

Original Research Article

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Avifaunal Diversity and Water Quality Analysis of an Inland Pond, Kondagai Village, Sivaganga District, South India

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ABSTRACT

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The key physical, chemical and biological parameters of one of the major habitats for birds in the wetlands are known to influence flock of migratory and resident species of birds. The present study deals with the interactions between these abiotic factors and faunal diversity of pond in semiarid zone of Konthagai, Sivaganga district, Tamil Nadu. The study area was visited and surveyed twice in a month. During each visit waterfowl census was carried out and water samples were also collected to document changes in physico-chemical parameters and microbial analysis over the seasons. The aggregation of birds in the area is mainly related to the increase in migratory population of birds during winter. The variations inland bird aggregations as well as physico-chemical factors are discussed.

Introduction

Avian community is an important component of an ecosystem. Birds are playing a major role in the environment as pollinators. Birds might live on this earth even if there were no human beings, but human beings cannot live without bird. Birds are an integral part of the whole system of life on this earth (Ali and Futehally, 2008). Birds are ideal bio-indicators and useful models for studying a variety of environmental problems (Newton and Anim, 1995). They are often common denizens of the ecosystem and they have been considered as indicator species of inhabited areas (Blair, 1999). Many species of birds

respond to small changes in habitat structure and composition, therefore 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 materials, presence of predators and competitors are the major factors influencing the foraging and breeding 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).

Birds are the most apparent and familiar wildlife in wetlands. Wetlands are vital feeding and nesting grounds for waders, feeding areas for fish-eating birds and wintering grounds for migratory birds (Whigham *et al.*, and Kusler *et al.*, 1994). The relation between wetlands and birds are shaped 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 seasonal dependencies on wetlands for food and other life-sustaining systems. The value of a wetland to a specific bird species is affected by the presence of surface water or moist soils and the duration 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 was undertaken to make a preliminary survey of physicochemical and biological parameters and birds on the Konthagai village ponds in relation to the associated water bodies with the objectives of analyzing the physicochemical and biological parameters of the ponds and to survey on avian fauna associated with the system.

Water birds and insects have long attracted the attention of the public and scientists because of their beauty, abundance, visibility and social behavior, as well as for their recreational and economic importance. Recently, water birds have become of interest as indicators of wetland quality and as parameters of restoration success and regional

biodiversity (Kumar and Gupta, 2009). The present study aims to survey of birds, insects and plants to identify the consequences of direct and indirect human interferences.

Materials and Methods

Study area

Kondagai is a village under Tiruppuvanam Taluk in Sivaganga district of Tamil Nadu, India. It is located 37 KM towards west from district head quarters of Sivaganga. It is 8 KM from Tiruppuvanam. Kondagai village is encompassing two ponds via pond A and pond B.

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 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.

Biological Parameters

The collected water samples were subjected to various analyses such as enumeration of RTU's and Total Coli form (MPN).

Enumeration of bacterial load: The bacterial load of water sample was

determined by spread plate technique after serial dilution of the sample.

Total Coli forms (MPN): The three basic tests (Presumptive, Confirmed, and Completed) were performed to detect coli form bacteria in water samples by using standard protocols described in Cappuccino and Sherman (1999).

Entomological survey

After netting a butterfly and dragonfly in sweeping or aerial net, the best way to kill it is by pinching its thorax (middle body segment) between thumb and forefinger. This technique takes some practice to learn the proper pressure, but it will quickly stun the specimen and prevent it from damaging itself. With its wings over its back, the specimen can then be slipped into an envelope or a paper triangle or envelope. Collected samples were brought to laboratory and identified under stereobinocular microscope using standard taxonomic literature. Samples were assigned to family and genus using keys for that particular group (Moore, 1890-1907; Talbot, 1939; Kehimkar, 2008; Kunte *et al.*, 2017; Subramanian, 2005).

Survey of birds

The bird's survey was made during pre monsoon, monsoon, post monsoon and winter season at Kondagai, Sivagangai, south India. The birds counting from 06:30hrs to 11:00hrs 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 and the diversity indices were calculated using PAST software.

Results and Discussion

Physico-chemical parameters

The results of physico-chemical parameters for the two ponds viz., Kondhagai pond A and B are given in table 1. In all the two ponds the temperature ranged from 25-29°C during the study period. The results of pH revealed that the water in both ponds were in slightly alkaline in nature ranging from 7.32-9.04. Dissolved oxygen level was concurrently high in pond B than in pond A in the month of December 2015. Free carbon dioxide level was high in pond A in the month of December 2015.

Enumeration of bacterial load

The different bacterial colony forming units observed by spread plate technique were designated as Recognizable Taxonomic Units and were depicted in tables 2 and 3.

Enumeration of total coli forms (MPN)

The fermentation of lactose by coli form bacteria producing acid and gas was studied using the positive results obtained from the fermentation broth. It was confirmed by EMB agar pates. Determination of MPN (Most Probable Number) was done by comparing the results with the MPN index provided by Cappuccino and Sherman (1999). Results of gas production by coliform bacteria were depicted in figure 1.

A decreasing trend in MPN count was observed during the sampling periods. The MPN values are 1100, 290 and 150/100ml of the sample in pond A in the month of October, December and February respectively. The MPN test results of both ponds were depicted in table 4 and 5. In EMB agar plate colonies with green metallic sheen were present in two ponds in the month of

October 2015. There were dark blue centered, pink colour and purple with black centered colonies (Figs. 2a and b) present in all the three ponds in the month of December and February and they were considered as coliform bacteria. EMB plate cultures were subjected to Gram negative staining and rods were observed.

Avian fauna

During the study period the Kondagai village pond was surveyed and 3063 birds of 52 species belonging to 29 families were recorded. The list of birds observed in the study area is annexed in table 6.

Ardeidae contributed the maximum species of seven (13%). Columbidae and Cuculidae emerged as the next dominant family by 4 species (7.7%). Three families were represented by 3 species (5.8%) and the families are Corvidae, Ralidae and Accipitridae. Five families were represented by 2 species (3.8%) and the families are Alcedinidae, Diceridae, Nectariniidae, Muscicapidae and phalacrocoracidae. Rests of the families were represented by one species each.

The genus *Streptopelia* (3 species) was found to be the most dominant in the sanctuary followed by *Corves*, *Dicrurus* and *Phalacrocorfax* (2 species each). Maximum number of birds species present were categorized into resident 17 species belonging to 11 families followed by 18 species belonging to 11 families as common, 3 species belonging to 3 families as rare, 11 species belonging to 7 species as local migrant and 3 species belonging to 3 families as foreign migrant.

The maximum numbers of individual birds (1736) were recorded during monsoon season (October, 2015). Asian openbill (*Anastomus*

oscitans) was the most abundant species 1053 (34.4 %) followed by common myna (*Acsridotheres tristis*) 275 (8.9%), Cattle egret (*Bubulcus ibis*) 178 (5.8%) were recorded in the sanctuary surveyed.

The seasonal local migrant observed throughout the study period were Asian openbill (*Anastomus oscitans*) and White-browed wagtail (*Motacilla maderaspartensis*). During the study periods 2 globally near threatened species were observed and the species are Darter (*Anhinga melanogaster*) and Oriental white ibis (*Threskiornis melanocephalus*).

Nine species recorded during the October 2015 survey were not seen during next two survey of the study area. Nearly 14 species recorded during the December 2015 and February 2016 survey were not seen in October 2015 survey.

Population change is usually displayed in the form of indices. Diversity indices were calculated by using PAST software and the values are reported in table 4b. The species richness index (Margalef) of birds in the study area was calculated which represented a high species richness (5.094) during October 2015 (Monsoon season) followed by (4.91) in December (Post monsoon season) and (4.188) in February (winter). The species richness index (Mehinick) was calculated and found to be high (1.211) in February 2016 (winter) followed by (1.18) in December (Post monsoon season) and (0.936) in October 2015 (Monsoon season).

The Shannon index showed highest diversity (3.054) during December followed by (2.553) in February and (1.912) in October. The month of October has the high Simpson index (0.6531) followed by 0.8851 and 0.9402 in February 2016 and December 2015 respectively. Maximum evenness index was

observed December (0.6237) followed by February (0.4758) and October (0.1735).

Survey of insects

During the study period the Kondagai village pond was surveyed and 10 different species of Butterflies and 22 different species of dragonflies were recorded. Some of the butterflies and dragonflies are given Plate 1.

Wetlands are relatively safe areas which provide the birds with abundance of food and safe place for roosting, nesting and molting (Imaran Dar and Mithas, 2009). In Indian wetlands an approximately 318 species of birds were recorded out of which 193 species are fully dependent on wetlands (Vijayan, 1986).

The range, distribution and abundance of birds are closely linked to climatic factors which shape the relation between wetlands and birds. The factors include the availability of depth, quality of water, availability of food and shelter and the presence or absence of predators. Birds that use wetlands for breeding depend on the physical and biological attributes of the wetland. Any variation in any of these wetland features affects the distribution of birds (HU Nong – Xing, 2005).

Any areas that possess 1 % of its world population in a regular manner can be declared as an important bird's area (Rahmani, 2002). In any wetland ecosystem water quality and inhabiting organisms are interrelated. Here the routine physico-chemical parameters of the water sample were analyzed. The pH of water plays an important role in the life of aquatic organisms because most of their metabolic activities are pH dependent (Kubendran and Ramesh 2016a&b). According to King (1970), higher pH is normally associated with a high

photosynthetic activity in water. The high pH in the month of November 2015 observed in the present study may be due to increased photosynthesis. Moreover, accumulation of dissolved salts, increased salinity due to high rate of evaporation in the month of February 2016.

Dissolved oxygen showed inverse relationship with water temperature. Maximum dissolved oxygen was observed during post monsoon season but minimum temperature was recorded. The results of the present study are in agreement with the studies of Ali *et al.*, (1994) and Salam *et al.*, (2000) who have observed the inverse relationship between dissolved oxygen and temperature.

Seasonal variation observed in dissolved oxygen content with higher values in rainy season could be due to increased aeration because of rainfall. Ayoade *et al.*, (2006) reported that dissolved oxygen level in art Asejire Lake attained its peak in the rainy season. Temporal variations in aquatic systems can have direct and indirect effects on factors influencing nutrient fluxes (Thayer, 1971).

In this sanctuary the plankton population is found to be poor during winter due to increase in salinity but it was abundant during monsoon. The increased CFU in pond water may be due to the influence of temperature. Sahn indicated the doubling of bacterial growth rate with high temperature. MPN reflect the intensity and type of anthropogenic activities in the surrounding of sanctuary. According to WHO the possible presence of a single *E. coli* will determine the water as an unpotable. Thus the water available at the study area is not suitable for drinking purpose, even in small quantity. In the present study survey of the Kondagai pond revealed the presence of 3063 species of birds

belonging to 29 families. In the study area only 26.92% of birds were migratory and the remaining was resident, common and rare. But in Bharathpur bird sanctuary 60% of birds are migratory (Vijayan, 1990).

In this sanctuary some colonially nesting large water birds that are known to breed in Indian heronries, for example, Little Cormorant, Great Cormorant, Darter, Little Egret, Grey Heron, Median Egret, Cattle Egret, Indian Pond-Heron, Night-Heron, Asian Openbill-Stork, Oriental White Ibis nest in Tamil Nadu. Little Egret and Cattle Egret are the some of the common species in the study site. This species are the resident and the food abundance of this species was high in most of the sites. It was found that rice fields and other agricultural habitats were used more by Cattle Egrets than other habitats (Lombardini *et al.*, 2001).

During the study period two globally near threatened species (Vijayan, 1986) were recorded. The recorded species were Darter (*Anhinga melanogaster*) and Oriental White ibis (*Threskiornis melanocephalus*). Results of the survey and observations highlight the fact that avifauna here is decrease in number which; indicates unhealthy status of the sanctuary. In September 2015, the bird fauna is considerable increased by the arrival of several species of migratory birds. Towards the end of post monsoon, December 2015-February 2016, most of the migratory birds started moving and also the water level started decreasing in the pond, which is the possible reason for the less number of birds. Various studies reported that water level and the bird abundance are inter-related (Colwell and Taft, 2000). Natural wetlands continue to decrease in area and throughout world (Czech and Parsons, 2002). Increasing anthropogenic activities are resulting into destruction of habitat and quality of water. In the present study, the abundance of native and migratory

birds in the monsoon season may be due to the availability of food in the form of plants, Invertebrates and smaller vertebrates, herbivorous birds eat the fruits, tubers and leaves of wetland plants. It is also evident that the water temperature influences food production. Invertebrate production in the water column is ultimately depending on water temperature and the ability of a wetland to produce algae.

The decrease counts in the winter season are mainly due to the unavailability of food which includes the planktons and smaller animals. Further, the physico-chemical factors like pH, salinity, dissolved oxygen and temperature, turbidity are also reported to be the determining factors, which may be conducive for native and migratory birds for feeding and breeding. A monsoon impact is the lowering of the temperature increasing the availability of water, which is followed by growth of vegetation. The rise in temperature and unavailability of vegetation during post monsoon and winter might have influenced the diversity of avian species. In the present study also, the relative density of avian species is lower in winter compared to monsoon and post monsoon. It may be due to high temperature and salinity and low dissolved oxygen content.

The seasonality of birds may be a reflection of their life style adaptation, particularly controlled by temperature. Further, unchecked poaching excessive grazing of littoral vegetation by domestic animals might have affected bird life by destroying habitats. The present investigation reveals that the impact of physic-chemical, biological parameters and the climatic changes after the monsoon highly affect the feeding, breeding and the population so that the avian community is failed to attain a better position to grow and establish for the continuation of the race.

Table.1 Physico- chemical parameters of Konthaigai pond A and B during the sampling period from October 2015 to February 2016

S.No	Parameters	Pond A			Pond B		
		Oct 2015	Dec 2015	Feb 2016	Oct 2015	Dec 2015	Feb 2016
1	Temperature °C	26	26	25	29	28	27
2	Total solids (g/L)	1.1	0.4	0.4	1.3	1.4	0.96
3	Total Dissolved Solids (g/L)	1	03	0.2	0.6	0.7	0.20
4	Total suspended solids (g/l)	0.1	0.1	0.2	0.7	0.7	0.70
5	Turbidity (NTU)	96	72	59	304	254	145
6	Electrical Conductivity(U/S)	297	237	428	144	173	446
7	Salinity (ppt)	0.16	0.14	0.25	0.09	0.09	0.27
8	pH	7.8	8.41	7.32	7.9	8.05	9.04
9	Dissolved Oxygen (mg/L)	9.9	11.01	8.16	9.1	8.56	7.8
10	Free Carbondioxide (ppm)	6	3	3	4	5	4
11	Alkalinity (mg/L)	255	265	305	160	170	190
12	Chloride (mg/L)	88.04	76.68	63.9	36.92	25.56	19.65
13	Residual chlorine (mg/L)	2.66	7.98	5.32	1.77	6.21	10.65

Table.2 Bacterial load of the Kondhagai pond A and B during the sampling period from October 2015 to February 2016

RTU	October - 2015		December – 2015		February - 2016	
	Pond A	Pond B	Pond A	Pond B	Pond A	Pond B
1	25	2	35	-	7	-
2	2	2	2	-	-	-
3	6	2	-	-	-	-
4	2	1	32	-	-	-
5	-	12	26	-	-	-
6	-	2	2	3	-	-
7	-	3	4	-	3	-
8	-	1	2	-	4	-
9	-	3	-	-	25	-
10	-	-	-	38	22	-
11	-	-	-	17	-	-
12	-	-	-	2	-	10
13	-	-	-	-	-	36

Table.3 Enumeration of Total coli forms (MPN) in Kondhagai pond A and B during the sampling period from October 2015 to February 2016

S.No	Test	October - 2015		December – 2015		February - 2016	
		Pond A	Pond B	Pond A	Pond B	Pond A	Pond B
1	MPN/100 ml	1100	1100	290	460	150	210
2	EMB Plate	Green Metallic sheen & Pink colonies	Green Metallic sheen & Pink colonies	Dark blue centered, Pink & Dark brown colonies	Dark blue centered, Pink & Dark brown colonies	Dark blue centered, Pink & Dark brown colonies	Dark blue centered, Pink & Dark brown colonies
3	Gram Stain	Rod	Rod	Rod	Rod	Rod	Rod

Table.4 Birds recorded in Kondhagai pond A and B during the sampling period from October 2015 to February 2016

S. No	Family	Scientific Name of the Birds	Common Name	Number of Individual					
				October - 2015		December 2015		February - 2016	
				A	B	A	B	A	B
1	Accipitridae	<i>Accipiter badius</i>	Shikra	0	0	0	0	2	2
2		<i>Milvus migrans</i>	Black Kite	0	0	0	0	3	3
3		<i>Pandion haliaetus</i>	Ospray	0	0	0	0	1	1
4	Alcedinidae	<i>Alcedo atthis</i>	Common Kingfisher	4	4	11	11	0	0
5		<i>Halcyon smyrenis</i>	White-Breasted Kingfisher	1	1	8	8	7	7
6	Anatidae	<i>Anas crecca</i>	Common Teal	4	4	29	29	0	0
7	Anhingidae	<i>Anhinga melanogaster</i>	Darter	26	26	0	0	0	0
8	Apodidae	<i>Tachymarptis melba</i>	Asian Palm-Swift	25	25	41	41	35	35
9	Ardeidae	<i>Ardea cinerea</i>	Gray Heron	1	1	0	0	0	0
10		<i>Ardeola grayii</i>	Indian Pond-Heron	20	20	30	30	35	35
11		<i>Bubulcus ibis</i>	Cattle Dgret	18	18	60	60	100	100
12		<i>Casmerodius albus</i>	Great Egret	3	3	0	0	0	0
13		<i>Egretta garzetta</i>	Little Egret	20	20	10	10	6	6
14		<i>Egretta intermedia</i>	Median Egret	50	50	0	0	0	0
15		<i>Nycticorax nycticorax</i>	Night Heron	40	40	0	0	0	0
16	Artamidae	<i>Artamus fuscus</i>	Ashy Woodswallow	0	0	35	35	0	0
17	Charadriidae	<i>Vanellus indicus</i>	Red-Watted Lapwing	0	0	3	3	0	0
18	Ciconiidae	<i>Anastomus oscitans</i>	Asian Openbill Stork	1000	1000	52	52	1	1
19	Columbidae	<i>Columba livia</i>	Rock Pigeon	16	16	0	0	0	0
20		<i>Streptopelis chinensis</i>	Spotted Dove	3	3	20	20	0	0
21		<i>Streptopelia decaocto</i>	Eurasian Collard Dove	7	7	12	12	0	0
22		<i>Streptopelia senegalensis</i>	Laughing Dove	2	2	1	1	0	0
23	Corvidae	<i>Corves macrorhynchos</i>	Jungle Crow	4	4	30	30	13	13
24		<i>Corves splendens</i>	House Crow	40	40	40	40	60	60

25		<i>Dentrocitta vagabunda</i>	Rufous Treepie	6	6	12	12	5	5
26	Cuculidae	<i>Centropes sinensis</i>	Greater Coucal	3	3	1	1	7	7
27		<i>Clamator jacobinus</i>	Pied Cuckoo	1	1	0	0	0	0
28		<i>Cuculus poliocephalus</i>	Lesser Cuckoo	1	1	1	1	1	1
29		<i>Eydynamys scolopecea</i>	Asian Koel	1	1	0	0	3	3
30		Dicruridae	<i>Dicrurus leucophaeus</i>	Ashy Drongo	7	7	7	7	0
31	<i>Dicrurus macrocercus</i>		Black Drongo	20	20	30	30	0	0
32	Monarchidae	<i>Terpsiphone paradise</i>	Asian Paradisebird	0	0	0	0	12	12
33	Motacillidae	<i>Motacilla maderaspatensis</i>	White-Browed Wagtail	10	10	3	3	26	26
34	Muscicapidae	<i>Luscinia brunnea</i>	Indian Blue Robin	0	0	7	7	0	0
35		<i>Saxicoloides fulicata</i>	Indian Robin	2	2	6	6	2	2
36	Nectariniidae	<i>Nectarinia asiatica</i>	Purple Sunbird	2	2	0	0	9	9
37		<i>Nectarinia zeylonica</i>	Purple Rumped Sunbird	0	0	0	0	4	4
38	Oriolidae	<i>Oriolus oriolus</i>	Golden Oriole	0	0	0	0	5	5
39	Passeridae	<i>Passer domesticus</i>	House Sparrow	40	40	36	36	12	12
40	Phalacrocoracidae	<i>Phalacrocorax carbo</i>	Great Cormorant	5	5	0	0	0	0
41		<i>Phalacrocorax niger</i>	Little Cormorant	150	150	4	4	1	1
42	Phasianidae	<i>Pavo cristatus</i>	Indian Peafowl	20	20	70	70	15	15
43	Picidae	<i>Dinopium benghalense</i>	Black-Rumped Flameback	1	1	1	1	0	0
44	Podicipedidae	<i>Tachybaptus ruficollis</i>	Little Grebe	0	0	9	9	0	0
45	Psittacidae	<i>Psittacula krameri</i>	Rose-Ringed Parakeet	20	20	40	40	25	25
46	Pycnonotidae	<i>Pycnonotus cafer</i>	Red-Vented Bulbul	6	6	0	0	0	0
47	Rallidae	<i>Amaurornis phoenicurus</i>	White-Breasted Waterhen	7	7	12	12	0	0
48		<i>Fulica atra</i>	Common Coot	0	0	21	21	0	0
49		<i>Gallinula chloropus</i>	Common Moorhen	0	0	3	3	0	0
50	Scolopacidae	<i>Actitis hypoleucos</i>	Common Sandpiper	0	0	0	0	7	7
51	Sturnidae	<i>Acridotheres tristis</i>	Common Myna	75	75	100	100	100	100
52	Threskiornithidae	<i>Threskiornis melanocephalus</i>	Oriental White Ibis	75	75	85	85	0	0

Table.5 Diversity indices of birds at Kondagai pond A and B during the sampling period from October 2015 to February 2016

S.No	Particulars	October - 2015		December – 2015		February - 2016	
		Pond A	Pond B	Pond A	Pond B	Pond A	Pond B
1	Taxa	39	39	34	34	27	27
2	Individuals	1736	1736	830	830	497	497
3	Dominance	0.3469	0.3469	0.05979	0.05979	0.1149	0.1149
4	Simpson	0.6531	0.6531	0.9402	0.9402	0.8851	0.8851
5	Shannon	1.912	1.912	3.054	3.054	2.553	2.553
6	Evenness	0.01735	0.01735	0.6237	0.6237	0.4758	0.4758
7	Menhinick	0.936	0.936	1.18	1.18	1.211	1.211
8	Margalef	5.094	5.094	4.91	4.91	4.188	4.188

Fig.1 Gas produced by coli form bacteria in Kondagai pond A and B during the sampling period from October 2015 to February 2016

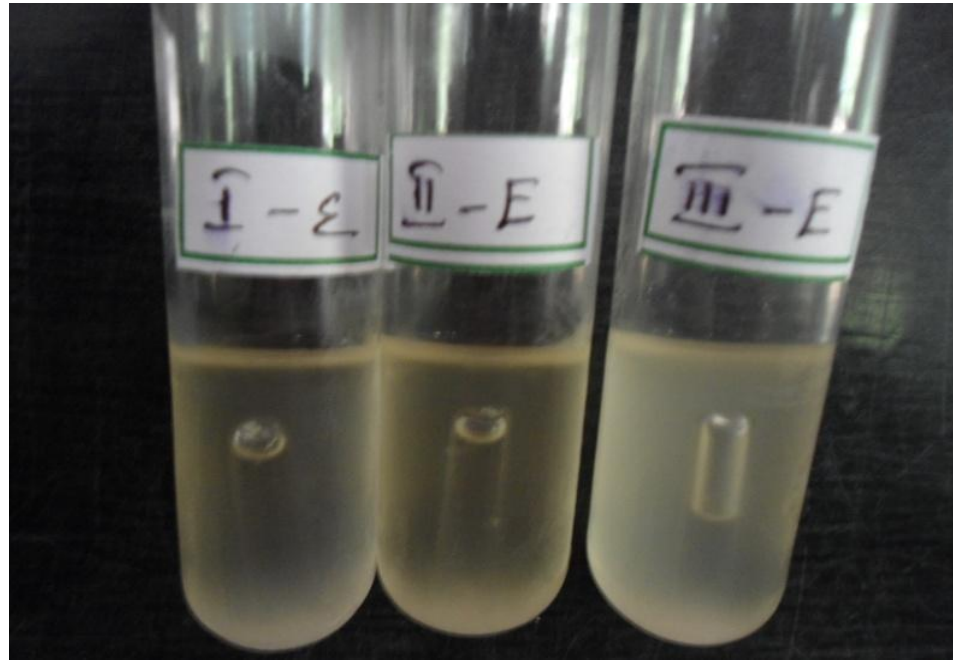


Fig.2a&b Colonies with green metallic sheen and blue centers in Kondagai pond A and B during the sampling period from October 2015 to February 2016



A



B



Plate 1: Some Butterflies and Draganflies recorded in Kondhagai pond A&B during the study period

In North America's Prairie Pothole region, models have projected an increase in drought with a 3°C regional temperature increase and varying changes in precipitation, leading to large losses of wetlands and to declines in the populations of waterfowl breeding there (Johnson *et al.*, 2005; Krishnan *et al* 2017). One review of 300 migrant bird species found that 84% face some threat from climate change, almost half because of changes in water regime and this was equal to the summed threats due to all other anthropogenic causes (Robinson *et al.*, 1982). The data on birds was subjected to diversity analysis using PAST and various diversity measures were calculated. The Shannon index of the samples ranged from 65 to 94. High Shannon value indicating low diversity was observed in the month of December 2015. In concurrence with this, the Shannon value was high in the same month.

The sanctuary was selected as one of important birds area due to large breeding colony of avifauna. About 5000 birds belonging to 250 species used to visit this sanctuary during breeding seasons and more than 250 nests of open bills and 100 of oriental ibis were normally found during this season. But only 52 species of birds were observed during the study period reveal the degradation of the habitat due to cattle grazing, non availability of nesting trees, predators, poor rainfall and so on which shrinks the bird's population. Restoration of habitat by native trees, restriction of grazing and improving water storage capacity of the ponds will enhance the population and diversity of the birds and the ecosystem.

In conclusion, in the present study, to evaluate the physico-chemical and biological characteristics of pond water and to assess the relative density, abundance of native and migratory avian species in pond A and B was carried out during the period of October 2015

to February 2016. In both ponds, the physico-chemical characteristics and MPN count were in accordance with general trend. The observation on the bird's population revealed that the presence of 3063 birds belonging to 29 families. In the study area only 26.92% of birds were migratory and the remaining ones were resident, common and rare. During the study period two globally near threatened species viz *Anhinga melanogaster* (Darter) and *Threskiornis melanocephalus* (Oriental White ibis) were recorded. In the present study, the abundance of native and migratory birds in the monsoon season may be due to the availability of food in the form of plants, Invertebrates and smaller vertebrates, herbivorous birds eat the fruits, tubers and leaves of wetland plants. It is also evident that the water temperature influences food production. Invertebrate production in the water column is ultimately depending on water temperature and the ability of a wetland to produce algae. The present investigation reveals that the impact of physic-chemical, biological parameters and the climatic changes after the monsoon highly affect the feeding, breeding and the population so that the avian community is failed to attain a better position to grow and establish for the continuation of the race.

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