Birds of the Indian Subcontinent" [20] and "The Book of Indian Birds" by Salim Ali (1996).

## 2.3 Data Analysis

Shannon-Weiner index of diversity [21] was used to assess the bird species diversity in Vaduvor Bird Sanctuary.

The formula for calculating the Shannon diversity index is

$$H' = - \sum P_i \ln P_i$$

Where H' = Shannon index of diversity, P<sub>i</sub> = the proportion of the i<sup>th</sup> species in the landscape element, Ln P<sub>i</sub> = Natural logarithm of the proportion of each species.

Richness was calculated by counting the number of species observed in a particular season and particular place [22].

Species richness = Number of species recorded

Pielou's evenness index was utilized to estimate the species evenness within the Vaduvor Bird Sanctuary. This index provides a measure of how evenly distributed the individuals are among different species, indicating the level of evenness in the community [12].

$$\text{Evenness/Equitability} = H'/H'\text{max}$$

Where, H' = Value recorded from Shannon-Weiner diversity index and H' max = Maximum possible value of H'.

The Relative Abundance [23,24] was analyzed from the collected data during the study period using the following formula:

$$\text{Relative Abundance} = (\text{Number of individual of species} / \text{Number of individuals of all species}) \times 100$$

Density indicates the number of individuals of a species in a specific area. It's calculated by dividing the total number of individuals of each species during a certain season by the total area of the wetland [25].

## 3. RESULTS AND DISCUSSION

The current investigation revealed that 147 species of birds belonging to 48 families and 18 orders were recorded during last 3 years in Vaduvor bird sanctuary. During this study, 140 Least Concern, four Near Threatened species viz., Curlew Sandpiper *Calidris ferruginea*, Spot billed Pelican *Pelecanus philippensis*, Black Headed Ibis *Threskiornis melanosephalus* and Oriental Darter *Anhinga melanogaster*; two Vulnerable viz., Yellow Throated Bulbul *Pycnonotus xantholaemus* and River Tern *Sterna hirundo* and one Endangered – Lesser Sand Plover (*Charadrius mongolus*) were observed (Fig. 1). Vijayan et al. [26] was conducted the survey in Vaduvor bird sanctuary who recorded the totally 24 species of wetland birds. This research finding was in line with findings of Baranidharan et al. [27] in Karaivetti bird sanctuary, with a total of 36 species of birds belonging to 13 families and 4 orders with Six Near Threatened species observed Oriental Darter (*Anhinga melanogaster*), Painted Stork (*Mycteria leucocephala*), Spot billed Pelican (*Pelecanus philippensis*), White Necked Stork (*Ciconia episcopus*), White Ibis (*Threskiornis*

*melanocephalus*) and Black-Tailed Godwit (*Limosa limosa*). In addition, one IUCN Red List Vulnerable Species River Tern (*Sterna aurantia*) was found to be in the Karaivetti bird sanctuary. Similar study was conducted by Krishnamoorthi et al. [6]. who found the 72 species of birds belonging to 38 families and 17 orders with three Near Threatened species Oriental Darter *Anhinga melanogaster*, Painted Stork *Mycteria leucocephala* and Spot billed Pelican *Pelecanus philippensis* in Vellode bird sanctuary. A similar study was done by Vas et al. [28] in Neyveli Lignite Corporation India Limited (NLCIL) in Neyveli, Tamil Nadu who identified the 107 different species comprising of 21 orders and 45 orders with three Near Threatened species.

### 3.1 Species Diversity

Regarding the species diversity in Vaduvloor bird sanctuary during different years, the maximum species diversity was recorded in the 2024 (3.05) followed by 2022 (2.63) whereas the minimum species diversity was obtained in the 2023 (2.11). Similar findings were found by Manohara et al. [29] on analysing the species diversity in Magadi bird sanctuary, Karnataka and they reported that the maximum diversity in 2012-2013 (1.01) and minimum diversity in 2015-16 (0.64). Concerning to the species richness of Vaduvloor bird sanctuary, the highest richness was found in the 2022 (117) followed by 2023 (93) and the lowest species richness was noted in the 2024 (84). A

similar finding was found by Manohara et al. [29] in Magadi bird sanctuary, Karnataka with maximum species richness was observed in 2012-13 (33) and minimum in 2015-16 (27). Pertaining to evenness of Vaduvloor bird sanctuary the highest evenness was noted during 2024 (0.37) followed by 2022 (0.29) and the lowest evenness was recorded during 2023 (0.21) (Table 1 & Fig. 2 & 3). The results were in accordance with findings of Anika and Parasharya (2013) with maximum evenness during summer ( $0.6273 \pm 0.0518$ ) and minimum in winter ( $0.5117 \pm 0.0285$ ) in Khodiyar wetland, Gujarat.

### 3.2 Total Density

The current investigation revealed that the maximum total density of Vaduvloor bird sanctuary was recorded in 2023 (162.68/ha) followed by 2022 (72.07/ha) whereas the minimum total density was recorded in 2024 (27.82/ha). This result was in line with the results of Krishnamoorthi et al. [6] who stated that the maximum total density was observed in monsoon season (1556.99/sq.km) and the lowest observed in the winter season (948.18 /sq.km) in Vellode bird sanctuary (Table 1 & Fig. 3). Pertaining to the species density, the highest density was obtained in the Black Headed Ibis (31.226/ha) followed by Asian Open Billed Stork (6.766/ha) and Baya weaver (4.356/ha) while the lowest density (0.003/ha) was noted in the Cinnamon bittern, Wood sandpiper, Glossy ibis, Yellow

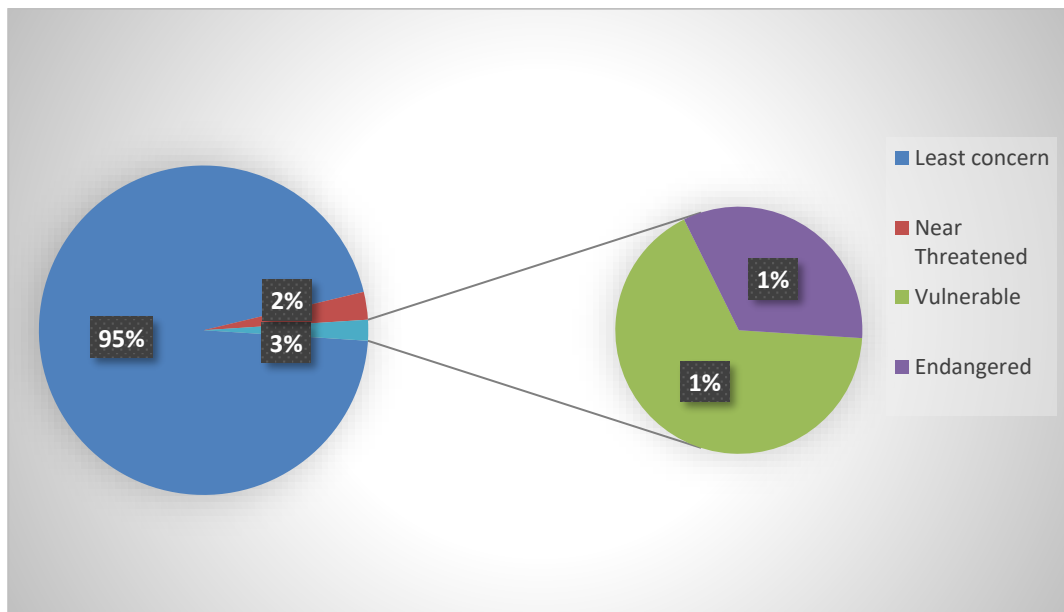
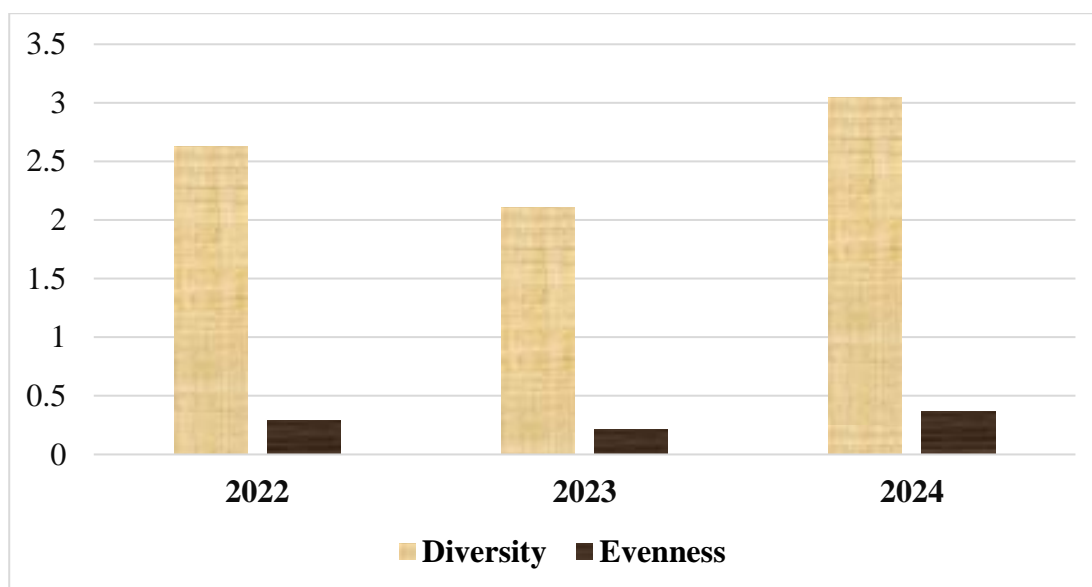


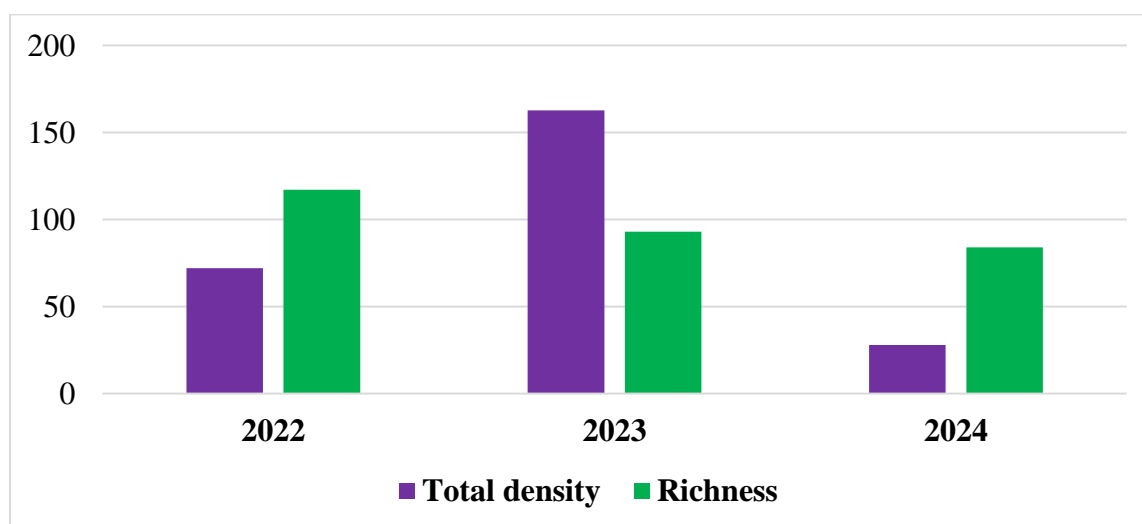
Fig. 1. IUCN status of birds in Vaduvloor bird sanctuary

**Table 1. Year-wise avian species diversity, total density richness and evenness of Vaduvloor bird sanctuary**

Year	Total density	Richness	Diversity	Evenness
2022	72.07	117	2.63	0.29
2023	162.68	93	2.11	0.21
2024	27.82	84	3.05	0.37



**Fig. 2. Year-wise avian diversity and evenness of Vaduvloor bird sanctuary**



**Fig. 3. Year-wise avian density and richness of Vaduvloor bird sanctuary**

Bittern, Ruff, Indian paradise flycatcher, Crested Serpent Eagle, Indian pitta, Western Marsh Harrier and Jerdon's Bushlark. In 2023, the maximum density was obtained in Cattle Egret (46.838/ha) followed by Asian Open-bill Stork (36.230/ha) and Black-headed Ibis (36.066/ha) while the minimum density (0.008/ha) was

obtained in the Sirkeer Malkoha, Blue-faced Malkoha, Grey-bellied Cuckoo, Common Cuckoo, Shikra, Greater Racket-tailed Drongo, Loten's Sunbird, Gray Wagtail and White-browed wagtail. In 2024, the highest density was noted in the Cattle Egret (4.411/ha) followed by Common Myna (3.903/ha) and House Crow (3.123/ha) and

the lowest (0.008/ha) in Blue-faced Malkoha, Indian Cuckoo, Common Tern, Purple Heron, Indian Golden Oriole and Booted Warbler. This result was in consonance with the results of Baranidharan et al. [7] who stated that the maximum density was recorded in Large Egret (57/sq. km) followed by Cattle Egret (56/sq.km), Little Cormorant (50/sq.km), Spot Bill duck (32/sq.km) and the lowest density as recorded in Darter, Purple Heron, Eurasian Spoon Bill and Common Teal (1.5 /sq.km) in Karaivetti bird sanctuary.

### 3.3 Relative Abundance

Pertaining to relative abundance during different years, the highest relative abundance was noted in the Black headed ibis (43.32%) followed by Asian open billed stork (9.38%) and Baya weaver (6.04%) while the minimum (0.004%) was noted in the Cinnamon bittern, Wood sandpiper, Glossy ibis, Yellow Bittern, Ruff, Indian paradise flycatcher, Crested Serpent Eagle, Indian pitta, Western Marsh Harrier and Jerdon's Bushlark in 2022. In 2023, the highest relative abundance was observed in Cattle Egret (28.79%) followed by Asian Open-bill Stork (22.27%) and Black-headed Ibis (22.16%) while the lowest relative abundance (0.005%) was recorded in the Sirkeer Malkoha, Blue-faced Malkoha, Grey-bellied Cuckoo, Common Cuckoo, Shikra, Greater Racket-tailed Drongo, Loten's Sunbird, Gray Wagtail and White-browed wagtail. In 2024, the maximum relative abundance was noted in the Cattle Egret (15.85%) followed by Common Myna (14.03%) and House Crow (11.22%) and the lowest (0.028%) in Blue-faced Malkoha, Indian Cuckoo, Common Tern, Purple Heron, Indian Golden Oriole and Booted Warbler. Bibi et al. (2003) reported similar findings "in Taunsa Barrage wildlife sanctuary, Pakistan and observed Eurasian Coot was the most abundant species (13.3%) followed by Cattle Egret (12.3%), Little White Egret (11.5%), Common Pochard (8.9%), House Crow (5.8%) etc" [30,31].

### 4. CONCLUSION

The Vaduvor Bird Sanctuary plays a crucial role as a feeding and wintering site for a significant population of resident and migratory waterbirds. This research offers valuable insights, information, and understanding regarding the avifauna present in the sanctuary located in Thiruvavur district. Of particular note are the findings concerning several bird species

categorized as follows: Four Near Threatened species, namely the Curlew Sandpiper, Spot-billed Pelican, Black-headed Ibis, and Oriental Darter; two Vulnerable species, the Yellow-throated Bulbul and River Tern; and one Endangered species, the Lesser Sand Plover. Specific conservation strategies are needed to safeguard these species, utilizing information gleaned from this study and future management activities. These strategies may include adaptation measures to mitigate the impacts of climate change, community engagement initiatives, policy advocacy efforts, as well as measures to control grazing and protect habitats.

### Appendix is available in the following link:

[https://journaljaeri.com/media/appendix\\_2024\\_JAERI\\_116019.pdf](https://journaljaeri.com/media/appendix_2024_JAERI_116019.pdf)

### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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