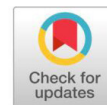


# Study on Seasonal Variations of Wetland Birds in Karaivetti Bird Sanctuary, Ariyalur, Tamil Nadu, India



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## Abstract

Birds are a key to natural resources that support ecology and ecological services with their vibrant colors and stunning beauty are also a well-known biological indicator of an ecosystem's health. The study was conducted during January 2020 to December 2020 in Karaivetti bird sanctuary. The species diversity, richness, relative diversity, evenness, density and relative abundance were calculated. Totally 36 species of wetland birds belonging to 13 families and 4 orders were recorded. The maximum diversity was recorded in Pre-Monsoon ( $7.69 \pm 1.21$ ), Monsoon ( $7.69 \pm 1.06$ ), and Winter ( $7.69 \pm 0.97$ ), and the least diversity was recorded in Summer ( $2.78 \pm 0.98$ ). The density was recorded high in Winter followed by Monsoon, Summer season and the least in the Pre-Monsoon season. This sanctuary complex supports Six IUCN Red listed Near Threatened species 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*) also One IUCN Red list Vulnerable Species River Tern (*Sterna aurantia*) and 29 birds are Least Concern.

**Keywords:** Wetland, Seasonal variations, Water Birds, Diversity Karaivetti

## Introduction

The class Aves contains more species distributed over the entire earth than other class of vertebrates. Birds form an important component of an ecosystem [16] as a part of a food web, potential pollinators, and bioindicators [21]. In worldwide, 9930 species of birds exist and belong to 204 families [10]. The Indian subcontinent, a part of the vast Oriental Biogeographic regions, has very rich in biodiversity. Indian biodiversity includes a large number of

species of invertebrates, 2546 species of fishes, 204 species of amphibians, 440 species of reptiles, 1266 species of birds, and 400 species of mammals. India consists of 13% of the world's bird fauna [12]. Out of 1266 species of birds, 302 species are water birds, 57 species are endemic, 3 species are breeding endemic and 85 species are threatened (TH) [7]. Avians are playing a significant role as seed dispersal agents, scavengers, and pollinators, control the insect pest, and bio-fertilizer and are an important indicator to evaluate the quantitative and qualitative of different habitats [20]. The birds are also an identifier of both terrestrial and aquatic changes and are used as a potent indicator of long-term environmental disturbances such as water pollution, anthropogenic damages, air pollution, habitat distraction, and urbanization. Birds are excellent indicators of water quality and measures of biodiversity [15]. The birds that are ecologically dependent on wetlands are called waterfowl or aquatic birds [23]. Wetland is an "Area of marsh, fen, peatland or water whether natural or

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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” [23]. Discharge of sewage and agricultural runoff are the two major factors for entering various nutrients into the wetland ecosystem and resulting in the death of those ecosystems [26]. Karaivetti bird sanctuary plays a vital role in harboring shelter for many wetland birds, still, now there is no systematic study on wetland birds concerning season, diversity, evenness, richness, and density. Hence this work was taken with the prime objective to make an inventory of the wetland birds in Karaivetti Bird Sanctuary.

## Materials and Methods

### Study area

The bird diversity assessment was carried out in Karaivetti Bird Sanctuary, is a protected area located at Karaivetti village in Ariyalur District of Tamil Nadu, South India. The freshwater lake is fed by Pullambadi and Kattalai canals. It is the largest waterbody in the district and attracts the large number of birds every year. The natural and planted vegetation present inside and on the edges of the lake consist of *Acacia nilotica*, *Prosopis chinensis*, *Azadirachta indica* and *Tamarindus indica*. Farmlands especially paddy, sugarcane, cotton, castor and maize surround the lake and are irrigated by the lake waters.

The sanctuary has been notified under Sec-18(1) of the Wildlife Protection Act 1972, Established on April 5, 1999, as “Karaivetti Bird Sanctuary” by the Tamil Nadu forest department. Recently, the lake has also been identified as one of the Important Bird and Biodiversity Areas (IBA) in India by Indian Bird Conservation Network [7]. About 200 bird species are recorded from this sanctuary that largely nests during the northeast monsoon. The sanctuary has an area of 321 Sq.Km with 108 Sq. Km of National Park area. The Rainfall ranges from 800 to 2000 mm.

Karaivetti Bird Sanctuary is home to migratory birds such as the Bar-headed goose, Northern pintail, White Stork, Northern Shoveler, Garganey, Blue-winged teal, Osprey, and Common Sandpiper. Globally threatened species such as Greater Spotted Eagle, Oriental Darter, Black-headed ibis, and Spot-billed Pelican were reported from this wetland. Karaivetti is one of the important active heronries in Tamil Nadu [22]. Spot-billed Pelican, Black-headed Ibis, Painted Stork, and Oriental Darter Eurasian Spoonbill are

some of the bird species breeding in this sanctuary [14]. The sanctuary lies within 10°58’ 19.61”North and 79°02’ 58.87”East.

## Methodology

The field survey was conducted every month from January 2020 to December 2020 using the total count method. Wherever possible, walking in and around the wetlands or from specific vantage points should be selected, and count all the birds [13]. The bird survey was conducted during dusk and dawn times (6:30 am to 10:00 am in the morning and 4:00 pm to 6:30 pm in the evening) and observations were carried out by using Binocular (Nikon 7x50) and Photographs of birds using a Camera (Nikon P900). Bird identification was confirmed from the book viz., Birds of the Indian Subcontinent [12] and The Book of Indian Birds [1]. The density is an utterance of the numerical strength of a particular species where the total number of individuals of each species in a particular season is divided by the total area of the wetland [22].

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

Where,  $H'$  = Value recoded from Shannon-Weiner diversity index,  $H' \text{ max}$  = maximum possible value of  $H'$

## Results and Discussion

The results revealed that 36 species of birds belonging to 13 families and 4 orders were found to be in the Karaivetti bird sanctuary. During this study, 29 Least Concern and Six Near Threatened species were 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*) also One IUCN Red List Vulnerable Species River Tern (*Sterna aurantia*). This research finding was in line with the findings of Guptha *et al.*, (2011), with a total of 78 species of birds belonging to 33 families and three species of Near Threatened as observed in Coimbatore, Trichy, Perambalur, and Thiruvarur district wetlands. This study revealed that the Shannon-Weiner index of bird diversity was maximum as found in Pre-Monsoon ( $7.69 \pm 1.21$ ), Monsoon ( $7.69 \pm 1.06$ ), Winter ( $7.69 \pm 0.97$ ), and the least diversity was recorded in Summer ( $2.78 \pm 0.98$ ). The density was recorded high in Winter

followed by Monsoon, Summer season, and the least in the Pre-Monsoon season. (Table.1 and Figure.1). Similar findings were found by Ekhande *et al.*, (2012) in analyzing the species diversity in Yashwant Lake. They reported the maximum diversity during winter ( $3.5 \pm 0.02$ ) and the minimum in monsoon ( $2.4 \pm 0.02$ ). The maximum richness was recorded in the winter season (60) and minimum in the monsoon season (58) (Table.1 and Figure.2). A similar finding was found by [19] in Bakhira Tal, Dist. Santkabir Nagar, Uttar Pradesh, India with maximum species richness was recorded.

### Data analysis

Shannon-Weiner index of diversity (Shannon and Wiener, 1963) was used to assess the bird species diversity in Vellode Bird Sanctuary.

The formula for calculating the Shannon diversity index is

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

Where  $H'$  = Shannon index of diversity,

$P_i$  = the proportion of the  $i$ th species in the landscape element,

$\ln P_i$  = Natural logarithm of the proportion of each species.

### Relative Diversity

Relative diversity (RD<sub>i</sub>) was calculated for each family and it was defined as the ratio of the total number of species in a particular family to total number of species in a recorded season (Mazumdar, 2019).

Richness was calculated by counting the number of bird species recorded in season [15]. The formula for calculating the richness is Species richness = Number of bird species recorded.

The Relative Abundance [3-4] was analyzed from the collected data during the study period using the following formula:

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

in the Winter, Monsoon, and Pre-Monsoon seasons (36 Sp.) and minimum in the summer season (31 Sp.). Among the species evenness, the Pre-Monsoon season had the maximum evenness ( $0.78 \pm 0.01$ ) and

lowest in the Winter season ( $0.62 \pm 0.01$ ) (Table.1 and Figure.1). The results were following findings of [2] with maximum evenness during summer ( $0.6273 \pm 0.0518$ ) and minimum in winter ( $0.5117 \pm 0.0285$ ).

### Density

The highest total density was observed in the winter season ( $7142.58 \pm 198.40$  /sq.km) and the lowest was observed in the Pre-Monsoon season ( $415.288 \pm 11.530$  /sq.km) (Table.1). This result was in line with the results of Rathod and Padate (2007) who stated that the highest density was recorded during winter ( $859.72 \pm 583.89$ ) and minimum density in monsoon ( $292.42 \pm 193.76$ ). In the monsoon season, Little cormorant had the highest species density (1910/sq.km) followed by Glossy Ibis (983), White Ibis (582/sq.km), Little Egret (561/sq.km), Red Wattled Lapwing (532/sq.km) and Northern Shoveler (483/sq.km), Cattle Egret (381/sq.km), Pond Heron (180/sq.km), Spot Bill Duck (165/sq.km), Large Egret (88/sq.km), Grey Pelican (21/sq.km) Darter (13/sq.km) and White Necked Stork (0.34/sq.km) with the lowest density. In the Pre-Monsoon season, Little egret (57/sq.km) recorded for highest density which was 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 Knight Heron (16/sq.km), Common Coot (15/sq.km), Large Egret were (11/sq.km), Darter, Purple Heron, Eurassian Spoon Bill, Common Teal were (1.5 /sq.km) (Table.2). This result aligned with the results of [17] who reported that, highest and lowest densities in Sal forest were of Plum-headed parakeet (11.63/sq.km) and blue whistling thrush (0.06/sq.km) respectively.

### Relative Diversity

In the winter season, Threskiornithidae (22.35) was the most dominant family followed by Phalacrocoracidae (26.94), Ardeidae (19.2) Anatidae (13.14), and all the remaining families Rallidae, Podicipedidae, Phalacrocoracidae, Pelicanidae, Laridae, Jacanidae, Dendrocygninae, and Ciconidae had the RD value less than 3.50. In the Pre-monsoon season, the maximum relative diversity was found in the Ardeidae family (40.72) followed by Phalacrocoracidae (12.45) Threskiornithidae (11.46) Ciconidae (10.36) Anatidae (8.08) Rallidae (6.01) and other families had RD value less than 3.50. Similar findings were reported by Mazumdar [18] in the human-modified wetland of Okhla bird sanctuary. He reported that the highest relative diversity was recorded from Ardeidae (4.30)

**Table 1:** Avian species diversity, total density richness, and evenness during Pre-monsoon and winter seasons

S. No.	Season	Diversity	Total density(sq.km)	Richness	Evenness
1.	Pre-Monsoon	(7.69±1.21)	(415.288±11.530/sq.km)	6.63	(0.78±0.01)
2.	Winter	(7.69±0.97)	(7142.58±198.40/sq.km)	5.37	(0.62±0.01)
3	Monsoon	(7.69±1.06)	(6164.67±333.22/sq.km)	5.42	(0.68±0.01)
4	Summer	(2.78±0.98)	(2583.49±139.64/sq.km)	5.76	(0.63±0.01)

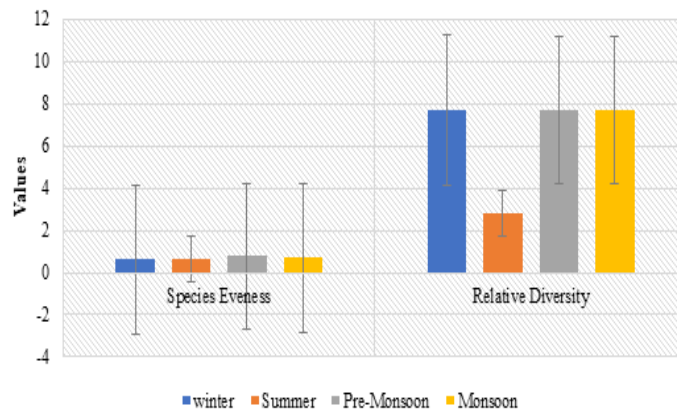
**Table2:** Avian species density and relative abundance during Pre-monsoon and winter seasons

S.No	Species Name	Pre-monsoon		winter	
		Density(sq.km)	RA(%)	Density(sq.km)	RA(%)
1	Little Grebe	6.244493	0.00015	78.28194	0.0001096
2	Little Cormorant	50.44053	0.001215	1910.793	0.0026752
3	Darter	1.292952	3.11E-05	13.64097	1.91E-05
4	Grey Pelican	9.581498	0.000231	21.60793	3.025E-05
5	Little Egret	57.2467	0.001378	561.1233	0.0007856
6	Large Egret	11.89427	0.000286	88.68282	0.0001242
7	Cattle Egret	56.28855	0.001355	381.1674	0.0005337
8	Pond Heron	13.34802	0.000321	180.3965	0.0002526
9	Night Heron	16.05727	0.000387	84.71366	0.0001186
10	Purple Heron	1.376652	3.31E-05	22.19163	3.107E-05
11	Grey Heron	12.90749	0.000311	58.31498	8.164E-05
12	Open Pill Stork	13.64537	0.000329	142.5441	0.0001996
13	Painted Stork	29.39427	0.000708	24.51542	3.432E-05
14	White-Necked Stork	0	0	0.348018	4.872E-07
15	White Ibis	31.21145	0.000752	582.5991	0.0008157
16	Glossy Ibis	14.86784	0.000358	983.7004	0.0013772
17	Eurassian Spoon Bill	1.539648	3.71E-05	30.35242	4.25E-05
18	Whishiling Duck	0.264317	6.36E-06	48.34802	6.769E-05
19	Spot Bill Duck	32.1696	0.000775	165.6828	0.000232
20	Common Teal	1.255507	3.02E-05	148.8546	0.0002084
21	Cotton Teal	0	0	16.28855	2.28E-05
22	Garganey	0	0	69.76872	9.768E-05
23	Northern Shoveler	0	0	483.5793	0.000677
24	Northern Pintail	0	0	22.57709	3.161E-05
25	Eurassian Wigeon	0	0	3.072687	4.302E-06
26	Bar Headed Goose	0	0	28.74449	4.024E-05
27	River Tern	9.922907	0.000239	105.5066	0.0001477
28	Common Coot	15.55066	0.000374	112.6652	0.0001577
29	Purplr Morhen	2.081498	5.01E-05	30.24229	4.234E-05
30	White Breased Waterhen	7.334802	0.000177	38.44714	5.383E-05
31	Pheasand-Tailed Jacana	0	0	22.31278	3.124E-05
32	Black-Tailed Godwit	0	0	55.17621	7.725E-05
33	Common Sand Piper	3.204846	7.72E-05	22.7533	3.186E-05
34	Wood Sand Piper	5	0.00012	26.663	3.733E-05
35	Red Wattled Lap Wing	7.53304	0.000181	532.0925	0.000745
36	Black Winged Stlit	3.634361	8.75E-05	44.8348	6.277E-05

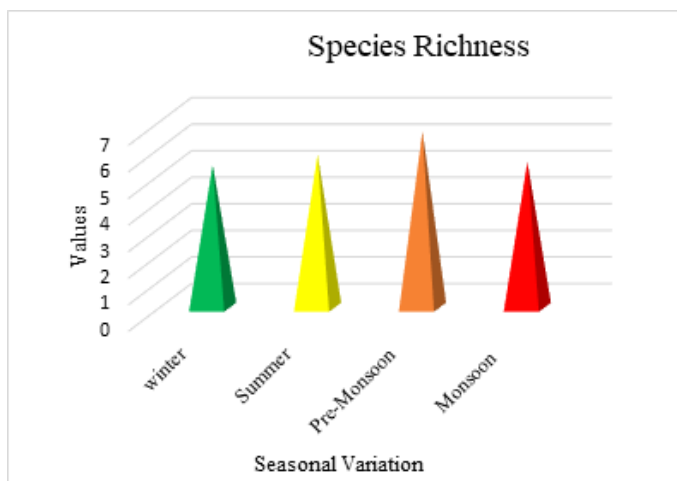
\*RA- Relative Abundance



family followed by Anatidae (3.84), Recurvirostridae (2.25), Sturnidae (2.18) Columbidae (2.12), Lariidae (2.12) and Cisticolidae (1.92).



**Fig 1:** Avian diversity (Shannon-Weiner diversity indices) and evenness in Monsoon and winter seasons of Karaivetti Bird Sanctuary



**Fig 2:** Species richness in Pre-Monsoon and winter seasons of Karaivetti Bird Sanctuary

### Relative abundance

In the winter season the highest relative abundance was observed in Garganey (9.76%) followed by Grey Heron (8.16%), Whistling Duck (6.79%) Black Winged Stilt (6.27) White Breasted waterhen (5.38), and lower relative abundance were recorded in Little Grebe, Little Cormorant, Little Egret, Cattle Egret, Pond Heron, Night Heron, Open bill Stork, White Ibis, Glossy Ibis, Common Teal, Northern Shoveler, River Tern, Common Coot, and Red Wattle Lapwing Eurasian (0.01%). In the Pre-Monsoon season, the highest relative abundance was observed in Black Winged Stilt (8.75%) and followed by Common Sand Piper (7.72%), Whistling Duck (6.36%), Purple Moorhen (5.01), and lower relative abundance was recorded in Little Grebe, Little Cormorant, Little Egret, Cattle Egret, Pond Heron, Night Heron, Open

bill Stork, White Ibis, Glossy Ibis, Common Teal, Northern Shoveler, River Tern, Common Coot, and Red Wattle Lapwing Eurasian (0.0003%) (Table.2). Bibi [5] 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.

### Conclusion

Karaivetti bird sanctuary serves as an important feeding and wintering ground for a large number of migratory water birds. This study gives new insight, information, and knowledge on the avifauna of

Karaivetti bird sanctuary, Ariyalur district. The near-threatened species like the Painted Stork, White Necked Stork, Oriental Darter, Grey pelican, White Ibis, and Black-Tailed Godwit Also One Vulnerable Species of River Tern and others are to be safeguarded with specific conservation strategies in conjunction with the information available through this study.

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