

Avifaunal assemblage in Urban ponds of Thirupparankundram and Koothiyarkundu, Madurai District, Tamilnadu, India

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ABSTRACT

The present study deals with the species abundance, diversity and species richness of avian communities in Thirupparankundram and koothiyarkundu ponds, Madurai, Tamilnadu, India. Forty nine species of birds belonging to 29 families under 42 genera were recorded. Shannon_H and Fisher's alpha diversities, species evenness, species richness of bird communities and number of bird species in Thirupparankundram and koothiyarkundu ponds are discussed. Analysis of variance (ANOVA) for observed data was carried out and number of individuals, Shannon_H and Menhinick indices are significant. The study area was visited and surveyed in October, November and December 2018. During each visit waterfowl census was carried out and water samples were also collected to document changes in physico-chemical parameters. Pearson's correlation coefficient (r) value is determined using correlation matrix to identify the highly correlated and interrelated water quality parameters. In both ponds, Chloride and Acidity are positively correlated and significant at the level of 0.05.

Key words: Abundance, Diversity, Species richness, ANOVA, Waterfowl.

Introduction

Avian community is a significant element of an ecosystem. Birds are playing a key role in the environment as pollinators. Birds live on this earth even if there were no human beings, but human beings cannot live without birds. Birds are an essential part of the complete structure of life on this earth (Ali and Futehally, 2008). Birds are ideal bio-indicators and valuable models for studying a variety of ecological troubles (Newton and Anim, 1995). They are often frequent denizens of the bionetwork and they have been measured as pointer species of occupied areas (Blair, 1999). A lot of species of birds react to little changes in habitat structure and com-

position; consequently they serve as good indicators of changes in the environment (Robert, 1932). Birds are one of the best indicators of environmental quality of any ecosystem a number of environmental factors are known to influence the population of birds directly. Availability of food, detestability and capture, location of nesting sites, availability of nesting resources, presence of predators and competitors are the major factors influence the foraging and propagation of birds and subsequently their population (Ali and Ripley, 1983). Out of more than 9000 bird's species of the world, the Indian subcontinent contains 1300 species or over 13% of the world's bird species (Grimmet *et al.*, 2004).

Wetlands are essential feeding and nesting

grounds for waders, feeding areas for fish-eating birds and wintering grounds for migrant birds (Whigham *et al.*, and Kusler *et al.*, 1994). The relation between wetlands and birds are fashioned by many factors. These include the availability, depth and quality of water, the availability of food and presence or absence of predators. Birds that use wetlands for breeding depend on the physical and biological attributes of the wetland. Birds have daily and cyclic dependency on wetlands for food and other life-suborn system. The worth of a wetland to a specific bird species is affected by the presence of surface water or moist soils and the period and timing of flooding (Mohapatra and Hussain, 1989). Wetlands are one of the most threatened habitats because of their vulnerability and attractiveness for their development (Hollis *et al.*, 1988). In my field it was undertaken to make a preliminary survey of physicochemical and birds on the Thirupparankundram and Koothiyarkundu ponds in relation to the associated water bodies with the objectives of analyzing the physic-chemical parameters of the ponds and to survey on avian fauna associated with the system and vegetation analysis.

Materials and Methods

The study area

Thiruppara E kuI_ am is a new town in Madurai district (created in 2011) in Tamil Nadu, India. The area is part of Madurai Municipal Corporation and the first local body election for the corporation was held on 18 October 2011. ThirupparaE kuI_ am is known for the Thirupparamkunram Murugan temple, which is one of the Six Abodes of Murugan. It is one of the most visited tourist places in Madurai. Koothiyarkundu is a small Village/hamlet in Tirupparangunram Block in Madurai District of Tamil Nadu State, India. It comes under Nilaiyyur I bit Panchayath. It is located 13 KM towards west from District head quarters Madurai. 5 km from Thirupparangunram.

Water analysis

Water samples were collected from the experimental ponds during the study period. Depending upon the availability, water samples were collected from the pond with clean plastic bottles at 06.00 hrs and brought to the laboratory for further analysis. Sampling and analytical procedures were done using

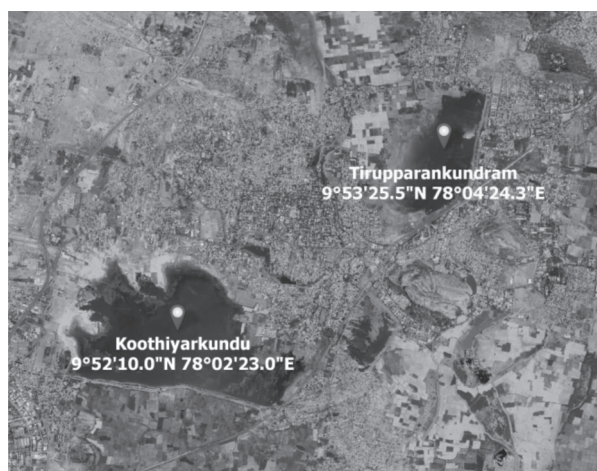


Fig. 1. The study area

American Public Health Association (APHA, 2005) method. Water pH was determined with the help of digital pH meter (Elico, India). Water temperature was measured during sampling with help of thermometer. Total Dissolved Solid (TDS), Conductivity, Salinity and Dissolved Oxygen (DO) were analyzed by using Water Analyzer Kit (Systronics Make; Model No. 371) also analyzed.

Survey of birds

The bird's survey was made during late monsoon, early winter, and late winter at Thirupparankundram and Koothiyarkundu, Madurai, South India. The birds counting from 06:00 hrs to 09:00 hrs in the morning and 16:00hrs to 18:00hrs in the evening counted point count protocol method using Nikon (16*50 4.1) Action Zooming Binocular during the study period and photographic documentation was made. Birds were identified by physical features by adopted Ali and Futehally (2008). Birds were identified up to species level. The statistical analysis was carried using PAST 3 and SPSS (version 23) software packages.

Results and Discussion

During the study period, 49 species of birds belonging to 29 families under 42 genera were recorded. The birds observed during the study are listed in Table 1 and its abundance index percentage also listed. There are 2370 and 2461 number of individual birds was counted in both ponds in Thirupparankundram and Koothiyarkundu respectively. Among 49 species in the

Table 1. List of birds and its percentage of abundant index

Family	Scientific Name of the Birds	No. of individuals		% abundance index	
		A	B	A	B
Accipitridae	<i>Accipiter badius</i>	6	3	0.18	0.12
	<i>Milvus migrans</i>	4	2	0.12	0.08
	<i>Pandion haliaetus</i>	1	1	0.03	0.04
Alcedinidae	<i>Alcedo atthis</i>	18	24	0.55	0.98
	<i>Halcyon smyrenis</i>	24	10	0.73	0.41
Anatidae	<i>Anas crecca</i>	42	15	1.28	0.61
Anhingidae	<i>Anhinga melanogaster</i>	34	28	1.04	1.14
Apodidae	<i>Tachymarpis melba</i>	57	57	1.74	2.32
Ardeidae	<i>Ardea cinerea</i>	43	39	1.31	1.58
	<i>Ardeola grayii</i>	76	89	2.32	3.62
	<i>Bubulcus ibis</i>	114	108	3.49	4.39
	<i>Casmerodius albus</i>	26	22	0.80	0.89
	<i>Egretta garzetta</i>	141	68	4.31	2.76
Artamidae	<i>Egretta intermedia</i>	50	51	1.53	2.07
	<i>Nycticorax nycticorax</i>	29	44	0.89	1.79
	<i>Artamus fuscus</i>	75	95	2.29	3.86
	<i>Charadriidae</i>	21	28	0.64	1.14
	<i>Vanellus indicus</i>	21	28	0.64	1.14
Ciconiidae	<i>Anastomus oscitans</i>	518	528	15.84	21.45
Columbidae	<i>Columba livia</i>	109	42	3.33	1.71
	<i>Streptopelia chinensis</i>	8	27	0.24	1.10
	<i>Streptopelia decaocto</i>	3	11	0.09	0.45
	<i>Streptopelia senegalensis</i>	3	10	0.09	0.41
Corvidae	<i>Corvus macrorhynchos</i>	28	27	0.86	1.10
	<i>Corvus splendens</i>	142	92	4.34	3.74
	<i>Dendrocitta vagabunda</i>	25	21	0.76	0.85
Cuculidae	<i>Centropus sinensis</i>	15	24	0.46	0.98
	<i>Eudynamis scolopacea</i>	10	3	0.31	0.12
Dicruridae	<i>Dicrurus leucophaeus</i>	59	37	1.80	1.50
	<i>Dicrurus macrocercus</i>	72	62	2.20	2.52
Monarchidae	<i>Terpsiphone paradise</i>	2	4	0.06	0.16
Motacillidae	<i>Motacilla maderaspatensis</i>	43	35	1.31	1.42
Muscicapidae	<i>Luscinia brunnea</i>	14	21	0.43	0.85
	<i>Saxicoloides fulicata</i>	5	10	0.15	0.41
Nectariniidae	<i>Nectarinia asiatica</i>	30	34	0.92	1.38
	<i>Nectarinia zeylonica</i>	6	15	0.18	0.61
Oriolidae	<i>Oriolus oriolus</i>	5	3	0.15	0.12
Passeridae	<i>Passer domesticus</i>	91	67	2.78	2.72
Phalacrocoracidae	<i>Phalacrocorax niger</i>	598	120	18.29	4.88
Phasianidae	<i>Pavo cristatus</i>	60	52	1.83	2.11
Picidae	<i>Dinopium benghalense</i>	4	3	0.12	0.12
Podicipedidae	<i>Tachybaptus ruficollis</i>	81	80	2.48	3.25
Psittacidae	<i>Psittacula krameri</i>	81	61	2.48	2.48
Pycnonotidae	<i>Pycnonotus cafer</i>	33	16	1.01	0.65
Rallidae	<i>Amaurornis phoenicurus</i>	31	8	0.95	0.33
	<i>Fulica atra</i>	150	68	4.59	2.76
	<i>Gallinula chloropus</i>	41	48	1.25	1.95
Scolopacidae	<i>Actitis hypoleucos</i>	16	11	0.49	0.45
Sturnidae	<i>Acridotheres tristis</i>	182	133	5.57	5.40
Threskiornithidae	<i>Threskiornis melanocephalus</i>	44	104	1.35	4.23

Thirupparankundaram pond, *Phalacrocorax niger* was the most abundant species (18.29 %), whereas *Pandion haliaetus* was the least abundant species (0.03 %). Among the species that are observed in the Koothiyarkundu pond, *Anastomus oscitans* was the most abundant species (21.45 %), whereas *Pandion haliaetus* was the least abundant species (0.04 %). The species *Pandion haliaetus* was the least abundant species in both ponds. The Relative Diversity index (RDi) was calculated for species. The highest RDi value was founded in Ardeidae family. There are 19 families with lowest RDi value as 2.04.

The number of Taxa_S was highest in the A site (45.33 ± 1.45) and least in the B site (45.00 ± 1.73). The number of individuals birds is significant (ANOVA, $F_{1,4} = 21.168$, $P < 0.05$). The high value of F indicates that the data observed in this study was more significant. The Simpson_1-D diversity index

was used to analyze that diversity among the species. The high value of index represents higher diversity among the species. Here in both sites the index was more than 0.90 was indicated that diversity in the both site have high. The Simpson_1-D diversity index was not significant (ANOVA, $F_{1,4} = 2.104$, $P > 0.05$). The diverse and equally distributed community was analyzed by using Shannon_H index. The Shannon_H index was highest in site B (3.22 ± 0.05) and least in site A (3.08 ± 0.01). The Shannon_H index among the sites were significant (ANOVA, $F_{1,4} = 6.245$, $P < 0.05$).

The Menhinick index was observed maximum in site B (1.57 ± 0.06) and minimum in site A (1.37 ± 0.02). The range of Mechinick index between the sites was 0.20. The Menhinick index among the sites were significant (ANOVA, $F_{1,4} = 6.245$, $P < 0.05$). The species richness was measured using Margalef rich-

Table 2. Avifaunal diversity in Thirupparankundram and Koothiyarkundu

Diversity Indices	A	B	F	Sign.
Taxa_S	45.33 ± 1.45	45.00 ± 1.73	0.220	0.890
Individuals	1090.00 ± 57.27	820.33 ± 12.45	21.168*	0.010
Simpson_1-D	0.92 ± 0.00	0.93 ± 0.01	2.104	0.221
Shannon_H	3.08 ± 0.01	3.22 ± 0.05	6.245*	0.042
Menhinick	1.37 ± 0.02	1.57 ± 0.06	9.139*	0.039
Margalef	6.34 ± 0.16	6.56 ± 0.26	0.506	0.516
Fisher_alpha	9.56 ± 0.26	10.25 ± 0.52	1.399	0.302
Chao-1	50.36 ± 5.86	52.11 ± 2.56	0.075	0.798

*significant at the 0.05 level.

Table 3. Physiochemical parameters of water in Thirupparankundram pond

	Temp	pH	DO	TDS	Sal	Con	Acid	Alk	CO2	Chlo	Cal	Hard	Mag	Nit
Temp	1	-0.728	-.547	-.203	-.990*	-.914	.719	.808	.919	.618	.771	.958	-.005	.567
pH		1	.972	.819	.816	.943	-.047	-.992*	-.939	.090	-.998*	-.500	.689	.152
DO			1	.931	.658	.839	.189	-.935	-.832	.321	-.955	-.283	.840	.380
TDS				1	.338	.582	.535	-.741	-.572	.645	-.781	.087	.980	.692
Sal					1	.962	-.615	-.882	-.965	-.502	-.852	-.908	.144	-.447
Con						1	-.376	-.977	-1.000**	-.246	-.963	-.759	.409	-.185
Acid							1	.172	.387	.991*	.111	.888	.692	.980
Alk								1	.975	.036	.998*	.605	-.593	-.027
CO2									1	.258	.959	.767	-.398	.197
Chlo										1	-.025	.818	.783	.998*
Cal											1	.555	-.641	-.088
Hard												1	.283	.780
Mag													1	.821
Nit														1

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Temp-Temperature, DO-Dissolved Oxygen, TDS-Total dissolved solids, Sal- Salinity, Con – conductivity, Acid-Acidity, CO2- Free CO2, Chlo-Chloride, Cal-Calcium, Hard-Total hardness, Mag-Magnesium, Nit-Nitrogen

Table 4. Physiochemical parameters of water in Koothiyarkundu pond

	Temp	pH	DO	TDS	Sal	Con	Acid	Alk	CO2	Chlo	Cal	Hard	Mag	Nit
Temp	1	.102	.321	-.315	.611	-.459	-.978	.485	.136	-.993*	.580	-.477	-.995*	-.657
pH		1	-.909	-.976	-.725	-.931	.108	.919	.999*	.014	-.751	.825	-.198	.683
DO			1	.797	.946	.694	-.512	-.672	-.894	-.430	.958	-.986	-.229	-.925
TDS				1	.559	.988*	.110	-.983	-.983	.202	.590	-.684	.405	-.509
Sal					1	.423	-.763	-.396	-.701	-.699	.999*	-.987	-.532	-.998*
Con						1	.263	-1.000**	-.943	.352	.457	-.562	.542	-.369
Acid							1	-.292	.074	.996*	-.738	.650	.953	.800
Alk								1	.932	-.380	-.430	.537	-.567	.341
CO2									1	-.020	-.728	.806	-.231	.658
Chlo										1	-.671	.576	.977	.740
Cal											1	-.993*	-.499	-.995*
Hard												1	.390	.976
Mag													1	.581
Nit														1

ness index. The Margalef species richness was highest in site B (6.56 ± 0.26) and lowest in site A (6.34 ± 0.16). The species richness among different site was not significantly different (ANOVA, $F_{1,4} = 0.506$, $P > 0.05$). The relationship between the number of species and the number of individuals in species was observed as 9.56 and 10.25 in site A and B respectively. The Fisher_alpha was not significant (ANOVA, $F_{1,4} = 1.399$, $P > 0.05$). The Chao-1 estimator was used to analyze singleton and doubleton species in the bird's community. The higher range of singleton and doubleton species was occurred in site B (52.11 ± 2.56) and lower range was observed in site A (50.36 ± 5.86). This means that the site B has more singleton and doubleton species. Chao-1 estimator was not significant (ANOVA, $F_{1,4} = 0.075$, $P > 0.05$). When comparing all the diversity and richness indices, the bird's communities in Koothiyarkundu have more diversity and richness compare to Thirupparankundram.

The correlation analysis results of selected water quality parameters of Thirupparankundram and Koothiyarkundu are shown in Table 3 and 4. From Table 3, it is found that the water temperature showed negative correlation with Salinity ($r = -0.990$, $p < 0.05$); pH was negatively correlated with Alkalinity ($r = -0.992$, $p < 0.05$) and Calcium ($r = -0.998$, $p < 0.05$); Conductivity and free CO₂ was negatively correlated ($r = -1.000$, $p < 0.01$); Alkalinity and Calcium was positively correlated ($r = 0.998$, $p < 0.05$); Chloride was positively correlated with Acidity ($r = 0.991$, $p < 0.05$) and Nitrogen ($r = 0.998$, $p < 0.05$) in Thirupparankundram pond. These results showed that pH was negatively correlated

with Alkalinity and Calcium whereas these two parameters are positively correlated.

From table 4, it is noticed that the water temperature was negative correlation with Chloride ($r = -0.993$, $p < 0.05$) and Magnesium ($r = -0.995$, $p < 0.05$); pH was positively correlated with free CO₂ ($r = 0.999$, $p < 0.05$); TDS and Conductivity was positively correlated ($r = 0.988$, $p < 0.05$); Salinity was positively correlated with Calcium ($r = 0.999$, $p < 0.05$) and negatively correlated with Nitrogen ($r = -0.998$, $p < 0.05$); Conductivity and Alkalinity was negatively correlated ($r = -1.000$, $p < 0.01$); Acidity was positively correlated with Chloride ($r = 0.996$, $p < 0.05$); Calcium was negatively correlated with Total hardness ($r = -0.993$, $p < 0.05$) and Nitrogen ($r = -0.995$, $p < 0.05$) in Koothiyarkundu pond. These results indicated that Nitrogen was negatively correlated with Salinity and Calcium whereas these two parameters are positively correlated. In both ponds, Chloride and Acidity are positively correlated.

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