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Diversity, Abundance and Activity Pattern of Wetland Birds Along Cauvery Basin at Kumbakonam, Tamil Nadu, India

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Diversity, Abundance and Activity Pattern of Wetland Birds Along Cauvery Basin at Kumbakonam, Tamil Nadu, India

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I. INTRODUCTION

Studies shows that wetlands are extremely important areas throughout the world for wildlife protection, recreation, sediment control, flood prevention (Sivaperuman and Jayson, 2000). They are also important bird habitats for feeding, roosting, nesting and rearing young (Wellar, 1999 and Stewart, 2001). Wetlands are being used for agriculture, aquaculture, reclamation for harbouring and industrial purpose, disposing the waste materials, discharging the industrial seasoning, dumping dredged soil, coir retting and for fishing (Nameer, 1998 and Balachandran *et al.*, 2002). 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 (Buckton, 2007).

Animal biodiversity in India has much number of invertebrate species, 2546 species of fishes, 204 species of amphibians, 446 species of reptiles, 1228 species of bird and 372 species of mammals (Agarwal, 2000). Among the bird, 9000 species were found in the world, over 13% of the world's bird fauna are found in India (Grimmett *et al.*, 1998). 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). The global diversity of birds is considerably decreasing due to anthropogenic activities and climate changes (Rapoport, 1993 and Chen *et al.*, 2011).

Out of 310 Indian wetland bird species, 130 are migrant, 173 are resident, however the status is unknown for seven species. Among the migrants, 107 are winter migrants, six have some passage population(s), 13 are summer migrants, and the remaining four are purely passage migrants (Kumar *et al.*, 2006). Systematic study on diversity and abundance of the water birds of Cauvery delta region is lacking. Hence the present study intended to document the avian fauna of these wetland habitats which was carried out from September 2016 to August 2017 with the following objectives.

Objectives

- To determine the status, distribution and abundance of wetland birds,
- To find out the activity pattern of important species of birds,
- To know the water quality parameters of the wetlands and
- To identify the conservation problems facing by wetland birds.

II. MATERIALS AND METHODS

a) Study location

The Cauvery is one of the largest Indian river and its origin is at Talakaveri of Kodagu in Karnataka, flows towards south and east through Karnataka and Tamil Nadu states and across the southern Deccan

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plateau through the southeastern lowlands, emptying into the Bay of Bengal. In Tiruchirappalli the river becomes wide, with a sandy bed, and flows in an eastern direction until it splits into two at upper Anicut. The northern branch of the river is called the Kollidam while the southern branch retains the name Cauvery and then goes directly eastwards into Thanjavur District. Then the river splits and goes to few places in the Delta regions of Cauvery.

Kumbakonam is located at 10.97°N and 79.42°E. It lies in the region called "New Delta" comprising of the southern taluks that were brought

under irrigation by the construction of the Grand Anicut canal and the Vadavar canal in 1934. It has an average elevation of 26 metres. The town is bounded by two rivers, the Cauvery River on the north and Arasalar River on the south.

Kumbakonam is surrounded by extensive paddy and other crops cultivation. Methods of irrigation were considerably improved following the opening of the Mettur Dam. The present study was conducted in the cultivated areas and water bodies of the villages adjacent to Kumbakonam are given in the Table. 1.

Table 1: Habitats selected for the study on Birds

Sl. No.	Place	River	Pond	Paddy field
1	Neelathanallur	*		*
2	Kumbakonam	*	*	
3	Karaikurichi		*	
4	Melathukurichi			*
5	Arul Mozhi		*	
6	Kadichambadi		*	*
7	Devanancheri	*		*
8	Asur		*	*
9	Paratai	*		*
10	Mathanathur	*	*	*

*Study habitats

III. STUDY METHODS

Observations were made in the morning and afternoon hours between the months of September 2016 to August 2017. Surveys were conducted on daily basis at different locations like agriculture fields, wetlands and tanks, river banks, road side, trees, etc. At each sighting birds were counted using a binocular and identified. In case of doubtful identification, photographs were taken and the species is identified later by consulting experts. Identification of birds was also done using field guides (Ali and Ripley, 1987; Grimmet *et al.*, 2000). The checklist was prepared using standardized common and scientific names of the birds following Manakadan and Pittie (2001). Abundance of the birds were established upon the following criteria: Common-recorded 9-10 times out of 10 visits, fairly common- 6 -8 times, uncommon- 3 -5 times and rare- recorded 0 -2 times out of 10 visits.

Birds were estimated using total count method (Hoves and Bakewell, 1989). In this method, representative wetlands were identified and birds were counted. All the visible individuals in the study area were counted by direct encounter method. Food and feeding and other behaviours was investigated using the observational method of Altman (1974). The activity patterns of each species were recorded by using focal

and scan sampling methods (record each animal's behavior at predetermined time for certain period) with 5 minutes intervals (Feeroz and Islam 1992, Hasan *et al.* 2005, Akhtaret *al.* 2007, 2009, Martin and Bateson 1993). The activities of all the visible individuals were recorded in each scan. The behaviour of one individual during the scan was recorded as one observation. Other important behaviours (event or instantaneous behaviour e.g. courtship and copulation, mating etc.) were also noted. Activities were recorded as foraging and feeding, moving, resting, calling, preening, chasing, hiding and breeding (Akhtaret *al.* 2009).

Species density: The individual and total water bird densities for different months, climatic season and regions of the study area were calculated as numbers per hectare. In order to investigate the variations in diversity of bird species and ecological groups during different month of the study period the species diversity was calculated using Shannon wiener index (Shannon and Wiener, 1949).

Physical and chemical analysis: Temperature, pH and DO were measured in the collection point, using mercury in glass Thermometer. The collected samples are immediately transferred and analysed in the laboratory. All samples analysed for various water quality parameters are determined according to standard procedure APHA (2005). The metals were

Analysed using Elmer Perkin Model 8100c Atomic Absorption Spectrophotometer.

Correlation analysis: The bird density, diversity, richness and physio-chemical factors are correlated with the help of SPSS and MINITAB softwares. Multiple regression equation model was developed for bird population characteristics feature (density, diversity and richness) and it was investigated for their influence of water quality parameter (Nagarajan, 2002).

IV. RESULTS AND DISCUSSION

The present investigation is showing that there are thirty one species of water birds belonging to 14 families have been identified in the waterways at the study area. Totally 65 percent of the birds were identified

at the study area are belongs to the ecological group of large and small wader birds (Table 2). These birds were ecologically classified into six groups namely, Divers, Swimming birds, small waders, large waders, aerial foragers and fringe feeders. Lower species richness of birds in this area is attributed due to the smaller size of the wetland (Gajardo *et al.*, 2009). As reported earlier from the Western Ghats, highest number of birds was recorded during the months of winter and there was a reduction in population size during the monsoon (Daniels, 1998). Many factors, which threaten the wetland ecosystem and in turn the bird population, were identified during the study. Birds use wetlands as a source of drinking water and for feeding, resting, shelter and social interactions (Steward, 2007).

Table 2: Water birds recorded at the Study areas

Sl. No.	Common Name	Scientific Name	Order	Family	Ecological Group
1	Little Grebe	Podicepsruficollis	Podicipediformes	Podicipedidae	Diver
2	Little cormorant	Phalacrocoraxniger	Pelecaniformes	Phalacrocoraxidae	Diver
3	Darter	Anhinga rufa	Pelecaniformes	Anhingidae	Diver
4	Common coot	Fulicaatra	Gruiformes	Rallidae	Diver
5	Purple moorhen	Porphyrioporpyrio	Gruiformes	Rallidae	Swimming bird
6	Pheasant tailed jacana	Hydrophasianuschirurgus	Charadriiformes	Charadriidae	Small wader
7	Little ringed plover	Charadriusdubius	Charadriiformes	Charadriidae	Small wader
8	Black winged stilt	Himanotopushimanotopus	Charadriiformes	Charadriidae	Small wader
9	Red wattle lapwing	Vanellusindicus	Charadriiformes	Scolopacidae	Small wader
10	Green shank	Tringanebularia	Charadriiformes	Scolopacidae	Small wader
11	Green sand piper	Tringaorchropus	Charadriiformes	Scolopacidae	Small wader
12	Common sand piper	Actitishypoleucos	Charadriiformes	Scolopacidae	Small wader
13	Little stint	Calidrisminuta	Charadriiformes	Scolopacidae	Small wader
14	Little egret	Egrettaagrazetta	Ciconiiformes	Ardeibae	Large waders
15	Grey heron	Ardeacinerea	Ciconiiformes	Ardeibae	Large waders
16	Purple heron	Ardeapurpurea	Ciconiiformes	Ardeibae	Large waders
17	Large egret	Ardea alba	Ciconiiformes	Ardeibae	Large waders
18	Median egret	Egrettaintermedia	Ciconiiformes	Ardeibae	Large waders
19	Cattle egret	Bubulcuss ibis	Ciconiiformes	Ardeibae	Large waders
20	Pond heron	Ardeolagrayii	Ciconiiformes	Ardeibae	Large waders
21	Open bill stork	Anastromusoscitans	Ciconiiformes	Ciconiidae	Large waders
22	White ibis	Threskiornismelanocephalus	Pelecaniformes	Threskiornithidae	Large waders
23	Black ibis	Pseudibispapillosa	Pelecaniformes	Threskiornithidae	Large waders
24	Little tern	Sterna albifrons	Charadriiformes	Laridae	Aerial forager

Sl. No.	Common Name	Scientific Name	Order	Family	Ecological Group
25	Small blue kingfisher	Alcedoatthis	Coraciiformes	Alcedinidae	Aerial forager
26	Pied kingfisher	Cerylerudis	Coraciiformes	Alcedinidae	Aerial forager
27	White breasted kingfisher	Halcyon smyrnensis	Coraciiformes	Alcedinidae	Aerial forager
28	White breasted waterhen	Amaurornisphoenicurus	Gruiformes	Rallidae	Small wader
29	Pied wagtail	Motacilla alba	Passeriformes	Motacillidae	Fringe feeder
30	Grey wagtail	Motacillacinerea	Passeriformes	Motacillidae	Fringe feeder
31	Brahmini kite	Haliasturindus	Accipitriformes	Accipitridae	Aerial forager

Total abundance of water birds seen in the study areas are given in the Table. 3. In the case of Kingfishers white-breasted kingfisher (118) is the most sighted bird followed by pied kingfisher (44) and small blue kingfisher (28). Among egrets, median egret (562) was sighted higher followed by cattle egret (209), little egrets (185). Whereas large egrets were sighted very less (38) in number. Pond heron is the bird sighted higher (419) and grey herons sighted very less in

number (59). Among the cormorants only little cormorants were seen less in number (8) whereas darter sighted high (23). Grey wagtail is the bird sighted high in number (175), followed by common sand piper. Others were seen only very less in number (Table. 3). The percentagewise water birds recorded in the agriculture fields especially paddy fields are higher (58%), followed by ponds (26%) and rivers (16%) (Fig. 1).

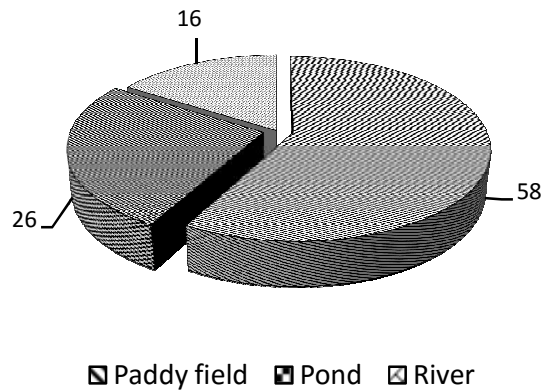


Fig. 1: Percentage of usage of different habitat types by water birds

Table. 3: Abundance of water birds sighted in the study areas

Name of the bird	Total numbers sighted
Kingfishers	
Small Blue Kingfisher	28
White-breasted kingfisher	118
Pied Kingfisher	44
Egret	
Little Egret	185
Median Egret	562
Large Egret	38
Cattle Egret	209
Hérons	
Pond Heron	419
Grey Heron	59
Cormorants and darter	
Little Cormorant	8
Darter	23
Spoonbill, bittern, ibis and storks	
Black Ibis	15
Purple Moorhen	9
Common Moorhen	42
Pheasant-tailed Jacana	7
Coot	19
Dabchick	78
White-breasted Waterhen	44
Grey Wagtail	175
Pied wagtail	61
Brahmini kite	65
Common sandpiper	106
Red – wattled lapwing	45

Density: The density of birds which are observed and recorded in the study areas were presented in Fig. 2. The density of diving birds, swimming birds, small waders, large waders and aerial foragers were slightly higher in the month of November than March. Similarly, most of the birds observed and recorded higher in monsoon followed by pre-monsoon and post-monsoon seasons. DeshkarSona *et al.*, 2010 reported the density and species richness of birds are expected to be

highest during winter when migratory population arrive and minimum during monsoon when the migratory populations leave the area and the resident species are engaged in the nesting activities. In the present study the density of diving birds, swimming birds, small waders, large waders and aerial foragers were slightly higher during the month of November than March. The species richness of diving bird and swimming bird were higher in the month of January and lower in the month of August. Species richness of small waders was high in the month of February and lower in August. In other hand richness of large waders was high in the months of November and lower in August. Thus the richness of large waders was higher during monsoon season of the study periods. Most of the birds observed and recorded higher in monsoon followed by pre-monsoon and post-monsoon seasons.

Pollution, mainly in the form of chemical effluents is the major threats to the birds in this ecosystem. The study area is one of the major feeding ground of many water birds and other resident species. During summer ponds are dried without water and people use to catch fishes. This activity makes the birds ignore ponds during summer except kites. Similar studies shows water is a major driven factor that affected aquatic vegetation composition and food resources that influenced bird density, diversity and distribution (Colwell and Taft 2000; Quinn 2002; Wilcox *et al.*, 2002; Mohanraj and Pandiyan, 2015).



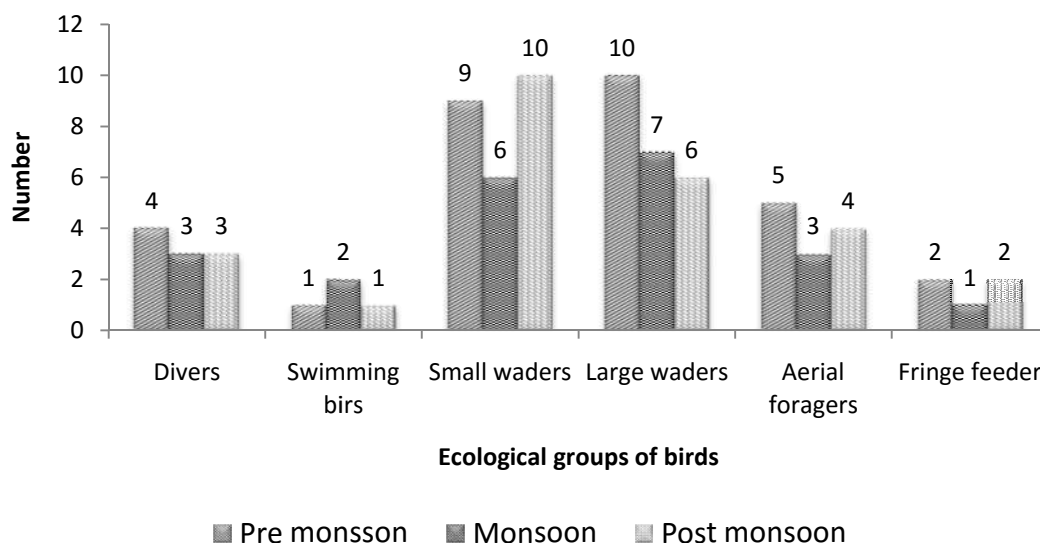


Fig. 2: A comparison of season wise variations in the bird density of the study periods

Diversity: The diversity of diving birds was highest in the month of February (1.07 ± 0.2) and lowest in August (0.5 ± 0.1). Similarly, the diversity of diving bird was higher in pre-monsoon (1.06 ± 0.8) than monsoon and post monsoon periods. The diversity of small waders was higher in the month of November (1.67 ± 0.1) and lower in August (1.17 ± 0.1) at the same time the diversity of large waders was higher in November

(1.88 ± 0.3) and lower in month of March (1.54 ± 0.1). The small waders and large waders were higher in monsoon followed by post monsoon and pre monsoon. In the other hand the diversity of swimming birds and aerial foragers were higher in the month of December and lower in March. Thus the diversity of swimming bird and aerial foragers were very high during monsoon and low in pre monsoon (Fig. 3).

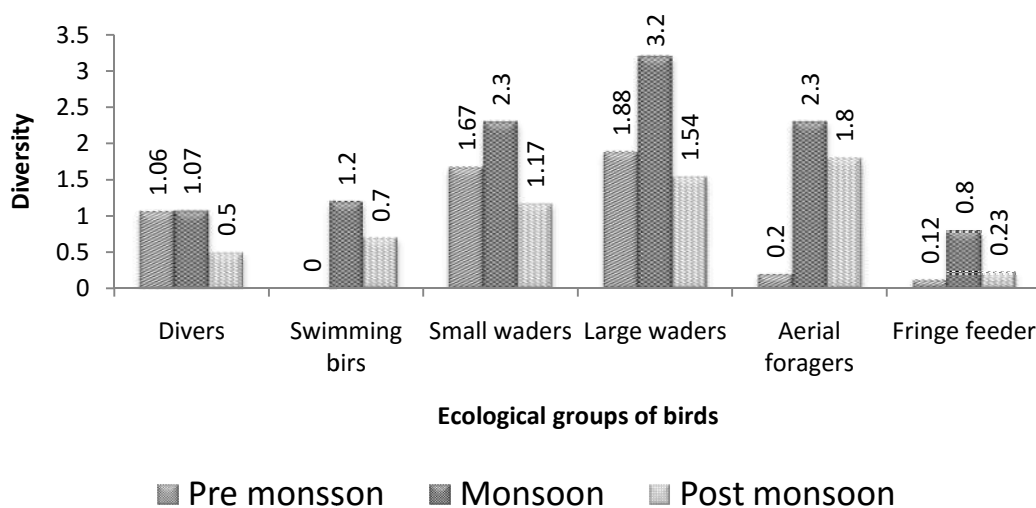


Fig. 3: A comparison of season wise variations in the bird diversity of the study periods

Richness: The species richness of diving bird and swimming bird were higher in the month of January and lower in the month of August similarly they are low in pre monsoon than post monsoon (Fig. 4). Species richness of small waders was high in the month of February (9 ± 2.6) and lower in the month of September (5 ± 1.5). Thus the post monsoon (8.7 ± 2.2) months of the study periods had higher species richness of small waders. In the other hand richness of large waders was high in the months of November (13 ± 1.5) and lower in the month of August (10 ± 1.2). Thus the richness of large waders

was higher during monsoon (10 ± 1.2) season of the study periods (Fig. 4). The manmade water bodies constructed by man to satisfy his own needs also form important habitats for several avian species. To study any ecosystem the birds serve as important component as they have the ability to fly away and avoid any obnoxious condition. Hence, they are considered as important health indicators of the ecological conditions and productivity of an ecosystem (Desai and Shanbhag, 2007, Li and Mundkur, 2007). The most important parameters of the bird study are the species richness

(Murphy *et al.*, 1984), their density (Nilsson and Nilsson, 1993) and diversity (Krebs, 1985). However among avian communities, the components of diversity are known to

differ between locations and seasons (Bethke and Nudds, 1993).

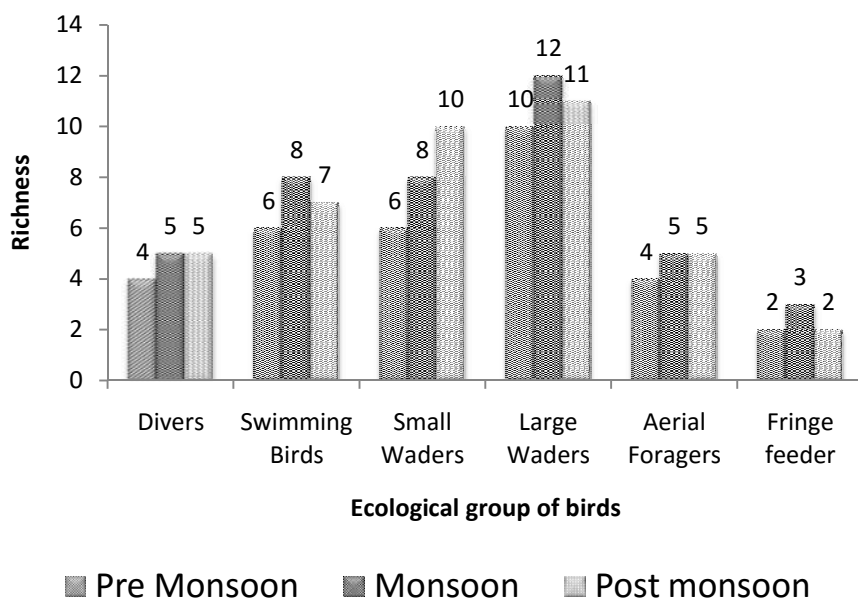


Fig. 4: A comparison of season wise variations in the bird richness of the study periods

V. ACTIVITY BUDGET OF SELECTED WATER BIRDS

All the birds have their own activity pattern for its daily life. Different activities observed in selected water birds are given below.

a) Pond heron

Pond heron is a shy bird takes more time for resting activity. The present observation on activity budget of pond heron shows most of its time they spent for resting or perching (55%) in a trees present adjacent to the pond. They do fishing and feed on other arthropods and spent 25% for feeding activity. They may fly in a short duration within or periphery of the pond. The present observation shows 14% of its time they did flying activity. Occasionally pond herons makes sound for communication with their pair.

b) Little grebe

The activity budget of little grebe was recorded and it show most of the time they do swimming (38%) under water and feeding (49%) activities. Other activities such as flying and courtship with its mate is less.

c) Pied kingfisher

Pied kingfisher shows that it takes most of its time perching (37%) and flying (29%) activities. Hovering activity shows (14%) while attacking the prey and very little time it takes feeding and vocalization activities.

d) Pheasant tailed jacana

In the present study it takes most of its time for feeding activity (42%) followed by walking (38%)

activity. Other activities are flying (12%) and interacting with other birds of its own and other birds.

e) Common moorhen

The activity budget of common moorhen shows that it spent most of its time for swimming activity for 43%. Feeding activity was observed (29%) followed by resting (19%) and courtship (9%) activities.

All the observations shows that the water birds in the study area normally active during early hours and late hours of the day, since the sunlight is warmer heavily in the mid day. The surroundings of the pond also polluted heavily for keeping all debris and are dumped along the bank. High resting in summer might reflect the tendency to rest in warmer day light hours of the water birds. Tamisier (1976) had also reported that wintering waterfowl benefit thermodynamically by feeding at night and preening, resting and courting during the warmer day light hours. In fact, the birds were seen to rest over the large floating leaves of water lily and grassy patches or other free floating vegetations. The water birds foraged and fed most actively before noon. After overnight fasting they try to maximize foraging and feeding during early morning. Similar observation was found in Bronze-winged Jacana (Akhtar *et al.* 2009).

f) Physico-chemical analysis of water

The results of water quality analysis and Phsysico-chemical characteristics of water are presented in the Table 4. The water was slightly alkaline nature and contained high amounts of pH, dissolved oxygen, electrical conductivity, salinity and turbidity in all

the seasons are examined. The surface water temperature was recorded highest during the post monsoon season ($29.4 \pm 0.12^\circ \text{C}$) than the other seasons. The water depth ($115 \pm 2.62 \text{ cm}$) was elevated in the monsoon season. The dissolved oxygen ($6.4 \pm 0.1 \text{ mg/l}$), salinity ($54.4 \pm 2.9 \text{ mg/l}$) was increased during the post monsoon season. The turbidity ($2.5 \pm 0.9 \text{ NTU}$) was recorded highest in the pre monsoon season during the study period. The elevated level of electrical conductivity ($662.5 \pm 15.7 \text{ mho/cm}$) was recorded during the pre monsoon season. High amount of pH was recorded in monsoon seasons during the study periods most of the parameters were slightly higher in the post monsoon than monsoon (Table 4). As anticipated the chemical parameters of water varied according to the seasonal fluctuations. Significant drop in the water cover during the post monsoon is predominantly because of the evaporation, however the water is also utilized for irrigating the neighboring fields. This also results in increasing the solids in water. The bird density was negatively correlated with water cover too. During the monsoon and the post monsoon the water level were high in turn maximum birds were present. The previous reports finding of DeshkarSona *et al.*, (2010) during monsoon the dissolved oxygen and the salinity are high which can be due to vigorous mixing of water because of precipitation. High amount of pH was recorded in monsoon seasons during the study periods most of the parameters were slightly higher in the post monsoon than monsoon.

VI. RELATIONSHIP OF WATER QUALITY PARAMETER WITH WATER BIRD POPULATION

Density of water birds: The correlation between water bird density and the water quality parameter revealed

Table 4: Correlation between water bird density, diversity, richness and water quality parameters at the study areas

	Density	Diversity	Richness	Depth	Temp	pH	DO	Salinity	Turbidity	EC
Density	1									
Diversity	0.862**	1								
Richness	0.650	0.917**	1							
Depth	0.690*	0.354*	0.008	1						
Temp	-0.800*	-0.472*	-0.135*	-0.821*	1					
pH	0.319	0.245	0.105*	-0.059	0.323	1				
DO	-0.003	-0.380	-0.582	-0.558	0.220	-0.174	1			
Salinity	-0.653	-0.293	-0.046	-0.871**	0.706	-0.047	0.512	1		
Turbidity	-0.271	-0.259	-0.214	-0.198	0.095	-0.371	0.391	0.280	1	
EC	-0.670	-0.528	-0.441*	-0.553	0.344	0.185	0.297	0.505	0.116	1

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

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

All the water quality factors were found to be significantly influence one or more water bird population characteristics. Sampath and Krishnamoorthy (1993) were reported on the effect of water quality factors for

that the turbidity, Dissolved oxygen, salinity and electrical conductivity were negatively correlated. The pH and water depth were positively correlated. The temperature (-0.803) was negatively correlated at the significant level of $P < 0.05$ and water depth (0.722) was positively correlated at the significant level of $P < 0.05$ (Table 4).

Diversity water birds: Relationship between the diversity of total water bird and the water quality variables revealed that the electrical conductivity, dissolved oxygen, turbidity and salinity levels were negatively correlated in the study period. The pH level was positively correlated. The temperature (-0.88) level was negatively correlated and its significant level of $P < 0.05$. The water depth (0.818) was positively correlated and significant level of $P < 0.05$ (Table 4).

Richness of water birds: The correlation between the water bird richness and the water quality variation revealed that the temperature (-0.85) was negatively significant and its significant level of $P < 0.01$. The electrical conductivity (-0.709) was negatively correlated at the significantly level of $P < 0.01$. The pH (0.7) was positively significant of $P < 0.05$. The depth level was positively correlated and the dissolved oxygen, salinity and turbidity levels were negatively correlated in the study period (Table 4).

the water birds in a wetland. In the present study the correlation between the water bird richness and the water quality variation revealed that the temperature was negatively significant. The electrical conductivity was

negatively correlated significantly. The pH was positively significant of $P < 0.05$. The depth level was positively correlated and the dissolved oxygen, salinity and turbidity levels were negatively correlated during the study period.

The present study concluded that the importance of the Cauvery basin as they prove to be the important feeding ground for the migratory and the resident species of the birds. Moreover various abiotic parameters play an important role to make up the density, diversity and richness of the water birds hence indicating a single abiotic factor is unfeasible. Thus it can be concluded that the variation in the water quality and the availability of different prey determined the distribution and diversity of aquatic birds in the area during the study period.

This study is proved that the water birds play an important role of the ecosystems as a biological agent of insect pest, helping the farmers in the way of giving free manure in the form of guanos, etc. and that if the present ecological characteristics of this wetland continue, the birds were unable to inhabit this habitat in the immediate future. Proper awareness class regarding the importance of birds to the local people, through different programmes will ultimately help the protection of birds of this region.

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