

Species Diversity of Avifauna in Vellayani and Kadinamkulam Wetlands of Thiruvananthapuram

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Abstract

Wetland ecosystems occupy only 6% of the earth's surface, yet they support approximately 20% of all living organisms and considered to be the most productive source of biodiversity. These diverse ecosystems benefit human being directly or indirectly through several hydrological and ecological functions. Diversity of flora and fauna is an obvious indicator of environmental health of wetland habitats. This paper reviews avian species diversity as an indicator of wetland wealth at two major lacustrine ecosystems viz. Vellayani and Kadinakulam in Thiruvananthapuram district of Kerala. Field observation was carried to model bird species abundance using line transect method. Diversity analysis *Shannon Diversity Index H'* showed values for 2.16 and 2.83 for Vellayani and Kadinamkulam respectively. Evenness/Equitability indices derived for the selected sites are 0.652 and 0.541. The study also identified adverse impacts of urbanization and habitat degradation detrimental to the avian species abundance in the study area.

KEYWORDS: Wetlands, Avifauna, Species Diversity, Shannon Diversity Index, GIS.

INTRODUCTION

A wetland is a land area that is saturated with water, either permanently or seasonally, such that it takes on the characteristics of a distinct ecosystem. Wetlands are the transitional lands between terrestrial and aquatic eco-systems where water table is near the surface or the land and is covered by shallow water (Mitsch and Gosselink, 1986). They are the most productive ecosystems play a vital role in flood control, aquifer recharge, nutrient absorption and erosion control. In addition, wetlands provide home for a many species of wildlife such as birds, mammals, fish, frogs, insects and plants. Under *Convention on wetlands (Ramsar, Iran, 1971)*, wetlands are defined as "areas of marsh, fen, peat land 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 at low tide does not exceed six metres". Wetlands support high concentrations of animals including mammals, birds, fish and invertebrates and serve as nurseries for many of these species. Many bird, insect, and other wildlife species are completely dependent on wetlands for critical stages in their life cycles, while many other species make use of wetlands for feeding, resting, or other life activities.

The concept of diversity arises quite naturally in various subject areas. Intuitively, diversity is related to the apportionment of some quantities into a number of well-defined categories, which may take the form of resources, investment, time, energy, abundance, etc, according to the problem under study (Patil and Talle, 1979a). In an ecological framework, the diversity concept relies on the apportionment of

abundances (or some related quantities such as biomass or coverage) into a number of animal or plant categories forming the ecological community under study. Humans have invented a variety of instruments to monitor the health of ecosystems (Pielou, 1977, p.269). For example, to examine water quality in a wetland, an environmental scientist may use a sensor to measure dissolved oxygen in the water or perform chemical assays in the lab to examine heavy metals in the soil. Several animals or species can act as indicators of environmental health. Birds are one such group that is often used for a number of reasons. Birds can give an indication whether the system is healthy or otherwise, and their study can be a useful way to gain an understanding of ecosystems and their needs. The role of avifauna in the ecosystem are as scavenger, pollinators, seeds dispersal agent and predators of insect pest and also an important indicator to evaluate different habitats both qualitatively and quantitatively (Niemi, 1985, Bilgram, 1995, Padmavathi et al, 2010).

Approximately, 9,990 bird species are recorded on our planet and the Indian subcontinent is home to 1,263 bird species. When birds are dependent on the habitat functioning in specific ways, the population trends of birds can tell us about how well the ecosystem is functioning. Population of bird is a very sensitive indicator of degree of pollution in both terrestrial and aquatic ecosystem (Ali, S., 1949). Identifying the species composition of a habitat will provide better understanding of the ecosystem and its functioning. Studying the biodiversity index will offer a better perspective regarding the stability of an ecosystem.

OBJECTIVES

- To estimate the abundance bird species in the study area.
- To understand the diversity of avian fauna using metric tools.
- To understand various problems faced by avian population.

METHODOLOGY

In order to estimate the abundance of avian fauna of the selected wetlands and their surroundings, monthly observations were conducted from January 2015 to March 2015. We used various counting methods. The first one is Fixed radius (20 m) point count method (for the Mixed Trees and orchard), line transect method (for the wetland habitat, agricultural field and road side plantations) and direct observation methods were used. The surveys were only performed during suitable weather (i.e., in the absence of rain or strong wind). Photography was done by making use of CANON SX-30 (14mp with x 30 optical zoom lenses) camera. PENDAX 10x50 DPS binoculars were used to observe the birds.

Shannon-Wiener Index: Species evenness, richness and diversity indices were estimated using as Shannon-Wiener Index (Shannon and Weaver, 1949). Shannon-Wiener Index assumes that individuals are randomly sampled from an independent large population and all the species are represented in the sample. Shannon diversity is very widely used index for comparing diversity between various habitats (Clarke and Warwick, 2001). It was calculated in order to know the species diversity in different habitat (Hutchinson, 1970) based on the abundance of the species by the following formula:

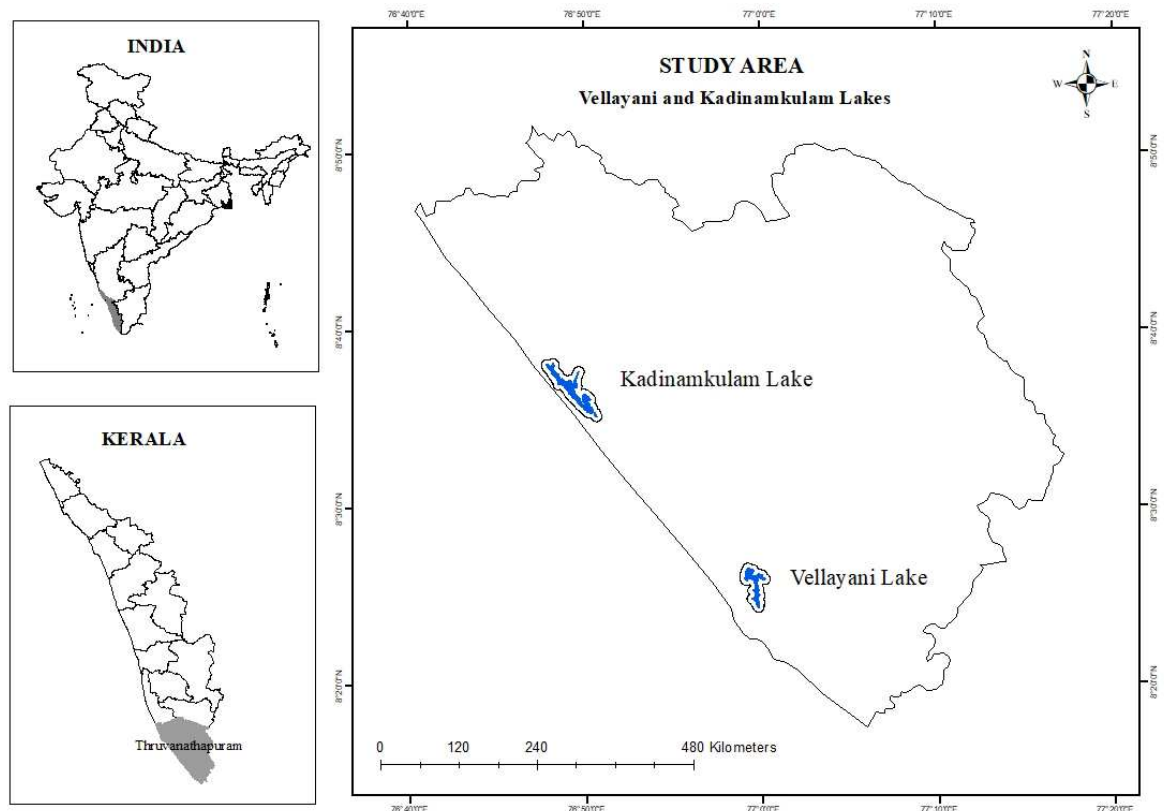
$$H' = - [\sum P_i \ln P_i]$$

Where, H' = Diversity Index; P_i = is the proportion of each species in the sample; $\ln P_i$ = natural logarithm of this proportion. The value of Shannon Wiener Diversity Index usually falls between 1.5 and 3.5, only rarely it surpasses 4.5. A value near 4.6 would indicate that the numbers of individuals are evenly distributed between all the species.

Shannon's equitability (EH) can be calculated by dividing H by H_{\max} (here $H_{\max} = \ln S$). Equitability assumes a value between 0 and 1 with 1 being complete evenness.

STUDY AREA

Figure:1



Vellayani Lake: The Vellayani lake (08°24'09" to 8°26'30" North and 76°59'08" to 76°59'57" East), the second largest fresh water lake of Kerala covers an area of about 441.98 Km with a depth of 1.2 meters. Seven rivulets drain into this lake and it forms the critical watershed area of Kalliyoor, Venganoor Gramapanchayats and Thiruvananthapuram Corporation. The North-western part of the lake is converted to a temporary reservoir for irrigation purpose.

Kadinamkulam Lake: (8°35' to 8°40' North and 76°46' to 76°52' East) is located near perunguzhi village in Kerala, India. It is situated 22 km north of Trivandrum; National Highway 47 is also 8 km away. Kadinamkulam is surrounded by Kadinamkulam Kayal to the east, the Arabian Sea to the west, Puthucurichy to the north and Channankara to the south.

RESULTS AND DISCUSSION

A total of 31 taxa of avifauna belonging to 68 families has been recorded in a survey carried out from 3-month observation at wetland sites (Vellayani and Kadinamkulam) and surroundings located in Thiruvananthapuram district, Kerala. These two wetland habitats lying close to the coastal zone are known to be a rich abode for avian fauna.

Shannon-Wiener Diversity Index

As per Asian Water fowl census (2015), 2431 waterfowl birds of 49 species were spotted in the wetland regions in Thiruvananthapuram district, 4442 Birds of 77 species of them were migratory birds. In the study area, extensive range of different waterfowl and land birds (a total of 4594 birds) belonging to 129 species have been identified. In order to understand the diversity of avian population i.e., richness, evenness and abundance the Shannon-Wiener Index was used. The following tables contain data from the field Survey conducted between January and June 2015 in the study area. The numbers below represent relative proportions of each species.

SITE 1: VELLAYANI LAKE

Table! Computational table of Shannon-Wiener Diversity Index

Species No	Species Name	Species count	Pi=sample/sum	ln(Pi)	Pi*ln(Pi)
1	Lesser Whistling-Duck	81	0.0285	-3.575	-0.1019
2	Cotton Pygmy-Goose	3	0.001	-6.907	-0.0069
3	Little Grebe	10	0.003	-5.809	-0.0174
4	Asian Openbill	3	0.001	-6.907	-0.0069
5	Painted Stork	5	0.001	-6.907	-0.0069
6	Little Cormorant	124	0.043	-3.146	-0.1353
7	Indian Cormorant	353	0.124	-2.087	-0.2588
8	Oriental Darter	7	0.002	-6.214	-0.0124
9	Gray Heron	11	0.003	-5.809	-0.0174
10	Purple Heron	22	0.007	-4.961	-0.0347
11	Great Egret	8	0.002	-6.214	-0.0124
12	Intermediate Egret	22	0.007	-4.961	-0.0347
13	Little Egret	48	0.016	-4.135	-0.0662
14	Cattle Egret	95	0.033	-3.411	-0.1126
15	Indian Pond-Heron	54	0.019	-3.963	-0.0753
16	Glossy Ibis	14	0.004	-5.521	-0.0221
17	Black-headed Ibis	17	0.005	-5.298	-0.0265
18	Eurasian Spoonbill	5	0.001	-6.907	-0.0069
19	Shikra	2	0.0007	-7.264	-0.0051
20	Black Kite	7	0.002	-6.124	-0.0122
21	Brahminy Kite	154	0.054	-2.918	-0.1576
22	White-breasted Waterhen	13	0.004	-5.521	-0.0221
23	Watercock	8	0.002	-6.214	-0.0124

24	Gray-headed Swamphen	411	0.144	-1.937	-0.2789
25	Eurasian Moorhen	34	0.011	-4.509	-0.0496
26	Eurasian Coot	24	0.008	-4.828	-0.0386
27	Black-winged Stilt	7	0.002	-6.214	-0.0124
28	Red-wattled Lapwing	14	0.004	-5.521	-0.0221
29	Pheasant-tailed Jacana	17	0.005	-5.298	-0.0265
30	Bronze-winged Jacana	26	0.009	-4.71	-0.0424
31	Green Sandpiper	4	0.001	-6.907	-0.0069
32	Marsh Sandpiper	4	0.001	-6.907	-0.0069
33	Wood Sandpiper	21	0.007	-4.961	-0.0347
34	Whiskered Tern	8	0.002	-6.214	-0.0124
35	Rock Pigeon (Feral Pigeon)	60	0.021	-3.863	-0.0811
36	Greater Coucal	6	0.002	-6.214	-0.0124
37	Pied Cuckoo	3	0.001	-6.907	-0.0069
38	Asian Koel	9	0.003	-5.809	-0.0174
39	Indian Cuckoo	1	0.0003	-8.111	-0.0024
40	Asian Palm-Swift	3	0.001	-6.907	-0.0069
41	Common Kingfisher	3	0.001	-6.907	-0.0069
42	White-throated Kingfisher	5	0.001	-6.907	-0.0069
43	Pied Kingfisher	8	0.002	-6.214	-0.0124
44	Green Bee-eater	5	0.001	-6.907	-0.0069
45	Blue-tailed Bee-eater	7	0.002	-6.214	-0.0124
46	White-cheeked Barbet	1	0.0003	-8.111	-0.0024
47	Black-rumped Flameback	2	0.0007	-7.264	-0.0051
48	Rose-ringed Parakeet	121	0.042	-3.17	-0.1331
49	Common Woodshrike	12	0.004	-5.521	-0.0221
50	Brown Shrike	3	0.001	-6.907	-0.0069
51	Indian Golden Oriole	3	0.001	-6.907	-0.0069
52	Black Drongo	10	0.003	-5.809	-0.0174
53	House Crow	11	0.003	-5.809	-0.0174
54	Large-billed Crow	144	0.05	-2.995	-0.1498
55	Barn Swallow	4	0.001	-6.907	-0.0069
56	Blyth's Reed Warbler	2	0.0007	-7.264	-0.0051
57	Clamorous Reed Warbler	4	0.001	-6.907	-0.0069
58	Zitting Cisticola	6	0.002	-6.214	-0.0124
59	Common Tailorbird	7	0.002	-6.214	-0.0124
60	Common Myna	13	0.004	-5.521	-0.0221
61	Pale-billed Flowerpecker	9	0.003	-5.809	-0.0174

62	Purple-rumped Sunbird	3	0.001	-6.907	-0.0069
63	Western Yellow Wagtail	2	0.0007	-7.264	-0.0051
64	Paddyfield Pipit	17	0.005	-5.298	-0.0265
65	Baya Weaver	632	0.222	-1.505	-0.3341
66	curlew Sandpiper	1	0.0003	-8.111	-0.0024
67	Common Snipe	2	0.0007	-7.264	-0.0051
68	Pacific golden plover	20	0.007	-4.961	-0.0347
69	Stork billed kingfisher	1	0.0003	-8.111	-0.0024
70	Little Ringed Plover	1	0.0003	-8.111	-0.0024
71	Grey headed Lapwing	1	0.0003	-8.111	-0.0024
72	Garganey	44	0.015	-4.199	-0.063
73	Indian Spot billed Duck	10	0.003	-5.809	-0.0174
74	Northern Pintail	2	0.0007	-7.264	-0.0051
75	Yellow Bittern	4	0.001	-6.907	-0.0069
76	Woolly Necked Stork	1	0.0003	-8.111	-0.0024
77	Black Bittern	1	0.0003	-8.111	-0.0024
	Total Species Count	2840			-2.8329

SITE2:KADINAMKULAM LAKE**Table 2: Computational table of Shannon-Wiener Diversity Index**

Sl.No.	Species Name	Total count	pi= sample/sum	In(Pi)	Pi*In(Pi)
1	Green Bee Eater	12	0.006	-5.115	-0.0307
2	Blue Tailed Bee Eater	5	0.002	-6.214	-0.0124
3	Jungle Babbler	6	0.003	-5.809	-0.0174
4	YellowHeaded Babbler	11	0.006	-5.115	-0.0307
5	Lesser WhistlingDuck	5	0.002	-6.214	-0.0124
6	Cotton Pygmy Goose	7	0.003	-5.809	-0.0174
7	Asian Palm Swift	6	0.003	-5.809	-0.0174
8	Little Comorant	856	0.479	-0.736	-0.3525
9	White Breasted Kingfisher	13	0.007	-4.961	-0.0347
10	Stork Billed Kingfisher	3	0.001	-6.907	-0.0069
11	Pied Kingfisher	8	0.004	-5.521	-0.0221
12	White Chicked Barbet	10	0.005	-5.298	-0.0265
13	Little Grebe	2	0.001	-6.907	-0.0069
14	Flame Back	4	0.002	-6.214	-0.0124
15	Rose Ringed Parakeet	7	0.003	-5.809	-0.0174
16	Pheasant Tailed Jacana	4	0.002	-6.214	-0.0124
17	White Breasted Water Hen	11	0.006	-5.115	-0.0307

18	Purple Sunbird	4	0.002	-6.214	-0.0124
19	Great Egret	32	0.017	-4.074	-0.0693
20	Cattle Egret	76	0.042	-3.17	-0.1331
21	Little Egret	71	0.039	-3.244	-0.1265
22	Black Drongo	6	0.003	-5.809	-0.0174
23	House Crow	246	0.137	-1.987	-0.2722
24	Black Kite	10	0.005	-5.298	-0.0265
25	Brahmini Kite	64	0.035	-3.352	-0.1173
26	Common Tailed Bird	6	0.003	-5.809	-0.0174
27	Asian Koel	1	0.0005	-7.6	-0.0038
28	Rufous Treepie	6	0.003	-5.809	-0.0174
29	Barn Swallow	29	0.016	-4.135	-0.0662
30	Magpie Robin	48	0.026	-3.649	-0.0949
31	Common Myna	12	0.006	-5.115	-0.0307
32	Indian Cormorant	22	0.012	-4.422	-0.0531
33	Oriental Darter	5	0.002	-6.214	-0.0124
34	Grey Heron	3	0.001	-6.907	-0.0069
35	Intermediate Egret	44	0.024	-3.729	-0.0895
36	Western Reef Heron	2	0.001	-6.907	-0.0069
37	Indian Pond Heron	14	0.007	-4.961	-0.0347
38	Striated Heron	3	0.001	-6.907	-0.0069
39	Black Headed Ibis	6	0.003	-5.809	-0.0174
40	Pacific Golden Plover	8	0.004	-5.521	-0.0221
41	Red Wattled Lapwing	22	0.012	-4.422	-0.0531
42	Common Sand Piper	8	0.004	-5.521	-0.0221
43	Common Green Shank	5	0.002	-6.214	-0.0124
44	Marsh Sand Piper	10	0.005	-5.298	-0.0265
45	Wood Sand Piper	3	0.001	-6.907	-0.0069
46	Common Red Shank	4	0.002	-6.214	-0.0124
48	Common Kingfisher	17	0.009	-4.71	-0.0424
49	Black Rumped Flameback	4	0.002	-6.214	-0.0124
50	Zittingcisticola	3	0.001	-6.907	-0.0069
51	Yellow Billed Babler	12	0.006	-5.115	-0.0307
53	Pale Billed Flower Pecker	3	0.001	-6.907	-0.0069
54	Common Coot	5	0.002	-6.214	-0.0124
	Total Species Count	1784			-2.1614

The above computations derived Shannon Diversity Index H' values for Kadinamkulam are 2.16 and that for Vellayani is 2.83. Shannon's Evenness/Equitability index is calculated by the formula:

$$E = H/H_{\max}$$

Evenness value for Vellayani and Kadinamkulam is 0.652 and 0.541 respectively.

Settlement with mixed trees is the most prominent land use in the Vellayani Lake region. Agricultural plantation mainly concentrated in the southern part of the lake. The large units of paddy fields are present in the North-Western & North-Eastern part of the lake. The small units are seen over the adjacent areas of the lake. There are 2840 bird sightings recorded that belongs to 77 species based on the 3-month observation checklist. Here most of the variety of Birds species seen over the River/water bodies area and paddy fields. Over 54 species Birds observed from these areas. Second rich species abundance is seen in Built up lands and settlements and mixed areas of the buffer region where 23 species are observed.

At the Kadinamkulam lake region, a total 1784 birds recorded that belongs to 52 species based on the 3-month observation field data. Most of the bird's species are seen over the River/Water bodies and agricultural fields over 27 bird's species observed from the River/Water bodies and agricultural fields. Over 14 bird species observed from the Built up land area and settlements and mixed tree area.

SUMMARY AND CONCLUSION

A diversity index is a mathematical measure of species diversity in a community. Diversity indices provide more information about community composition than simply species richness; they also take the relative abundances of different species into account. The area selected for the study lies the coastal belt of Keralastate; the adjacent areas of which are known to be a rich abode for avian fauna. Major findings of this study are:

- There is a rich diversity of avian fauna present in the area. The present study provides baseline information for the bird diversity in and around this area.
- Shannon Diversity Index H' values for Kadinamkulam are 2.16 and that for Vellayani is 2.83. Evenness values for Kadinamkulam is 0.541 and Vellayani is 0.652.
- Wetlands are under threat due to the increasing anthropogenic activities.

There for it is important to earmark this area as a rich abode in avian fauna and should take necessary steps to preserve the diversity so the state government immediately. Kadinamkulam site also holds an immense potential to be developed as make it have for bird watchers and a tourist spot. Studies of the effects of land-use on birds in the wetlands of Thiruvananthapuram may be scarce, so further study of additional factors affecting bird diversity in different habitats is recommended, such as considering spatio-temporal factors and the availability of specific food resources.

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