

COMPARATIVE STUDY OF AQUATIC AVIAN DIVERSITY BETWEEN PULICAT LAKE AND ADYAR ECO PARK, TAMIL NADU

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ABSTRACT

Wetlands are one of the most thriving ecosystems in our environment. Their value is gaining more and more needed attention as it contributes to a healthy environment in many ways. They play an important role for local flora and fauna, as well as for the societies that live around and outside the wetlands. They are highly diverse ecosystems and are exposed to various threats especially with regard to bird species. Due to the presence of ample shelter and lack of large predators, wetlands make a desirable layout for birds to refuel and rest during migrations. Wetlands see an immense amount of aquatic bird species, which are born, reproduced, feed, and die here. Two such diverse ecosystems were taken as the study areas: Pulicat Lake and Adyar Eco-Park. Pulicat Lake is the second largest brackish water lagoon in India. It is an unrestored ecosystem which harbours rich, floristic treasures and faunal diversity. The banks of the lagoon are suitable nesting sites for terns, gulls and waders. Adyar Eco Park, a restored ecosystem of Coromandel Coast with freshwater ponds, brackish water areas, mangroves, mudflats, dunes and islands. This place has been a substantial link for wading birds on their annual migrations which feed on the coastal mudflats. The aquatic avian fauna of the unrestored Pulicat wetland and restored Adyar Eco Park were observed and documented from July 2021 – November 2021. The observation of the birds was carried out by point count method. Random sites were chosen on the study areas and birds of various species were counted around a 20m radius from the point of view. Water quality, pH, temperature, salinity, vegetation and size of the areas were also analysed. As a result 22 species of aquatic birds were recorded in Pulicat and 20 species were found in Adyar Eco Park.

Keywords: *Wetlands, Aquatic Avian Species, Diversity, Water Quality*

INTRODUCTION

Wetlands can be defined as an ecosystem that's doused in water where the coexistence between terrestrial and aquatic eco-systems can be found. The land here is covered by a good deal water or the water table is usually near or at the surface level, in other words, wetlands are land saturated with water. Wetlands are one of the most flourishing ecosystems of our environment, with their value increasingly receiving much needed attention as they contribute to a healthy environment in many ways. They play an essential role for the local flora and fauna and furthermore for the societies living around and outside of the wetland.

Wetlands are highly diverse ecosystems, especially in their bird species, and are subject to a variety of threats (Munoz-Pedrerros and Merino. 2014). Wetlands support a diverse variety of plants and animals with ample shelter and lack of large predators, this makes it a desirable layout for birds to refuel and rest during migrations. Similarly, semi-permanent and permanent and coastal wetlands provide refuge for birds when seasonal wetlands are dry for longer period.

On the subject of bird species, wetlands see an immense amount of aquatic birds, these birds are born, reproduce, feed and die here. Many of these birds make use of a particular wetland during a certain period of the year to cover part of their annual cycle (e.g. breeding), while spending another part of the cycle in other wetlands; this explains their seasonal concentrations and migratory movements.

Aquatic birds do not compulsorily stay in one particular wetland area, they constantly keep moving between various wetlands according to the habitat being flooded to feed or breed before the area dries up. During heavy rainfall, especially in the monsoon and pre-monsoon the water reaches higher

levels, increasing the availability of food which in-turn attracts a large number of birds therefore consecutively acting as an ideal breeding ground.

Some water fowls have adapted to the wetlands to such an extent that their survival depends on the availability of certain types of wetland ecology within their geographic area. Whereas others use wetlands only during some parts of their lives.

Study area

Pulicat Lake: Pulicat Lake’s name was derived from the vernacular name ‘Pazhaverkadu’ meaning a forest with many number of roots, since mangroves which has visible aerial roots called Pneumatophores were a wide availability here. The word mangrove is a combination of the Portuguese word for the plant “Mangue” and English Word “Grove”. These salt tolerant plants rich in this particular area might be the reason for this very name. The Pulicat Lake harbours rich and valued floristic treasures because of its diverse ecological habitat such as, salt marshes, canals, mangroves, islands, low lying areas etc.

The lagoon’s boundary limits range between 13.33° to 13.66° N and 80.23° to 80.25°E, with a dried part of the lagoon extending up to 14.0°N.; with about 84% of the lagoon in Andhra Pradesh and 16% in Tamil Nadu. (Basha *et al.*, 2012) Sprawling across Andhra Pradesh and Tamil Nadu, it covers an area of about 720 sq. km and is the second largest brackish-water lagoon in India after the Chilika Lake in Orissa.

The lake has a number of islands of different sizes which are declared as Reserved Forests, the large ones are Sriharikota, Irukkam, Venadu and Pernadu. The entire area is a vast, brackish to saline lagoon with extensive mud and sand flats. In year 1976 the lake was also declared as a bird sanctuary by Andhra Pradesh forest Department. The Buckingham Canal traverses in a north to south direction along the eastern edge of the lake. The lake is subjected to the north-east and south-west monsoons, with most rainfall occurring in between the months of October and December.

The lake receives water from three major rivers namely the Swarnamukhi, Kalangi and Arani during the monsoon season. The Pulicat Lake has three openings (Durgarajupatnam, Rayadurg and Pazhaverkadu) from the sea which plays an important role on the flora and fauna of Pulicat Lake.

Like the other major water areas in the east coast this site is identified as a potential Important Bird Area (IBA) and the lake is one of the identified costal flyway used by a number of pelagic and coastal migrants linking Point Calimere in Tamil Nadu with Chilika (Orissa) and Pulicat Lake (Andhra Pradesh and Tamil Nadu) on the India’s east coast. The sanctuary is bonded in the eastern side by the spindle shaped Sriharikota Island. However, the Pulicat Lake has been declared as a threatened lake of the year 2010. (Vaithianathan and Jeganathan. 2012)

Adyar Eco Park/ Adyar Tholkappia Poonga: The Adyar Creek, also known as the Adyar Estuary is the oldest eco system of Chennai. This is one of the most highly productive and transitional zones of the south-eastern Indian peninsula. Situated in the southern part of the Chennai, a metropolitan city in the southern state of Tamil Nadu, India. This estuary acts as a predominant nursery ground for several endemic flora and fauna.

Before forming an estuary and entering the Bay of Bengal, a part of the Adyar River, about 40 km long takes on a route northwards and then travels westward as a tidal creek with the tidal influence of up to 5km long. (Altaff *et al.*, 2019)

Development, construction, encroachment and dumping of waste into the creek has shrunk its width to a narrow channel. To prevent further destruction of the creek in 2008 the Government of Tamil Nadu proposed to develop an eco-park and rehabilitate the wetland and was accorded permission by the Madras High Court. The ‘Adyar Poonga Ecological Restoration Plan’ was put into operation.

In a bustling city with an ever growing population, Adyar Tholkappia Poonga is an ‘eco-spot ’where the land is allowed to function undisturbed. Admission into the park for general public is limited with prior reservation and is well monitored. Also known by the name Adyar Eco park, this ecological restoration of the Adyar Creek estuary in Chennai and is 58- acres wide. It manifests the ecosystem of the Coromandel Coast with freshwater ponds, brackish areas, mangroves, mud flats, dunes and islands. One of the focal point of this park is the presence of water bodies encompassed by typical flora found in a Tropical Dry Evergreen Forest.

The Adyar wetland reserve has been a substantial link for birds on their annual migrations particularly for the wading birds which feed on the coastal mudflat. About 200 species of migratory birds visit the Adyar Creek region, many of which are now on International Union for Conservation of Nature Red List that is put out for endangered species. The restoration of this wetland was to promote the return of many of these species to this area and to act as a safe space unbothered from the public. The Adyar Creek Trust was set up by the government of Tamil Nadu to co-ordinate the execution of the project. The Adyar Poonga Trust was later renamed as Chennai Rivers Restoration Trust (CRRT).

The bewitching ecology of the estuary includes many creatures from mud skippers and crabs, to monitor lizards. Restored mangroves and estuarine vegetation function as an important fish breeding habitat by providing a natural barrier against cyclones and storms, and also play a major role in the cleaning of the Adyar River.

The park educates visitors of an environmentally sustainable living by demonstrating collection, conservation and treatment of water, usage of energy efficient alternatives such as bio-gas, solar and wind energies, and waste management techniques as well as offering alternate ideas for an eco-friendly building material. The use of non-conventional energy is demonstrated in a practical and engaging method for visitors, especially children to understand how energy is produced by sunlight, wind and bio-masses. The bio resource Centre illustrates the uses of plants and their relationship to human kind through an interesting and artistic approach.

As there is no much work done on the aquatic avian diversity in both Pulicat Lake and Adyar Eco Park, this study was initiated to assess the aquatic avian diversity in each of the study areas individually and compare them. The study also aims to analyse the interdependence of the aquatic avian diversity with regard to factors such as water quality parameters (temperature, pH and salinity), vegetation, size of the area and human settlement. Comparison of results with previous findings for the assessment of the current status of the diversity.

MATERIALS AND METHODS

Aquatic avian fauna of the unrestored Pulicat Wetland and the restored Adyar Eco Park (Adyar Tholkappia Poonga) were observed and documented from July 2021 to November 2021. The observation of the birds was carried out by point count method. Random sites were chosen on the study areas and the birds of various species were counted around a 20m radius from the point of view. The counts made within the 20m radius area was time bound. The maximum time spent on each point was 60 minutes approx. Survey was conducted in the early morning hours from 05.00 to 08.00 and in the evening from 4.00 to 6.00. The binocular Olympus 80x40 DPS was used for bird watching and were identified with the help of Salim Ali's book. (1997). Pictures of the birds were taken using the Nikon 800 camera at the sampling sites. Water samples were collected from the sites to analyze the quality of the water. Parameters such as pH and temperature were measured onsite using portable sensors. Salinity was measured by using a hand refractometer and expressed as Practical Salinity Unit (PSU). The Vegetation and size of both the study areas were found and compared. Human settlement in and around the study area was also noted.

Six sites were chosen in Pulicat where the survey was conducted (Table 1)

Four sites were chosen in Adyar Eco Park where the survey was conducted (Table 2)

Table 1. Latitude and Longitude of the Sampling Sites in Pulicat Lake

	Pulicat Lake					
Sites	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Latitude	13.41314	13.413008	13.413609	13.419709	13.419072	13.419878
Longitude	80.31772	80.31729	80.318785	80.318517	80.319144	80.321643

Table 2. Latitude and Longitude of the Sampling Sites in Adyar Eco Park

Adyar Eco Park				
Sites	Site 1	Site 2	Site 3	Site 4
Latitude	13.0233586	13.0209953	13.0212327	13.0198209
Longitude	80.2725472	80.2640731	80.2650454	80.265192

RESULTS AND DISCUSSION

A survey on the aquatic avian diversity was conducted in the respective sites of Pulicat and Adyar Eco Park using point count method and the following were recorded.

Pulicat

During the survey a total of 22 species of aquatic birds were recorded in Pulicat out of which 10 are resident birds to Pulicat Lake while 12 are migrant birds. (Sanjeevaraja, 2006)

Table 3 – List of aquatic birds recorded in Pulicat Lake

S.No	Common Name	Scientific Name	Status	Conservation Status
1.	Painted stork	<i>Mycteria leucocephala</i>	Resident	Near threatened
2.	Grey heron	<i>Ardea cineria</i>	Resident	Least concern
3.	Pond heron	<i>Ardeola grayii</i>	Resident	Least concern
4.	Little egret	<i>Egretta garzetta</i>	Resident	Least concern
5.	Large egret	<i>Ardea alba</i>	Resident	Least concern
6.	Spotted-billed pelican	<i>Pelicanus philippensis</i>	Resident	Near threatened
7.	Indian cormorant	<i>Phalacrocorax fuscicollis</i>	Resident	Least concern
8.	Little cormorant	<i>Phalacrocorax niger</i>	Resident	Least concern
9.	Glossy ibis	<i>Plegadis falcinellus</i>	Migrant	Least concern
10.	Lesser sand plover	<i>Charadrius mongolus</i>	Migrant	Least concern
11.	Eurasian curlew	<i>Numenius arquata</i>	Migrant	Near threatened
12.	Redshank	<i>Tringa erythropus</i>	Migrant	Least concern

13.	Terek sandpiper	<i>Xenus cinereus</i>	Migrant	Least concern
14.	Marsh sandpiper	<i>Tringa stagnatilis</i>	Migrant	Least concern
15.	Common sandpiper	<i>Tringa hypoleucos</i>	Migrant	Least concern
16.	Knot	<i>Calidris canutus</i>	Migrant	Near threatened
17.	Little stint	<i>Calidris minuta</i>	Migrant	Least concern
18.	Curlew sandpiper	<i>Calidris testacea</i>	Migrant	Near threatened
19.	Black-winged stilt	<i>Himantopus himantopus</i>	Resident	Least concern
20.	Indian whiskered tern	<i>Chlidonias hybrida</i>	Migrant	Least concern
21.	Common tern	<i>Sterna hirundo</i>	Migrant	Least concern
22.	Lesser-pied kingfisher	<i>Ceryle rudis</i>	Resident	Least concern

The most common aquatic bird sited in Pulicat Lake was the little egret which were found on the mudflats and near the fish market. The second most common were the Painted storks and the least sited were the Knot and Redshank which were found only on the mudflats.

Adyar Eco Park

During the survey in Adyar Eco Park a total of 20 species of aquatic birds were recorded out of which 18 are resident birds and 2 are migrant birds to the Adyar Eco Park. (Ali, 1997)

Table 4: List of aquatic birds recorded in Adyar Eco Park

S.No	Common Name	Scientific Name	Status	Conservation Status
1.	Painted stork	<i>Mycteria leucocephala</i>	Resident	Near threatened
2.	Grey heron	<i>Ardea cineria</i>	Resident	Least concern
3.	Indian pond heron	<i>Ardeola grayii</i>	Resident	Least concern

4.	Purple heron	<i>Ardea purpurea</i>	Resident	Least concern
5.	Night heron	<i>Nycticorax nycticorax</i>	Resident	Least concern
6.	Little green heron	<i>Butorides virescens</i>	Resident	Least concern
7.	Spotted-billed pelican	<i>Pelicanus philippensis</i>	Resident	Near threatened
8.	Little egret	<i>Egretta garzetta</i>	Resident	Least concern
9.	Large egret	<i>Ardea alba</i>	Resident	Least concern
10.	Pond heron	<i>Ardeola grayii</i>	Resident	Least concern
11.	Little cormorant	<i>Phalacrocorax niger</i>	Resident	Least concern
12.	Oriental darter	<i>Anhinga melanogaster</i>	Migrant	Near threatened
13.	Indian cormorant	<i>Phalacrocorax fuscicollis</i>	Resident	Least concern
14.	Red wattle lapwing	<i>Vanellus indicus</i>	Resident	Least concern
15.	Common moorhen	<i>Gallinula chloropus</i>	Resident	Least concern
16.	White breasted water hen	<i>Amourornis phoenicurus</i>	Resident	Least concern
17.	Indian spot-billed duck	<i>Anas poecilorhynca</i>	Resident	Least concern
18.	Black winged stilt	<i>Himantopus himantopus</i>	Migrant	Least concern
19.	Little grebe	<i>Tachybaptus ruficollis</i>	Resident	Least concern
20.	Lesser whistling duck	<i>Dendrocygna javanica</i>	Resident	Least concern

The most common aquatic bird sighted in the Adyar Eco Park was the Indian spot-billed duck and the little egret. The uncommon or rare sighting was of the Night heron.

Comparing the Aquatic Birds of Pulicat with Adyar Eco Park

The diversity of the aquatic avifauna of the Pulicat Lake was higher than the diversity in the Adyar Eco Park. A total of 31 species of aquatic birds were recorded where 22 species were from Pulicat Lake and 19 species were observed in the Adyar Eco park.

Table 5 – Comparison of aquatic birds found in Pulicat Lake and Adyar Eco Park

S.No	Common Name	Scientific Name	Pulicat	Adyar Eco Park
1.	Painted stork	<i>Mycteria leucocephala</i>	+++	++
2.	Grey heron	<i>Ardea cineria</i>	+	+

3.	Indian pond heron	<i>Ardeola grayii</i>	+	++
4.	Purple heron	<i>Ardea purpurea</i>	-	+
5.	Night heron	<i>Nycticorax nycticorax</i>	+	+
6.	Little green heron	<i>Butorides virescens</i>	-	+
7.	Spotted-billed pelican	<i>Pelicanus philippensis</i>	++	++
8.	Little egret	<i>Egretta garzetta</i>	+++	++
9.	Large egret	<i>Ardea alba</i>	+	+
10.	Little cormorant	<i>Phalacrocorax niger</i>	+	++
11.	Oriental darter	<i>Anhinga melanogaster</i>	-	+
12.	Indian cormorant	<i>Phalacrocorax fuscicollis</i>	+	++
13.	Red wattled lapwing	<i>Vanellus indicus</i>	-	+
14.	Common moorehen	<i>Gallinula chloropus</i>	-	+
15.	White breasted water hen	<i>Amourornis phoenicurus</i>	-	+
16.	Indian spot-billed duck	<i>Anas poecilorhynca</i>	-	++
17.	Black winged stilt	<i>Himantopus himantopus</i>	+	++
18.	Little grebe	<i>Tachybaptus ruficollis</i>	-	++
19.	Glossy ibis	<i>Plegadis falcinellus</i>	+	-

20.	Lesser sand plover	<i>Charadrius mongolus</i>	+	-
21.	Eurasian curlew	<i>Numenius arquata</i>	+	-
22.	Redshank	<i>Tringa erythropus</i>	+	-
23.	Terek sandpiper	<i>Xenus cinereus</i>	+	-
24.	Marsh sandpiper	<i>Tringa stagnatilis</i>	+	-
25.	Common sandpiper	<i>Tringa hypoleucos</i>	+	-
26.	Knot	<i>Calidris canutus</i>	+	-
27.	Little stint	<i>Calidris minuta</i>	+	-
28.	Curlew sandpiper	<i>Calidris testacea</i>	+	-
29.	Indian whiskered tern	<i>Chlidonias hybrida</i>	+	-
30.	Common tern	<i>Sterna hirundo</i>	+	-
31.	Lesser-pied kingfisher	<i>Ceryle rudis</i>	+	-

+++ - **Abundant** ++ - **More in number** + - **Present**

The observation of the aquatic birds based in their habitat is listed.

Pulicat - Estuarine Biological Laboratory – Site 1, 2, 3

Fish market – Site 4, 5&6

Adyar Eco Park – Brackish water Mudflat – Site 1

Brackish water – Site 2

Freshwater habitat - Site 3 & 4

Painted stork (Mycteria leucocephala)

The painted storks are large waders found in shallow wetlands and marshes. They can be found in both freshwater and saltwater habitats. They were common residents in both Pulicat Lake and Adyar Eco Park. A flock of 15-20 painted storks were recorded in the shallow waters near the Pulicat fish market and estuarine biological laboratory. They were present as a flock of 10-15 in the brackish water mudflats of the Adyar Eco Park. These water birds are found throughout the year in both the wetlands.

Grey heron (Ardea cinerea)

The grey heron is another commonly bird found in both the wetlands. They live in freshwater, saltwater and brackish water environments. They were seen feeding along with Painted storks, little egrets and spot billed Pelicans in shallow waters of both Pulicat Lake and Adyar Eco Park. They were less in number when compared to the painted storks.

Indian pond heron (Ardeola grayii)

Indian pond herons are small birds which live in shallow aquatic habitats of freshwater, saltwater and brackish water. They prefer very shallow, non-flowing or slowly flowing water bodies. They were seen feeding individually in the muddy margins of Pulicat Lake and Adyar Eco Park.

Purple heron (Ardea purpurea)

Purple heron is a solitary and uncommon species found in both the wetlands. During the study, this water bird was seen only in the Adyar Eco Park and not in the Pulicat Lake. It is a freshwater bird found only in thick vegetated wetlands hence found in the Adyar Eco Park.

Night heron (Nycticorax nycticorax)

The night heron was not recorded in the Pulicat Lake but seen in the Adyar Eco Park during the study. They are most active during the night or at dusk as they are nocturnal. They can be found in freshwater swamps or marshes, salt marshes, lagoons, mudflats.

Little green heron (Butorides virescens)

The little green herons were exclusively found in the freshwaters of Adyar Eco Park lined with trees, shrubs and tall vegetation. They were not recorded in Pulicat Lake. They become more active during the night. These birds were spotted as individuals and not in groups in Adyar Eco Park.

Spot-billed pelican (Pelecanus phillippensis)

The spot-billed pelican is a common species in both Pulicat Lake and Adyar Eco Park. They were seen in large congregations in the large water body near the fish market in Pulicat during October. They can be found to be seen in places with less aquatic vegetation. These birds were recorded in small flocks in the shallow waters of Adyar Eco Park.

Little egret (Egretta garzetta)

This water bird is a very commonly distributed species in both Pulicat Lake and Adyar Eco Park and occur throughout the year. It is the most common egret species found in all water bodies. They were seen in flocks of 8-12 near the Pulicat fish market, mudflats of the Estuarine Biological Laboratory. They were found in small flocks or as a solitary bird in the Adyar Eco Park in the mudflats and in the stream. These birds were commonly sighted in small flocks near drying pools and temporary wetlands. (Vaithianathan et al 2008).

Large egret (Egretta alba)

The large egret is another common species found in both Pulicat Lake and Adyar Eco Park. They were recorded to be seen along the edges of the water body as solitary birds in both the study areas. They inhabit both freshwater and saltwater bodies.

Little cormorant (Phalacrocorax niger)

Little cormorant is a resident species in both the study areas and was seen throughout the study period in both freshwater and saltwater areas. They were recorded in the waters near the Pulicat fish market as individuals and in flocks of 5-10 along the edges and on the trees near the lake of the Adyar Eco Park.

Oriental darter (Anhinga melanogaster)

No oriental darters were recorded in the Pulicat Lake during the study period while large flocks of the species were found on along the edges and on the trees near the lake of the Adyar Eco Park. These birds were found to be seen only in freshwater lakes and hence were not present in Pulicat Lake.

Indian cormorant (Phalacrocorax fuscicollis)

Indian cormorant is also known by the name Indian Shag. It is an uncommon species in the Pulicat Lake. 2-3 solitary birds were recorded in the Pulicat Lake during the study. A small flock were spotted together with the Little Cormorants and Oriental Darters in the Adyar Eco Park.

Red wattled lapwing (Vanellus indicus)

Red-wattled lapwing is a commonly found bird in freshwater habitats. They were found in pairs in the mudflats of the Adyar Eco Park. According to (Krishnan.S, 1994) the islets between the bridge and the sea shore and open meadow on the northern bank of Adyar estuary served as nesting sites for the Red-wattled lapwings. There were no records of this species in Pulicat Lake during the study period.

Common moorehen (Gallinula chloropus)

The common moorehen was found in pairs in the freshwaters of Adyar Eco Park. The highest count was 4-6 in the Adyar Eco Park. This species was not found in the Pulicat Lake during the study.

White breasted waterhen (Amourornis phoenicurus)

White breasted water hen is a commonly found species in freshwater bodies. It was recorded as a solitary bird in Adyar Eco Park and was not seen in Pulicat Lake.

Indian spot-billed duck (Anas poecilorhyncha)

The Indian spot-billed duck is mostly found in a freshwater habitat. This species was found in abundance in the freshwaters and few in brackish waters of Adyar Eco Park. They were found in flocks along with their young ones. No records of this bird in the Pulicat Lake during the study.

Black-winged stilt (Himantopus himantopus)

It is a long-legged wader and is found in freshwater and saltwater marshes, mudflats and shallow edges of the water bodies. They were recorded in the mudflats as individuals or pair in the Estuarine Biological Laboratory, Pulicat Lake. They were seen in small groups in the mudflats of the Adyar Eco Park along with Painted storks and Spot-billed Pelicans.

Little grebe (Tachybaptus ruficollis)

Little grebe was observed as a common bird in the freshwaters of Adyar Eco park. They were seen in small groups. These birds were not found in the Pulicat Lake.

Eurasian curlew (Numenius arquata)

This species was found in the mudflats of Estuarine Biological Laboratory, Pulicat Lake in twos and threes. It was not found anywhere else in Pulicat. There was no record of this bird in the Adyar Eco Park during the study period.

Common redshank (Tringa totanus)

It is a sandpiper commonly found in the mudflats. It was recorded in the mudflats of the Estuarine Biological Laboratory, Pulicat. No record of this bird in the Adyar Eco Park during the survey period.

Terek sandpiper (Xenus cinereus)

The terek sandpiper was sighted only once in the mudflats of the Estuarine Biological Laboratory, Pulicat during the survey. No record of it to be found in the Adyar Eco Park.

Marsh sandpiper (Tringa stagnatilis)

The marsh sandpiper was also recorded only once in the mudflats of the Estuarine Biological Laboratory, Pulicat. No sightings of this species in the Adyar Eco Park.

Common sandpiper (Actitis hypoleucos)

These species of birds were found in solitary in the mudflats of the Estuarine Biological Laboratory, in Pulicat. They were no records of these birds in the Adyar Eco Park.

Knot (Calidris tenuirostris)

Knot was sighted only once and a rare sighting in the mudflats of the Estuarine Biological Laboratory, Pulicat. No sightings in Adyar Eco park.

Little stint (Calidris minuta)

Little stint is a small wader. It was sighted in small flocks in the mudflats of the Estuarine Biological Laboratory, Pulicat Lake. No records were found in the Adyar Eco Park.

Curlew sandpiper (Calidris ferruginea)

Curlew sandpiper was twice sighted in the mudflats of the Estuarine Biological Laboratory, Pulicat. It was sighted in a pair and as a solitary bird. This species was not found in Adyar Eco Park.

Indian whiskered tern (Chilodinius hybridus)

This species is a common bird in Pulicat Lake. They were found in a flock flying over and feeding from the Pulicat Lake near the fish market. They were not recorded in the Adyar Eco Park.

Common tern (Sterna hirundo)

Common tern is a coastal species and was found in the Pulicat Lake near the fish market. A few in number of this species was found. No sightings of this water bird in the Adyar Eco Park.

Lesser pied kingfisher (Ceryle rudis)

Lesser pied kingfisher was sighted as a solitary bird near the water in the estuarine biological Laboratory, Pulicat. And was not seen anywhere in the Adyar Eco park.

Lesser whistling duck (Dendrocyna javanica)

Lesser whistling duck was sighted in the Adyar Eco Park. It is generally found in still freshwater lakes. It was not sighted in the Pulicat Lake.

Water Quality Analysis

The water sample collected during the study from Pulicat Lake and Adyar Eco Park to analyse its quality. Basic Parameters like Temperature, pH, Salinity were found using portable sensors.

Temperature

Water temperature is considered one of the most important parameters in an aquatic environment since it governs most physicochemical and biological activities. Generally, the surface water temperature is influenced by the intensity of solar radiation, evaporation, fresh water influx and cooling. The difference in temperature in each site might also be due to the presence of vegetation. The temperature of water samples collected at the Pulicat Lake during pre-monsoon ranged from 31.3-33.5C. The temperature of the samples collected from Adyar eco-park during pre-monsoon varied from 30.5-32.4 C. The low temperature was because of the freshwater influx, precipitation and the recorded high temperature could be due to direct high solar radiation. Temperature controls behavioral characteristics of organisms and also the solubility of gases and salts in water.

Table 6 – Temperature recorded from the sampling sites in Pulicat Lake and Adyar Eco Park

Pulicat Lake						Adyar Eco-Park or Tholkappia Poonga			
Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 1	Site 2	Site 3	Site 4
31.6	31.3	31.8	33.2	33.5	33	32.4	30.5	32.1	31.9

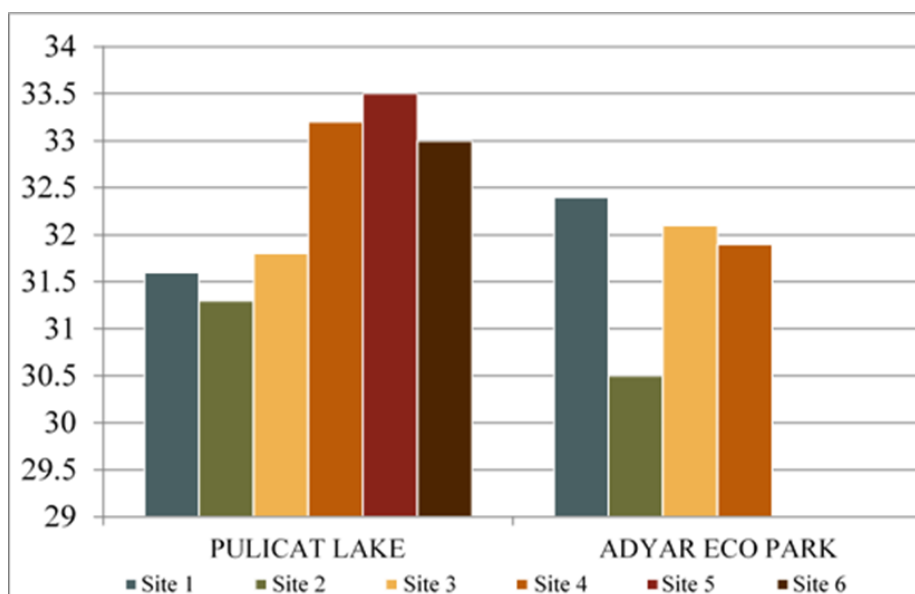


Fig 1 : Temperature in Pulicat lake and Adyar Eco park

pH level

The pH of the Pulicat Lake ranged between 8.1 – 8.3 at various sites during pre-monsoon. pH level is indispensable in brackish water environment. Fluctuating pH might be due to fluctuating salinity and oxygen. Increase in number of phytoplankton and its successive photosynthetic activity which removes CO₂ increasing the surface water pH. It might also be due to the use of alkaline detergents in the residential areas or flow of alkaline material from the industries. The pH of the Tholkappia Poonga or Adyar Eco park ranged between 8.1 – 8.2 at various sites during pre-monsoon.

Table 7 – pH level recorded from the sampling sites

Pulicat lake						Adyar Eco-park or Tholkappia Poonga			
Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 1	Site 2	Site 3	Site 4
8.1	8.1	8.2	8.3	8.3	8.3	8.2	8.2	8.1	8.1

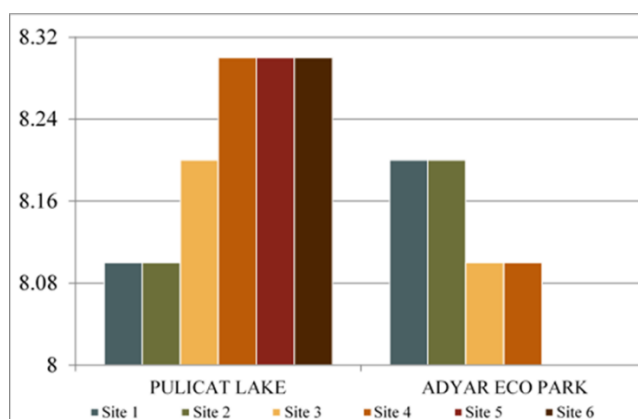


Fig 2: pH in Pulicat lake and Adyar Eco park

Salinity level

Salinity is another important factor which influences the abundance and distribution of the animals in estuarine environment. Salinity acts as a limiting factor in the distribution of living organisms and its variation caused by dilution and evaporation which influence the characteristic change of fauna in the intertidal zone. High salinity might be due to high temperature which decreases the freshwater inflow and land drainage. The salinity in Pulicat Lake ranged from 31-31.6 while the salinity in the Adyar Eco Park varied between 19-22.5 during pre-monsoon

Table 8 – Salinity level recorded from the sampling sites

Pulicat lake						Adyar eco-park or tholkappia poonga			
Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 1	Site 2	Site 3	Site 4
31.1	31.1	31	31	31.5	31.6	22.5	22.2	20	19

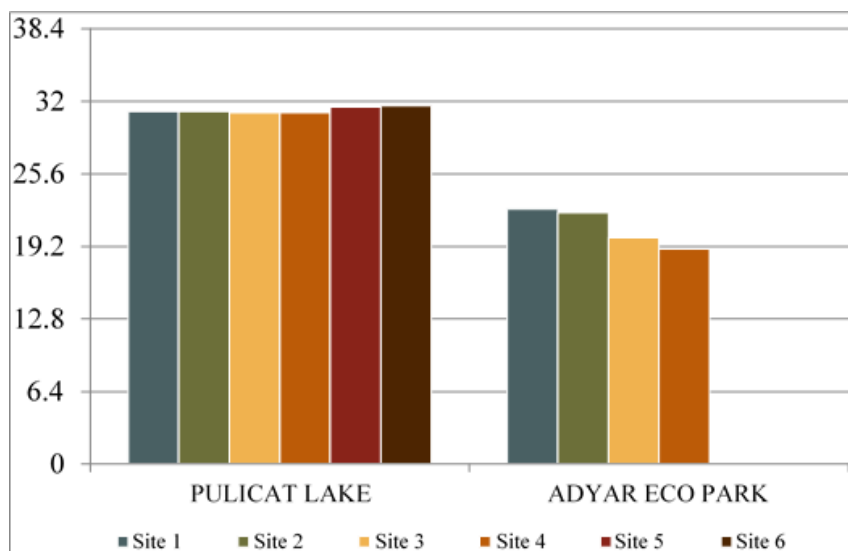


Fig 3: Salinity in Pulicat lake and Adyar Eco par

Vegetation

Vegetation plays an important role in maintaining the water’s temperature and also provide a good shelter for the avian fauna. Solar radiation and vegetation are inter depending factors. Water body that is exposed directly to the radiation when there is no vegetation gets heated up easily. Radiation reaches the water body directly and increases the temperature when the water body has no vegetation.

Vegetation in Pulicat Lake:

Site 1 was Mudflat of the Estuarine Biological Laboratory. No much vegetation was seen except sparse bushes and shrubs. There were some bushes and trees along the edges of the lake. Site 2 and site 3 also had similar vegetation. Site 4, 5 and 6 had no vegetation as it was the fish market.

Vegetation in Adyar Eco Park:

Site 1 was mudflats, it had numerous trees, bushes and shrubs along the coastline and very less vegetation in the centre area. Site 2 had comparatively more vegetation than site 1. Trees, bushes and shrubs were seen. Site 3 and 4 had trees, bushes and shrubs along the coastline. All the sites had similar vegetation with no much variation except the distribution.

DISCUSSION

Pulicat Lake attracts water birds of more than 80 species (Basha *et al.*, 2012). It is significant that near threatened species like Spot billed pelican, painted stork breed in the vicinity of the Pulicat Lake. Adyar Estuary has been a home to around 175 bird species including greater and lesser flamingoes. It includes three near threatened species like painted stork, oriental darter and spot billed pelicans. (Krishnan, 1994) In the current study the occurrence, conservation status, ecological status of aquatic avifauna were recorded and compared between the Pulicat Lake and Adyar Eco Park during the pre-monsoon. A total of 31 species of water birds were recorded in both Pulicat and Adyar Eco Park. The diversity in the Pulicat Lake was higher than that of the Adyar Eco Park.

Twenty two species were observed in the Pulicat Lake out of which ten were resident water birds to the area and twelve were migrant water birds. A total of nineteen species were recorded in the Adyar Eco Park out of which 18 were Residents and 2 were Migrants. Vaithianathan and Jeganathan (2012) recorded 28 species of shorebirds in Pulicat Lake. More species of shorebirds were recorded due to a long duration of 3 years. Ranjit *et al* (2008) recorded 77 species of water birds during their three year duration of study while in the current study only 22 were recorded as the study was limited to the pre-monsoon season only.

Sivalingam *et al* (2015) documented 56 species of birds in Pulicat during one year of the study period in which 25 species were Residents, 13 Migrants and 18 Resident Migrants.

Majority of the water birds that visit Pulicat Lake are waders and swimmers which prefer shallow waters. (Sanjeevaraja, 2006) A total of 175 bird species have been sighted in the Adyar Estuary which was a home for rare species like greater and lesser flamingos, oyster catcher, eastern ringed plover, and avocet. Out of which 75 were migrants (Krishnan. 1994). Currently 20 species of aquatic birds were documented in the Adyar Eco Park alone. The number of species might have been reduced due to the excessive dumping of garbage, sewage, landfills and pollution in and around the Adyar estuary. Padoa- Schioppa *et al.*, 2006 recognized Avifauna to be fast responders to any change in the environment and this has led them to be considered as a bio-indicator tool in environment monitoring and assessment for any type of ecosystem.

Human settlement is another major factor for the water bird diversity. Usually human settlement disturbs and alters the diversity of avifauna of a place. The aquatic birds in the Pulicat fish market have been adapted to humans as there is continuous human movement. Human settlement does not seem to affect or disturb the birds in the market. Whereas the aquatic bird diversity in the Adyar Eco Park is completely dependent on the human settlement. As the Adyar Eco Park is a restricted zone with limited human activity and movement it is a secured place hence, the avifauna has been adapted to the same. Human movement affects and disturbs the avifauna of the place. The other factor which can determine the diversity of the aquatic avifauna is the size of the study area. The study area of Pulicat Lake is larger than the Adyar Eco Park. Therefore, the diversity might be more in a larger area than a comparatively smaller area.

Water quality parameters show interdependence to water bird diversity. Temperature is an important limiting factor in determining the activity of a wetland ecosystem. The temperature recorded in the current study ranged between 31.3°-33.5° C in Pulicat Lake while Dhinamala *et al.*, 2011 recorded a temperature of 27.4° and 31.7° C and 28.4 and 30.2 in 2012 during the monsoon and post monsoon respectively. A temperature of 30.5o-32.4o C in Adyar Eco Park was recorded in the current study while 26.58o C was recorded by (Tamil and John. 2016.) The temperature in the monsoon might have been low due to strong land breeze and precipitation.

Salinity is an important factor in the management of water bird population. Water of high salinity is harmful to water birds as it can cause loss in body weight by dehydration. Water birds avoid high saline water. (Zhijiun *et al.*, 2010)

Little Grebe, White breasted water hen, Indian spot billed duck, little green heron, indian pond heron were observed only in the freshwater habitat of Adyar Eco park.

The salinity of the Pulicat lake during the monsoon and post monsoon ranged from 31.3 and 31.8ppt in 2011, 30.9 and 31.1 in 2012 (Dhinamala *et al.*, 2015). In this study salinity ranged from 31.1-

31.5ppt in Pulicat and 19-22.5 ppt in Adyar Eco park. High salinity might be due to high temperature which decreases the inflow of freshwater and land drainage.

Water depth is another variable affecting the use of wetland habitats by water birds. Larger species with long necks, bills, legs can feed in deeper habitats than smaller taxa. Non-diving water birds, waders, dabblers require shallow water to forage. In contrast diving water birds require deep water. (Zhijiun *et al.*, 2010)

Water pH ranged between 8.1-8.3 in Pulicat whilst 8.1-8.2 in Adyar Eco park. A pH of 8.7 was recorded by (Tamil and John. 2016) in Adyar Eco Park. pH of 7.6-7.7 in 2011 and 7.3-7.5 in 2012 was recorded in Pulicat by (Dhinamala *et al.*, 2015). High pH value might be due to sea water penetration and high biological activity. Use of alkaline detergents can also increase the pH of the water body.

All these parameters would in turn affect the diversity of the water birds. Aquatic birds are generally at or near the top of the most food chains of the wetlands are highly susceptible to habitat disturbances and are therefore good indicators to predict the status of the wetlands. (James. 2006)

A technical and extensive approach to protect and conserve these natural treasures is important. Contributing in the conservation and preservation of the aquatic birds and wetlands can be done only with people's participation and awareness spreading.

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