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BIODIVERSITY AND CONSERVATION OF PULICAT LAKE- ANDHRA PRADESH

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ABSTRACT

Pulicat Lake is the second largest brackish water lagoon after Chilika Lake of Orissa along the east coast of India. Estuaries and lagoons have brackish water which shows high biological productivity than fresh or sea water. Hence it has wide range of aquatic, terrestrial flora and fauna. The World Wide Fund for Nature declared it as a protected area. Present study aims to explore the flora and fauna of the lagoon along with the various threats for its eco-degradation which helps to plan necessary conservation methods.

Key Words: *Biodiversity – Pulicat Lake – Threats – Conservation*

INTRODUCTION

Biodiversity describes the occurrence of huge variety of species including algae to Monocots of Plant Kingdom and Protozoans to Mammals of Animal Kingdom on the Earth in natural way which leads to the formation of ecosystems and communities. It satisfies human needs in two different ways namely direct and indirect. Direct way is in increasing agricultural productivity which supports the existence of life on the Earth. Indirect way include nutrient tapping, maintaining water cycles, production and protection of soil, absorption and breakdown of pollutants, provision of recreational, aesthetic, scientific and spiritual values that helps to continue life on the Earth. On the World Map, out of 12 Mega Biodiversity countries, India ranks 10th place. It has already been affected by numerous threats like habitat destruction, over exploitation, pollutants through human action and epidemics, floods, droughts, cyclones, Ptsunamies through Nature.

Two attributes of biodiversity according to International Conservation Point of view are species richness (The number of species in an area) and Endemism (Species restricted to a given region and occur no where else). Pulicat Lake satisfies both the attributes of biodiversity by having rich and numerous flora and fauna. Endangered Green sea turtles are found only on the beaches of pulicat. Calamus rotang and Cappris rotundifolia are endemic to this area only. Hence Pulicat lake is one among the Six Internationally significant wetlands of India. Wet lands are wonderful lands which show wide diversity in both flora and fauna.

Aquatic and Avian fauna of Pulicat Brackish water lake is studied by Nandakumar et.al (2000) and reported the visiting of 31 bird species to Pulicat lake feeding bed during 2007-2009. Jayadev ,(1975) examined 50 species of fish out of which 16 species had macro parasites.

Study Area

Pulicat Lake derived its name from a vernacular name ‘Palaverkadu’ means plants with many number of roots. Those plants are mangroves with aerial roots called Pneumatophores. The word mangrove is considered to be a combination of the Portuguese word “Mangue” and English Word “Grove”. These are salt tolerant plants and are rich in this area and might be the reason for that name. The lake harbours rich and valued floristic wealth because of its varied ecological habitat viz., 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. The large spindle-shaped barrier island named Sriharikota separates the lake from the Bay of

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Bengal. The lake spreads over an area of about 620 km² are of numerous islands that lie in it. Out of the total area of the lake, about 360 km² in the southern part is active where as the rest of the lake are in its northern part is desiccated and now it appears more or less like a mudflat. It has 20 islands, the largest being Sriharikota island. The other large are Pernadu, Irrakam and Venadu.

Three major Rivers which feed the lagoon are Arani river, Kalangi river and Swarmukhi river. The Buckingham Canal, a navigation Channel is part of the lagoon on its western side. It is connected to the sea through three tidal inlets, one each at Tupilipalem, Rayadoruvu and Pulicat villages respectively, from north to south. The sea mouths are not simply a passage of water into lake but a biocorridor for survival of both aquatic fauna and avian fauna. The annual rain fall is 1200mm and temperature varies from 10⁰C to 40⁰C. Its soil varies from sandy, clayey to fine alluvial.

MATERIALS AND METHODS

Study was undertaken in the Pulicat Lake and Bird Sanctuary and data of both flora and fauna collected by frequent visits during 2009-2010. Photographs of both native and migratory birds were taken. Herbaria of various plants also collected for future reference.

Herbaria-specimens are preserved at N.B.K.R. Medicinal Plant Research Centre, Vidyanagar, and Nellore District.

RESULTS AND DISCUSSION

53 species of phytoplanktons and 29 species of zooplanktons are studied by Chacko et al. (1953). Gradually, it has been declining due to chemical production from the south, and today, plankton in Pulicat Lake may be just half that original level. Aquatic macroflora of this lake are described by Chacko et al. (1953). Macrophytes like *Halophila ovails* popularly called sea grass and *Syringodium isoetifolium* are more common in the central zone, around the Kuuvithittu mudflat.

Primary Consumers:

The diverse and rich benthic invertebrate fauna in pulicat lake, are detritivorous primary consumers, excepting the pelagic zooplankton which feeds on phytoplankton, isopods, amphipods, juvenile and sub-adult penaeid prawns, species of the lamellibranch *Modiola* and Crabs are all epifauna. Species of Cerithidea are most abundant ecological indicators in inter-tidal brackish waters. The edible Oysters, on the other hand are filter-feeders in shallow waters. Filtering large quantities of detritus, suspended in water. Also, in the food web of Pulicat Lake items like detritus, Polychaetes, amphipods and penaeid prawns may be considered as 'Keystone prey' and Carnivorous fish may be considered as 'Keystone Predators'.

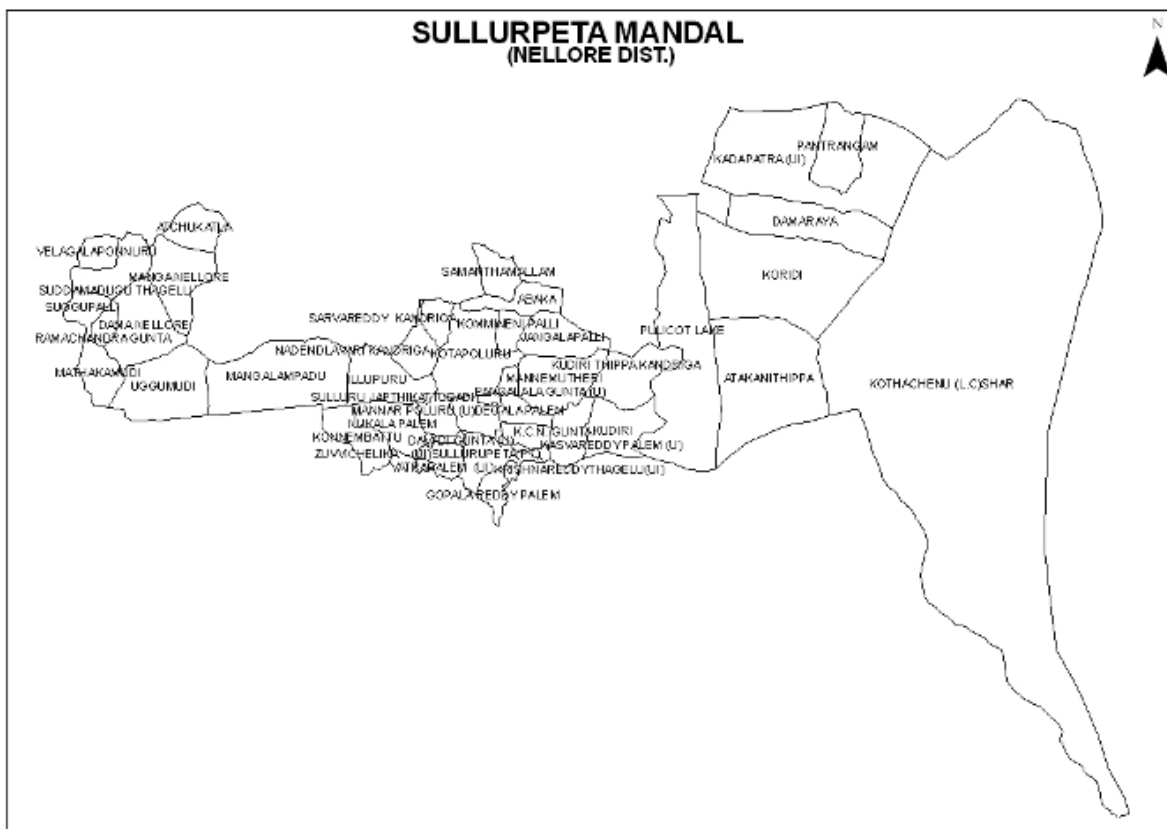
Fauna of the Lagoon

Aquatic Fauna:

Fishers are the most common secondary consumers in aquatic ecosystems in a lagoon like the Pulicat Lake with the inflow Sea water and fresh water. Kaliyamurthy and Rao (1972) have analyzed the food of 37 species of fishes from the Pulicat Lake. Fish in turn contribute as the food of not only aquatic birds which are the tertiary or top consumers. Diversity wise, detritivorous fishes form the major category.

The lake has rich diversified fish species, mostly marine species, some truly brackish water and a few freshwater species. It is recorded that the average animal protein production of an estuary is seven times more than that of a natural terrestrial ecosystem. Major brackish water fishes are Mulletts and Catfish. An average 1200 tonnes of fish and Crustaceans are harvested annually, of which prawns constitute 60% followed by Mulletts. Sea food exports include white and tiger prawns, jelly fish, fin fish and Green crabs. It is an ideal habitat for edible oyster (*Crossostrea madrasensis*) which was introduced and cultured in the lake by the Fisheries department of Madras Presidency during 1920's. It is called as Keystone species of the lagoon.

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Avian Fauna:

Pulicat Lake attracts 80-100 water birds belonging to 80 species (Jacobson and Sanjeeva Raj, 2009) every winter, some from Ladakh, Tibet and China. It is significant that the near threatened species like the spot billed pelican, Painted Stork, white Ibis, breed in the vicinity of the Pulicat Lake. The greater Flamingo about 15,000 of them spends the winter on this Lake. Eleven raptor species recorded on this Lake (Jacobson and Sanjeeva Raj, 2009).

During Monsoon period, lake is filled by nutritious water and large numbers of both Phytoplankton and Zooplankton constitute essential food for invertebrates and fishes. This large amounts of food attracts numerous wet land birds especially Greater Flamingoes along with Pelicans, Kingfisher, Herons, Painted Storks, Spoon bills, Ducks, Black Drongo, Blue Jay, Common Teal, Coot, Cormorant little, Curlew, Dabchick, Egret large, Earget Little, Garganey, Little Stint, Open Billed Stork, Painted Stork, Pond Heron, Sand Piper, Shoveller, White Ibis, Herring Gull etc. The Concentration of Flamingoes depends on water level along with high algal, fish and benthic diversity. Kudiri, Moolah Kuppam, Annamalcheri are three important places large number of Flemingoos can be seen. Oriental White-backed Vulture (*Gyps bengalensis*) is the critically endangered species, Spot-billed Pelican (*Pelecanus philippensis*) and Greater Spotted Eagle (*Aquila clanga*) are the Vulnerable species of Pulicat lake.

In view of rich avifauna of the lagoon, two Bird Sanctuaries are established in the lagoon, one in each of the two states of Andhra Pradesh and Tamil Nadu. The Andhra Pradesh portion of Pulicat Lake Bird Sanctuary established in September 1976 has an area of 172 km² (66 sq mi) in the Tada Taluk of Nellore District. The Tamil Nadu portion of Bird Sanctuary established in October 1980, has an area of 60 km² (23 sq mi) extending over the Ponneri and Gummidipundi taluqs of Thiruvallur District.

The checklist of Birds prepared by Wild Life Division of Andhra Pradesh has listed 115 species of both aquatic and terrestrial birds in the Pulicat Bird Sanctuary. About 15,000 Flamingos visit the lake on their

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annual migration route. More than 60,000 migrant water birds feed and breed in the Northern part of Lagoon during winter.

The mammalian fauna of Pulicat lake includes the Jungle Cat (*Felis Chaus*), Golden Jackal (*Canis aureus*), Wild Boar (*Sus scrofa*), Small Indian Mongoose (*Herpestes auro-punctatus*) and Monitor Lizard (*Varanus benghalensis*). Recently, a dead Leopard (*Panthera Pardus*) was found, trapped in the slush in the lake. This was the first record of Leopard from Pulicat Lake (Kannan and Manakadan in press).

Flora of the Lagoon

Salt Marshes are abundantly occupied by halophytic species like *Aleuropous lagopoides*, *Etriplex repens*, *Cressa cretica*, *Crotalaria retusa*, *Cyperus haspan*, *Fimbristylis ferrugenea*, *Salicornia brachiata*, *Sesuvium portulacastrum*, *suaedamonoica*, *suaedamonoica nudiflora* and rare a few *Macroptilum lathyroides* plants were found along the road side in Pulicat lake. *Halophila ovalis* popularly called sea grass belong to the family Hydrocharitaceae appear prominently all along the margins Buckingham canal. It grows above and below the ground level and provide a habitat for fish, shrimp and other aquatic species and also provide forage for waterfowl.

Aquatic vegetation includes eight *Cyanophyceae*, seven *Chlorophyceae* and two *Rhodophyceae*. Invasive phytoplankton species of *Spirulina major*, *Oscillatoria sps.*, *Anabaena spp.*, *Rhizosolenia castracanei*, *Eucampia cornuta* and *Climacodium fravenfeldianum* in the plains on the periphery of the lake have been recorded.

Common shrubs like *Azima tetracantha*, *Cassia auriculata*, *Excoecaria agallocha*, *Gmelina asiatica*, *Jatropha gossypifolia*, *Lawsonia inermis*, *Maytenus emarginatus*, *Pandanus tectoreus*, *Salvadora persica*, *Zyziphus mauritiana* etc., grow on the margins of Marshes and along the canals. On the bunds of the canals trees like *Azadirachta indica*, *Borassus flabellifer*, *Lepisanthus tetraphylla*, *Sapindus emarginatus*, *Syzizium cumini*, *Thespesia populinea* etc., appear here and there. *Prosopis chilensis* is the dominated exotic species invaded in many areas of other islands in the lake due to lack of protection. (Scott, 1989). Submerged macrophytes include species of *Enteromorpha*, *Hypnea*, *Ulva*, *Halophila* and *Enhalus* (Oswin, 1987).

Brackish water is more saltier than fresh water and less saltier than sea water. Hence it is biologically more productive than either freshwater or sea water. It shows very rich aquatic population diversity including free floating, submerged, suspended, marginal, amphibious plants along with halophytes and mangroves. But distribution of aquatic flora depends on environmental variables like COD, BOD, Nitrate, phosphate and Potassium sediments of the lake. Region of pulicat lake includes salt marshes, canals and mangroves.

Aquatic flora of the Lake exists in two forms namely microphytes and macrophytes which helps to maintain Biodiversity of the Lake Basha et al., (2011). Common macrophytic plant species like *Nymphaea* species., (Rooted floating) *Lemna* species., *Azolla*, *Eichhornia*, *Pistia* (Free floating, *Hydrilla sp.*, *Ceratophyllum sp.*, *Chara sp.*, (submerged) and *Cyperus sp.*, *Typha sp.*, (Emergent) and *Merremia*, *Lippia*, *Phyla nodiflora*, *Oxalis*, *Hydrocotyl vulgaris* are identified in and around the lake. *Suaeda nudiflora*, *suaeda monoica* and rare a few *Macroptilum lathyroides* plants were found along the road side in Pulicat Lake. Water hyacinth can remove 70% of the Lead from contaminated water within 24 hours and also absorb Cadmium, Nickel, Chromium, Zinc, Copper, Iron and toxic substances such as pesticides. At two places that is near vapenjeri canal close to Chandrasikuppam, and Chengalpalem small mangrove pockets are located. Four species of mangroves belonging to four families are prominent over here. They include *Aegiceras corniculatus* of Myrsinaceae, *Avicennia marina* of Avicenniaceae, *Excoecaria agallocha* of Euphorbiaceae and *Lumnitzera racemosa* of Combretaceae. They develop pneumatophores in response to oxygen deficient conditions. They are buffers between the land and the sea. They help in removing pollution, coastal erosion and protection from saline water intrusion and storms.

The bio-diversity and food chains were prosper in Pulicat Lake during earlier days, perhaps due to the fertilizing of the waters by the mangrove leaves and due to the extra habitats that the mangrove root

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system and the trunks provided. If mangroves are restored to their original native soil of Pulicat Lake, the biodiversity and food chains may be promoted once again.

Threats to Pulicat Lagoon

It also faces several anthropogenic, developmental, industrial and environmental issues threatening not only the livelihoods of fisher folk and also the very survival of this ancient lake itself. Major threat for Andhra Pradesh part of the lagoon is pollution from sewage, pesticides, industrial wastes from numerous fish processing units and oil spills from mechanized boats carries through Arani and Kalangi rivers draining in to the lagoon. Marine chemicals and salt manufacturing industries and Shrimp farming on the eastern part of the lagoon affected the Pulicat Bird Sanctuary along with disturbing the livelihood of fishermen and agricultural workers. It has serious impact on aquaculture development.

Major ecological threats to pulicat lagoon of Tamil Nadu part are Petrochemical complex, Power Plant and the Satellite port on Ennore Creek. Siltation and complete closure of Mouths at Tupilipalem and Rayadoruvu leads to fluctuation in salinity and water level of the lake. It has maximum effect on Biotic component of the ecosystem. The areas of Pulicat lake in tamilnadu faces a greater threat than those of Andhra Pradesh. The 630 MW North Central Thermal power station (NCTPS), the Ennore satellite port project and a proposed Petro chemical park are major threats to the lake eco system. Thousands of acres of land have been cleared for three projects that will progressively damage the ecosystem stretching across 40 km from Ennore to Pulicat.

NCTPS draws 44 lakh liters of fresh water from the Ennore creek, lets out hot coolant water in to the B. canal and discharges toxic fly ash in the form of slurry in to the lagoon. This has been resulted in increase of temperature 5 °C at the outlets. Despite precipitatus and chemical filters the fly ash content toxic elements such as Arsenic, cadmium, Mercury, Lead, Manganese, Florene and Beryllium. In Athapattu village, 10km from NCTPS the concentration of salt pans has forced the people to give up their occupation. Fly ash is especially harmful as it can be inhaled and leads to permanent respiratory disorder, dermatitis, asthma, bronchitis and Cancer. The silica in fly ash could cause silicosis.

The site of Ennore satellite port constructed brack water has caused the sea to ingress 50 m in to the main land that separates the Pulicat lagoon system and the sea. This has caused severe water erosion at Koraiuppam and eight other fishing hamlets. Pazhaberkade area which form an island with sea to its east and lagoon to the west. The tamilnadu industrial development corporation(TIDCO) is acquiring 2900 ha for the proposed Rs. 600 million petro chemical industrial complex which may require 45 million liters of water per day, an amount that would seriously deplete coastal aquifers.

Unethical practice of fishing through 'Padi-Valai', fishing net with very fine mesh has affected the aquatic resources. Edible oysters of the lagoon were lost now due to heavy siltation. This also causes rapid shrinking of water spread area of the lagoon.

Conservation of Pulicat Lake

Both State and Central Governments have taken so many measures to protect the biodiversity of the lake. Pulicat Lake Bird Lovers Society (PLBLS) was established in Sullurpet town, Nellore District which mainly focused on the protection of the biodiversity of the lake and also on developing public awareness. Mangrove Pockets have to be developed along the north and north-west margins of Island which helps in soil binding. Exotic species have to be eradicated from Mangrove habitats to prevent the alteration of native habitats. Plants like *Barringtonia acutangula* serve as a nesting tree to meet the nutritional and breeding requirements of the birds have to be grown in large numbers to attract the migratory birds. The most important conservational aspect of Biodiversity of Pulicat lake is to be build up to create awareness in public through communication, cooperation and education.

Environmental Impacts and Climatic Change on Biodiversity of Pulicat Lake

Climate change has its own specific impacts on the biodiversity. These impacts were already felt, but rather sporadically, since the past 30 years. They have shown up through two major manifestations, through drought, and through cyclonic storms and floods. The water temperatures were uniformly high all over the lake 30°C with incredibly high salinities of 70-80‰. Sanjeev Raj (1985) described the impacts of

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the Sriharikota cyclone of 1984 that had its eye right on the northern part of Sriharikota Island, and created cataclysmic changes on the lake ecosystem. Natural calamities by cyclones, forest fire, grazing and browsing are alarming in causing damage to the flora of the Pulicat lake (Basha et al., 2010). Natural About 3000 and above wild cattle roam in the forest, pasture lands and also resident areas trampling heavily the under growth grazing and browsing vegetation. A German based NGO, which deals with Protection of Environment and Nature, has described Pulicat Lake as “Threatened lake of the Year, 2010”. Phytodiversity provides a buffer against the effect of climate change and a source of raw material for adaptation. Plants are the major sinks of carbon dioxide and rich phytodiversity is essential for a healthy ecosystem.

Conclusion

So far as the Pulicat Lake is concerned, management of the lake mouth is crucial for the health and prosperity of the eco- system. The wider and the deeper lake mouth is and the longer it opens into the sea, during the year, the more will be the vital inputs in the sea, like nutrients, oxygen, plankton and fish-seed, which are the very basis of life and food chains in this lake, Keeping the lake mouth open right round the year and opening of the extra mouth in the north, will surely enhance the productivity and food chains in the lake.

Protection and conservation of Biodiversity is the urgent need of the hour in order to maintain the balance of nature and support the availability of natural resources for future generations Assessment of Biodiversity of a particular region is very important to formulate appropriate conservation strategies. Priority should be given to in-situ conservation by protecting the natural habitats. Each village panchayat of India should have the PBR (People’s Biodiversity Register) according to the Biodiversity Act-002. PBR is record of traditional knowledge and practices of sustainable use of local bio-resources and conservation of biodiversity. They may form an appropriate instrument for designing conservation efforts. The plant species are chosen with the twin goal of raising the bio-shields and deriving livelihood to the local communities, creating awareness among local resident about the numerous benefits imparted by the coastal ecosystem on mankind. Along the beach line Casuarina is found to be quite ideal for plantation. In addition Anacardium occidentale is suitable species in preventing soil erosion.

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