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# FAUNAL DIVERSITY OF ASHTAMUDI WETLANDS, KERALA

M. B. RAGHUNATHAN

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# RECORDS OF THE ZOOLOGICAL SURVEY OF INDIA

# Faunal Diversity of Ashtamudi Wetlands, Kerala

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## INTRODUCTION

Studies on Ashtamudi Wetland, the second largest in Coastal Kerala were undertaken from 1988 to 1991. During the study collections were made from the following localities in Ashtamudi Lake namely Sakthikulangara, Mukkada, Tekkumbagam, Chambranikadavu, Kerettakadavu and Perumon. On the whole 3641 examples of various groups of animals were collected which are check-listed in this account.

## COASTAL KERALA

An outstanding phenomenon of the coastal belt of Kerala is the extensive system of estuaries and backwater lakes lying parallel to the Arabian Sea. These Water bodies popularly known as 'Kayals' which exist in different sizes and shapes have their bed level at about 1.5 to 1.8 m below mean sea level. The waters of a majority of the 41 rivers in Kerala drain into the Kayals before they empty into the sea through a large number of perennial and temporary openings. The important brackish water lakes of Kerala from the north to south are Cauvery, Kottapuzha, Valapatnam, Korapuzha, Valiangode, Grangahere, Parur, Vembanad, Kayamkulam, Ashtamudi, Paravur, Edavanadayara, Anjengo, Kadinamkulam and Veli.

Coastal Lakes and floodplain wetlands are highly productive and spawning, nursery and feeding areas for fish. They protect young fish from strong currents, sunlight and predators. Coastal wetlands and estuaries encourage the settlement of particles of organic matter and nutrient, which may have originated in the open sea.

## ASHTAMUDI LAKE

Ashtamudi Lake is the second largest estuary in Kerala and is situated at 8.52' – 8.60' N lat. and 76.30'-76.40' long. It is a palm shaped set of eight lakes with a water spread of 4335 ha. These lakes join to form the main lake constituting the Ashtamudi estuary, which opens into the Arabian Sea. Kallada River enters the Ashtamudi estuary. The maximum length is 16 km and the breadth is 14 km. The Lake has an outlet to the sea at the western end known as Neendakara Bar. The depth of the bar mouth is sufficient enough to facilitate plying of small vessels and barges. A road bridge of 440 m length spans the backwater near the Neendakara bar. The following different zones have been noted in the lake.

**River zone** : Paper mill effluents, manual dredging, coir processing and heavy siltation characterises this area.

**Confluence zone** : This area experiences siltation through the river mouth and is under the influence of isolated retting and paper mill effluents.

**Kanjirakode** : It is the interior mouth segment and characterized by algal and seagrass beds, intensive fishing, coir processing, clam beds and industrial pollutants.

**Ashtamudi** : This is the central portion of the estuary with intensive fishing, isolated retting and patches of algal beds.

**Chavara** : The interior area of the estuary with pollution from the coconut husk retting.

**Thopilkadavu** : This area is characterized by isolated retting, coir processing and shelters.

**Kandarachira** : This is the interior area of the estuary with intensive retting and sewage pollution.

**Marine zone** : Zone closest to Arabian sea with Neendakara harbour area. Major fish landing center on the south West Coast of India, studded with several small islands rich both of algae and clams.

## REVIEW OF THE WORK ON ASHTAMUDI LAKE

Ashtamudi Lake being one of the biggest brackish water Lake on the West Coast has been receiving attention from various research workers. The following important publications give to certain extent the picture on the quality of water, nutrients and other biological parameters. Kuthalingam et al. (1978) made observations on the catches of the mechanized boats at Neendakara (Ashtamudi). The catch data of the mechanized boats for the period from August 1969 to July 1971 revealed that the area of Neendakara is the potential trawling ground for prawns and other fish with an estimated annual total catch of 12079 tons. Observations also indicate the area of Neendakara to be potential fishing ground for quality fishes such as seer fishes and tunas that are caught in surface gill nets. Trawl catch formed the main bulk of the landings constitute 92.8% and gill net catch formed the rest. The estimated trawl landing for the period amounted to 22419 tons and the estimated average being 11209 tons. Prawns dominated the catch contributing 38.32%. Of this *Parapenaeopsis stylifera, Metapenaeus affinis, M. dobsoni and Penaeus indicus* constitute the major component. Among the fishes, Nemipterids, Sciaenids, Synodontids, Cynoglossids, Tachysurids, Millids, Leiognathids, Platycephalids, Trichurids, Carangids and Elasmobranchs formed the main constituents. The total landings of the gill nets amounted to 1739 tons with an average of 869.5 tons. Sharks, rays and skates represent the major landings of gill net. Besides Tachysurids, Scomberomorids, Tunnies, Rachycentrids, Carangids and Sciaenids were also noted.

As per Balan (1979), during summer the entire water tract of the river is black emanating foul smell. Mass mortality of fishes and other aquatic fauna occur frequently. Water at this time is unusable for human consumption and normal civic use. The toxicity of pulp and paper mill waste is well known and usually associated with sulphur containing compounds arising from the wood digestion process and chlorinated phenolic compounds created by bleaching of the pulp and paper. High BOD is characteristic of untreated sulphite pulp effluents and many fish kills have occurred because of oxygen depletion. The solid fractions of pulp and paper mill wastes that accumulated in sledge produce local nuisance. These undergo decomposition and remove dissolved oxygen from wastes, which often leads to the formation of noxious gases. In addition, large areas of river have been now covered with a layer of settled organic material having undesirable effects on the faunal and floral communities in the water tract.

Dharmaraj and Balakrishnan Nair (1979, 1981) made studies on the ecology of wood boring sphaeromatids and on the timber destroying organisms. The ecology of timber destroyers was studied during 1978 – 1979. Studies at Neendakara port were carried out with a system of wooden blocks suspended at three levels of the water column. Regular collections of timber boring animals were made from the interior part of the Ashtamudi backwaters during 1980–1981. From Neendakara the following species namely *Dicyathifer manni. Teredo furcifera, Nausitora hedlayi, Bankia carinata, B. campanellata, Martesia striata, Sphaeroma terebrans, S. annandalei,* and *S. walkeri* were collected and from Edanthuruthi canal all the species were collected except for *Bankia carinata* and *B. campanellata*. From the other stations, Pallikodi, Ashtamudi swamps, Ashtamudi rail bridge, Olayikadavu, Thevally bridge and Quilon jetty two species were collected namely *Lyrodus pedicellatus* and *Martesia striata*. In Neendakara, the mouth of Ashtamudi Lake, *L. pedicellatus*, the most abundant shipworm of the area, was found settled during almost all months except during October and November. Maximum settlement was observed in June followed by January. During the pre-monsoon period a few *T. furcifera* also settled on the experimental blocks. *M. striata* settled abundantly during January, February, May, June and December. Spaeromatids invaded almost throughout the year except for March with heavy incidence during October and September. Ecological parameters such as the depth of the locality, salinity distribution, temperature, light penetration, nature and abundance of woody substrata, density of larvae present in the vicinity would significantly alter the pattern of the settlement of the organisms. In Neendakara at depths of about 210 cm Pholatid attack is severe.

Mathew and Nair (1980) studied distribution and seasonal fluctuation of phytoplankton in relation to temperature, salinity, phosphate and nitrate. Two stations were selected in Ashtamudi Lake, one at Neendakara port and other at Olayikadavu. Monthly collections from January to December 1997 were made using standard procedures and the algae were counted in a Sedgewick–Rafter counting cell. Temperature at Neendakara varied between 27–32°C and at Olayikadavu between 26.5 and 33°C. The minimum at Neendakara was in April and Olayikadavu it was in October. Salinity ranged

between 13.7 and 32.5% at Neendakara and it was between 7.9 and 30% at Olayikadavu. At both the stations it reached the highest in April and lowest in September and November. Phosphate concentration at Neendakara varied from 0.5 to 1.51 µg/l, and at Olayikadavu from 0.3 to 1.63 µg/l. Nitrate fluctuated between 1.5 to 9.9 µg/l at Neendakara and between 1.47 to 10.5 µg/l at Olayikadavu. Phytoplankton community included 52 species belonging to 38 genera and the dominant group was Cyanophycea (42.9%) followed by Chlorophycea (30.66%), Bacillariophycea (25.56%), Dinophycea (0.04%) and miscellaneous forms (0.82%). At Neendakara the primary peak was in June. Peaks of small magnitudes were noticeable in February and November. At Olayikadavu primary peak was in August with a minor peak in February. Total absence of phytoplankton at Olayikadavu during March and October may be due to the influence of the pollutants. Abundance of algae was found during the monsoon months characterized by low salinity. Lowering of salinity and enrichment of nutrients during the southwest monsoon are mainly responsible for the abundance of phytoplankton.

Dharmaraj and Balakrishnan Nair (1981) studied the nature and distribution of major inorganic nutrients in the Ashtamudi Lake in relation to environmental factors. Investigations were carried out for about 18 months from December 1976 to May 1978 and the results for 12 months from February 1977 to January 1978 were reported. Investigations were carried out at two localities, the Neendakara estuary and Olayikadavu situated at about 8 km south east of Neendakara, one of the arms of which is reaching Quilon town. The maximum and minimum temperature values of the surface waters in both the stations show 33°C and 26.5°C respectively where as in bottom waters it is 32°C and 26°C. The maximum temperature value was noted during October from Olayikadavu and in the other station it is high in April but the minimum temperature was noted during July in both the stations. In Neendakara the salinity was high in bottom waters with a maximum of 33.6% during April. The minimum values were noted during May, June and July with the lowest value during November (7.9%). While pH values were in the range of 7.3 to 8.3, dissolved oxygen values were in the range of 2.9 to 5.3 ml. Highly saline waters were prevalent at both the localities except during the rainy season. Water temperature, pH value and transparency varied irregularly while the dissolved oxygen content did not vary much at Neendakara and exhibited wider fluctuations at Olayikadavu. Concentrations of all the nutrients were comparatively high during the monsoon months and low during the high saline summer months. Bottom waters normally contained higher concentrations of nutrients except for silicate, which exhibited a negative correlation with salinity. N/P values were generally lower than that of the ocean. Human interference in several ways has contributed to the pollution of Ashtamudi Lake. Retting of coconut husk for coir industry is prevalent almost all along the backwaters whereas husks are submerged for varying periods to decay out the connective tissues binding the fibers. In the process of decay, which is more of a microbial process, particulate organic matter and colloidal substances are released into water making the vicinity highly turbid. Further degradation of organic matter consumes large quantities of dissolved oxygen. With the diminishing dissolved oxygen content, possibilities of

denitrification and sulphate reduction are created which leads to the depletion of nitrate and also the production of hydrogen sulphide. Direct release of raw sewage into the backwater is a very common feature along the banks. This also significantly alters the natural cycle of nutrients. Several tons of solid organic wastes mostly of starchy materials are discharged into one of the arms of the backwater daily. Accumulations of products resulting from the degradation of the waste materials impart high turbidity to the nearby areas. Gases produced in the process of decay bubble over the colloidal and turbid water surface. This along with the mixing of ret liquor from the retting pits situated in the vicinity, and the discharge of effluents from the ceramics and metal industries situated nearby make the area a highly polluted zone. Besides, the Kallada river brings in the toxic effluents from the Punalur paper mills. The impact of effluents and nutrient chemistry of the backwaters is not known. The ingredients and the composition of the effluents are not known precisely. Neendakara port area is polluted also by oil spillage from several mechanized fishing boats plying over the area. The quantity and quality of inorganic nutrients available to primary producers forms a very important abiotic factor governing the rate of energy fixation. Backwater nutrient dynamics are related to compositional gradients associated with the mixing of sea water and dilution with freshwater, uptake of nutrients which are released in the process of decomposition of dead organic matter by primary producers, stratification and silt load. Ashtamudi backwaters receive the fullest benefits of southwest monsoon from June to September with annually varying quantities of precipitation from the north-east monsoon from October to December. The year could be divided into three seasons on the basis of the quantity of precipitation during different months as pre-monsoon (February-May), monsoon (June-September) and post-monsoon (October-January) the last including the north-east period also. The pre-monsoon is a hot and highly saline period, the monsoon period is characterized by a fluviatile conditions with fluctuating low salinity and temperature and post-monsoon represents the transitional stages between the other two.

Abdul Aziz and Balakrishnan Nair (1981) made studies on pollution of Ashtamudi Lake. Punaloor paper mills is the source of pollution in Kallada river. The Lakshmi starch factory, the Kundare ceramics factory and Alind are industrial concerns causing large-scale pollution in the Kanjirakode branch of the Ashtamudi estuary. Retting of coconut has led to severe pollution in several arms and inlets of Ashtamudi estuary. The paper mills effluents from the Kallada river engulfing vast areas of the Ashtamudi estuary has also resulted in the pollution of the ecosystem in a big way. Water pollution in the Kallada has been evident since 1944. About 6,01,300 cubic meters of used up water is discharged into the Kallada along with several dissolved chemicals. A study the Public Health Engineering department of the Government of Kerala held in 1952 has reported the harmful nature of effluents in the Kallada river water.

Distribution and seasonal variation of the benthic fauna of Ashtamudi Lake were reported by Divakaran *et al.* (1981). Samples were collected in monthly intervals by using a cylindrical corer of 12cm diameter and 15cm height from the two stations, Neendakara and Olayikadavu. Among the hydrographic features studied salinity and oxygen were the

most fluctuating parameters. Salinity ranged between 13.7–32.5% at Neendakara and 7.6–30.0% at Olayikadavu in surface waters. In bottom waters salinity ranged from 16.5–33.6% at Neendakara and 8.1–32.5% at Olayikadavu. Surface water temperatures ranged between 26.5°C–32°C and 27°C–33°C at Neendakara and Olayikadavu respectively. Though lowest temperature was recorded during July at both the stations, the highest temperature was recorded during April at Neendakara and in October at Olayikadavu. At Neendakara the seasonal variation in the dissolved oxygen content varied between 4.0 to 4.6 ml/l in surface water and 3.6 to 4.0ml/l in bottom water. However at Olayikadavu the fluctuations were very high because of the frequent admixture of polluted water from the nearby area. It fluctuated between 3.9 to 5.3 ml/l and 2.9 to 4.8 ml/l in surface and bottom waters respectively. pH values varied between a narrow range at both the stations being 7.9 to 8.2 and 7.4 to 8.3 in surface and 7.8 to 8.2 and 7.3 to 8.3 in bottom waters of Neendakara and Olayikadavu respectively. The benthic fauna of the Lake is subjected to wide seasonal fluctuations. The faunal density ranged between 1480–195410/m$^2$ (mean 26396) at Neendakara and 150–1200/m$^2$ (mean 445) at Olayikadavu with peaks of abundance during monsoon. Corresponding biomass values ranged between 2.13–220.20g/m$^2$ (mean 49.47) at Neendakara and 0.3–4.6g/m$^2$ (mean 2.0) at Olayikadavu. While polychaetes and amphipods constituted the bulk of the population at both the stations, isopods and pelecypods were well represented at Neendakara and oligochaetes at Olayikadavu. Of the 14 taxa of polychaetes identified, *Nereis* sp. *Diopatra neapolitana* and *Prionospio* sp. were common at both the stations and their density was always higher than that of other polychaetes. Among the others, *Goniada* sp., *Perinereis* sp., *Polydora* sp., *Nephthys* sp., Sabellids and maldanids were present only in Neendakara. They were well represented during the pre and post-monsoon periods except the one genus *Polydora* and were virtually absent during monsoon. *Dendronereis* sp. was obtained from Olayikadavu during the monsoon and post-monsoon period and its number was greater than that of any other taxa of that area. Crustaceans were the next important group represented by amphipods, isopods, decapods and tanaidaceans. Though amphipods were second only to polychaetes in species composition their density was higher than that of any other components of the benthic community. Of the 7 species of amphipods identified *Corophium triaenonyx, Ampeliscs scabripes, Photis digitata and P. geniculata* were common at both the stations. Their density was noticeably higher during the monsoon and post-monsoon periods with peak during November ranging between 60-186600/m$^2$ (mean 23574) at Neendakara and 0-360/m$^2$ (mean 143) at Olayikadavu. A few *Melita zeylonica* and *Quadrivisio bengalensis* were occasionally obtained from Neendakara. Others like isopods, tanaidaceans and decapods were found only in Neendakara occurring periodically in small numbers. While *Tanais* sp. was the only representative of Tanaidacea, *Cirolana willeyi, Sphaeroma terebrans* and *Xenanthura linearis* represented isopoda. Molluscs were present only at Neendakara mainly composed of Pelecypods represented by *Musculists arcuatula* and *Solen* sp. The population density of the benthic fauna was generally high during the monsoon season. The density of the benthic fauna of Olayikadavu was poor throughout the year especially during the pre-monsoon period. An inversely proportional correlation was observed between population count and density.

It was also found that even though there were remarkable seasonal fluctuations in the population density the fauna characteristics were more or less constant during the yearly cycle. Regarding the population density it was much higher than that of Zuary estuary, Mandovi estuary and Cochin estuary.

Divakaran *et al.* (1982) have made seasonal studies of Zooplankton of Ashtamudi Lake. Zooplankton constituted of freshwater, brackish water and marine forms. They were subjected to wide seasonal fluctuations with a major density peak during the monsoon and a minor peak during the post-monsoon periods. Crustaceans constituted the bulk of the community and others like coelenterates, polychaetes, chaetognaths, tunicates and fish eggs and larvae were frequently obtained in small numbers. *Hydromedusae* and larval forms were the common representatives of the coelenterates. *Sagitta enflata, S. pulchra* and *S. bipunctata* were represented chaetognaths. Cladocerans were represented by *Evadne* sp. *Leydigia* sp. and *Diaphanosoma* sp. Among the copepods marine forms like *Paracalanus, Acrocalanus, Undinula, Euchaeta* sp., *Centropages* sp. *Acartia* sp. and *Oithona* sp. and the freshwater forms like *Paradiaptomus* sp., *Phyllodiaptomus* sp. and *Diaptomus* sp. *Mesocyclops* sp. and *Cyclops* sp. were recorded. Other Crustaceans like ostracods, mysids, cumaceans and amphipods were also collected.

Suseelan and Kathirvel (1982) made detailed studies on the prawns of Ashtamudi backwaters. During their studies the following prawns were collected namely *Penaeus indicus, P. monodon, P. semisulcatus, P. latisulcatus, P. canaiculatus, Metapenaeus dobsoni, M. monoceros, M. affinis* and *Parapenaeopsis stylifera*. Penaeid prawns were chiefly represented by juveniles. *P. semisulcatus* occurred more abundantly in some of the deeper areas having relatively higher salinity (9.42-32.11%). *P. laticaudatus* formed one of the common species during the post-monsoon period. *Parapenaeopsis stylifera*, the most dominant species contributing to the marine fishery of the area was encountered only in stray numbers.

Ramachandran Nair *et al.* (1982) discussed the prospects and problems of brackish water prawn farming in Ashtamudi Lake area. Fourteen ponds having a total area of 205ha owned by M/s Blackstone industries at Neendakara were selected for prawn farming. Prestocking observations on the bio-ecological parameters were carried out which indicated that these ponds were highly productive and provided optimum conditions for culture operations. Early juveniles of *P. indicus* of 15–25 mm (18.2 mm mean length) size group were stocked during June–July 1978 at a rate of 50,000 to 70,000/ha. During the pre-monsoon period 1979 (January to June) the stocking rate of *P. indicus* seeds (mean length 18.0 mm) varied from 56,000–2,52,000/ha. The average growth per day in the culture experiments of 1978 and 1979 was found to be 0.73 mm and 0.54 mm respectively. The difference observed in the growth rate was mainly due to the increase in stocking density in 1979. However the growth rate of the species during the first 20 days after stocking was considerably faster in both the years, average being 1.86 mm/day, inspite of varying environmental conditions and density. In view of the lack of information on the behavior of prawns in culture ponds under extreme environmental

conditions such as low salinity and high temperature, the present cultural experiments were also aimed at understanding the impact of the above conditions on the growth and survival of prawns in confinement. Therefore the two sets of farming were carried out in different seasons, one during the southwest monsoon which was characterized by extremely low salinity and the other during pre-monsoon summer when the temperature of water rose to higher level. It was observed that in the initial 20 days the prawns grew at a faster rate. The causal factors for the low growth rate during the second twenty days other than the stocking density have also been investigated. Extreme fluctuations in the environmental parameters like water temperature and salinity have influenced the growth rate. The encouraging results obtained on the growth rate of prawns during the present experiments proved beyond doubt that Ashtamudi Lake area is one where faster growth rate for prawns could be expected.

Balakrishnan Nair *et al.* (1983) have made detailed analysis of the physico-chemical features of water and sediment nutrients of Ashtamudi estuary. Samples were collected from the following localities, Neendakara, Ashtamudi, Kanjirakode and Kadapuzha. Neendakara is one of the biggest fish landing harbours of the West Coast of India at the mouth of the estuary. Ashtamudi is the central portion of the vast expense of the backwater, which is very important fishing zone. Kanjirakode represents the interior segment of the estuary and it has three arms and several creeks. Even though the retting of coconut husks and industrial effluents have created some pollution in this area, it is an excellent fishing zone. Kadapuzha is near the confluence of the Kallada river into the estuary and heavily polluted by the Punalur paper mill effluents. Fortnightly samples were collected from February 1980 to January 1981 from all the four stations. Data on rainfall and river discharge show clear seasonal variations. The south-west monsoon over Kerala brings heavy rains in the river basin during June-August and north-east monsoon causes heavy precipitation during October-November. During the period of poor rainfall salt water penetrates upto Uppukutu in the Kallada river. Water temperature in Neendakara shows higher values during February to May, and from June to January it is almost same. But in Ashtamudi, temperature values were on the higher side during February to May with peak during May and minimum temperature values were also of the same pattern with peaks during May. Surface and bottom waters normally remained on the alkaline side in all stations except for a brief phase at Kanjirakode and Kadapuzha. A clear decrease in pH from the marine to the freshwater zone was evident. Light penetration was at the maximum in all stations during monsoon. Based on the trend of salinity variations three broad patterns of distribution are known, a period of high salinity with very little fluctuations from June to November (period of the two monsoons), a period of recovery during December and January and post northeast monsoon period. The impacts of paper mill effluents, retting, eutrophication, rainfall etc. are reflected in the oxygen regime. There were rapid and wide fluctuations in the dissolved oxygen concentrations from fortnight to fortnight and there was total oxygen depletion resulting in the occurrence of brief anoxic periods during September-October in all the stations except Neendakara. Phosphate-phosphorus at Neendakara indicates a maximum value during pre-monsoon

season and minimum in monsoon. From Ashtamudi to Kadapuzha phosphate was maximum during post-monsoon and minimum in pre-monsoon period. Seasonal value of Nitrite-nitrogen was maximum at Kadapuzha and minimum at Neendakara. The concentration exhibited an upward trend from the marine to the riverine zone. Nitrite-nitrogen also exhibited a similar trend. Silicate-silicon values were high throughout the estuary, the values were maximum at Kadapuzha and minimum at Neendakara. With reference to sediments at Neendakara coarse sand ranged from 6.05% in July to 15.29% in February, fine sand from 22.94% in February to 73.44% in July and clay from 1.04% in May to 11.98% in January and silt from 0% in July to 4.2% in April. At Ashtamudi also same trend was noted. At Kanjirakode coarse sand ranged between 33.28% in March to 92.56% in June dominating the textural characteristics due to a fall in the fine sized material during monsoon. Pre-monsoon season showed the peak percentage of clay (26.04%) and silt (11.46%). At Kadapuzha coarse sand ranged between 33.34% – 76.45% in August and February. Percentage of clay and sift varied between 4.17% in November and 18.29% in March and 0% in March and 10.2% in April respectively. Organic matter in Lake sediments is derived from primary production with in the aquatic ecosystem (autochthonous sources) and also from terrestrial biota (allochthonous sources) by transport of leached and eroded material into the Lake. Higher organic carbon (OC) during the pre-monsoon at Neendakara, Kanjirakode and Kadapuzha and during post-monsoon at Ashtamudi as compared with that during monsoon revealed that allochthonous input of organic matter into the system is less. Increase of OC during pre-monsoon may be due to the retting of coconut husk. Correlation between organic OC, total Phosphorus, total Nitrogen and total Potassium in the sediment and grain size reveal that fine grained elements contain more OC and Phosphorus. Existence of organic phosphate in the sediments is evidenced by the correlation between OC and phosphorus in all the four stations. Results of the present study indicate the imperative need to keep the effect of pollution within the manageable limits.

Balakrishnan Nair *et al*, (1983) have studied the ecology of seagrass bed of *Halophila ovalis* in the Ashtamudi estuary. Sampling was done at Kanjirakode, the interior most segment of the Ashtamudi estuary. The average standing stock of *H. ovalis* varied from 3.6 to 4.8$g^2$ (dry) during June to January. Temperature variations in the overlying water in the seagrass bed area were between 28.4°C in January and 32°C in June. The minimum temperature in January coincided with the peak biomass (322$g/m^2$ wet and 48$g/m^2$ dry). Salinity of the seagrass bed area showed fluctuation between 12.46 and 27.05x $10^3$. As a consequence of ecological differences during monsoon, seagrass density varied from 5 to 25$g/m^2$ (dry). The influx of turbid freshwater affects the healthy growth of seagrass and even decay is noticeable. The turbid and polluted waters from the Kallada river enter the estuary with heavy loads of suspended particulate and this naturally prevents light penetration, which would hinder photosynthetic activities. Maximum growth of *H. ovalis* was noted during the pre-monsoon and post-monsoon when the transparency was high. pH varied only slightly with minimum 7.4 in December. The oxygen contents in the overlying water fluctuated between 3.05 and 11.5 $ml/1^{-1}$ during October and April. The

OC content in the sediments fluctuated from 6.45 to 11.55 $mg/g^{-1}$ An increase during pre-monsoon period indicates that the role of allochthonous organic matter input is minimal and the increase may be from autochthonous sources mainly from the decomposition of micro algae and seagrass that are subjected to stress and destruction during monsoon. Seagrass alter the prevailing sedimentation process in a variety of ways, but the major effects are to increase the sedimentation rate to concentrate preferentially to finer particle sizes and to stabilize the depositions.

Balakrishnan Nair *et al.* (1983) have studied the distribution of OC in the sediments of Ashtamudi estuary. For this study 52 stations were selected during 3–17$^{th}$ March 1981 using a metal corer. A portion of the sediment for chemical analysis was oven dried at 100-105°C overnight, ground and sieved. Dried material was taken for OC and grain size analysis. At riverine zone sediments showed higher concentrations of OC in all stations and the content ranged from 0.9 to 3.24%. In confluence zone, erratic fluctuations of OC values were noted. But in Chavara zone and Thopilkadavu zone maximum concentrations of OC were found because of coir processing units and retting of coconut husks. Based on the average values of OC in different zones of Ashtamudi estuary distinct distribution patterns are seen namely a minimum in the marine zone and Kandanchira zone because of retting of coconut husks.

Damodaran and Sajan (1983) studied carbonate content of the sediments of Ashtamudi Lake. Lake sediments have been studied for type of sediment, rate of sedimentation, carbonate content of sediments and biogenic productivity. Sediment samples were collected from the river mouth and from the tidal channel. The sediments at the Kallada river mouth are mainly of clay and silty clay while the samples from the tidal channel, Kallada river mouth sediments characterized by a low carbonate content (average 2.92%). High nature of sedimentation and fine nature of substratum affects the biogenic activity and hence a low carbonate value. The sediments in and around tidal channel are with high carbonate content (8.77%), due to high amount of biogenic activity. From the distribution pattern of organic matter content in the lake sediments, a striking relation is found between the grain size and the organic matter content. Clay, silty clay and silt have higher values or organic matter content when compared to sands. Normally it is seen that high organic matter content in the sediments of an area supports high biogenic activity in that area as organic matter serves as food for the latter. But in the present investigation, inspite of high organic matter content (average 8.48% by wt) found in the sediments at the river mouth, the other factors such as high rate of sedimentation, the depth of water, fluctuation in salinity, prevalence of reducing environment have affected the biogenic activity in order to bring the carbonate content to the minimum (average 2.92% by wt). In spite of the low organic matter content (average 1.32% by wt) in and around the tidal channel, high biogenic activity is prevalent as evidenced by high carbonate value (average 8.77%). The low organic matter content may be due to the consumption of the same to some extent by benthic organisms that contribute to the total carbonate content. The consumption of the organic matter by the benthos does not seem to be compensated by supply.

Balakrishnan Nair *et al.* (1983) made a preliminary survey of fishery resources of the Ashtamudi estuarine system. The estuarine system is divided into four zones as follows :

**Marine zone** (Neendakara zone) : It lies adjoining to the mouth of the estuary. Neendakara one of the fish landing centers along the West Coast is situated in this zone.

**Brackish water zone I** (Ashtamudi zone) : It occupies the central portion of the estuary.

**Brackish water zone II** (Kanjirakode zone) : It represents the interior most part of the estuary.

**Tidal river zone** (Kadapuzha zone) : This is the lower reach of the Kallada river and is heavily polluted by the Punalur paper mills.

From February 1980 to January 1981 regular fortnightly surface and bottom water temperature were recorded from four stations namely, Neendakara, Ashtamudi, Kanjirakode and Kadapuzha. Fish samples were collected at random from fisherman in the estuary and from the major landing centers along the banks during the fortnightly visits to the various zones. 97 species of fishes belonging to 39 families were collected. Of the 39 families 16 were represented by single members and family Gobiidae has the largest representation (10 species). Families such as, Clupeidae, Eugraulidae, Cyprinidae, Hemiramphidae, Mugillidae, Carangidae, Lutjanidae, Gerridae, and Leiognathidae had fair representation.The fauna of brackish water system is generally composed of marine and freshwater organisms, which can adapt to waters of different and varying salinity and truly resident estuarine species. Among 97 species nearly 50% (42 species) were typically marine and 11 were typically freshwater. Only three namely, *Megalops cyprinoides, Pelates quatrilineatus, and Gerromorpha setifer* were truly estuarine. Others were transient forms inhabiting estuarine and riverine (9 species), marine and estuarine (15 species) and marine estuarine and riverine (8 species) habitats. Further out of the 97 species recorded 69 were common. The pearlspot *(Etroplus suratensis)* and the mullets were the most abundant forms having considerable market value and contribute appreciably to the landings. *Etroplus* sp. and *Chanda* sp. are available round the year, Mullets were most abundant during December-January. Among the mullet species *Osteomugil cunnesius* was the most common form and *Mugil cephalus, Liza parsia* and *L. microlepis* also contributed considerably to the fishery. Gobioids were seasonal with a peak-fishing season during April – June. Anchovies landed in large quantities during July – October. Economically less important groups like gobiids, anchovids, chandids, leiognathids, gerrids and theraponids constitute a rich raw material which can be utilized for the production of fish meal, fish protein concentrate etc. In Ashtamudi the fin fish fishery was generally poor during August – October. The estuary had a rich Prawn resource and the season lasted for about 6 – 7 months (May-November) with a peak in August – October.

Studies on primary productivity of Ashtamudi estuary were carried out by Balakrishnan Nair *et al.* (1984). The Kallada river with a catchment basin of about 960km$^{-2}$ and traversing for about 120km across the state drains into the estuary. A paper mill situated on the banks of the river is the major source of pollution. Four stations namely Neendakara, Ashtamudi, Kanjirakode and Kadapuzha were selected for regular studies. Neendakara is the marine dominated estuary mouth and Kadapuzha is the riverine zone and Ashtamudi and Kanjirakode are intermediate zones. Studies were undertaken from July 1980 to June 1981. The maximum gross productivity of the surface at Neendakara was recorded in July (341.82 mgC.m$^3$/hr) at Ashtamudi and Kadapuzha in August (280.40 and 227.90 mgC/nrVhr). Net productivity of the surface water at Neendakara was maximum in July (284.85 mgC/m$^3$/hr) at Ashtamudi in April (208.89 mgC/m$^3$/hr) at Kanjirakode in May (151.92 mgC/m$^3$/hr) and Kadapuzha in August (180.40 mgC/m$^3$/hr). The correlation coefficient did not reveal any significant relationship between primary production and either temperature or salinity or hydrogen ion concentration. The correlation between dissolved oxygen and the gross productivity in the surface water was remarkable, productivity decreased and increased along with the fluctuations of oxygen concentration. Availability of nutrients was recognized as one of the major factors controlling primary production. Phosphate showed a positive correlation with the gross productivity in the surface water at Neendakara whereas the relationship at other stations was always available in the environment. High concentration of nitrate had not coincided with high production. Silicate concentration positively correlated with gross productivity. A scrutiny of the data on primary productivity rates had shown that the Ashtamudi estuary was one of the extremely productive in the country with tremendous resilience to face the threat of pollution and sustain a rich fishery composed of prawns, crabs, clams and fishes. The gross productivity in Ashtamudi ranged from 18.99 to 341.82 mgC/m$^3$/hr in the surface water and 18.99 to 398.78 mgC/m$^3$/hr in the bottom water. The net productivity in the Ashtamudi estuary ranged from 4.8 to 284.85 mgC/m$^3$/hr. in the surface and from 31.30 to 225.86 mgC/m$^3$/hr. in the bottom water.

Experimental culture of *Crassostrea madrasensis* (Preston) was carried out by Velayuthan *et al.* (1995). Studies on the plankton population of Asramam creek of Ashtamudi lake were carried out by Bhadran Geetha (2001). Asramam creek is the most prominent creek of Ashtamudi lake. A comparative study of the plankton population of this creek portion of this lake and the open lake revealed that in the creek portion the plankton density reached upto 273 ml./lit. whereas in the open lake it was only upto 50 ml./lit. Studies pertaining to natural radioactivity and human mitochondrial DNA mutations were carried out by Lucy Foster *et al.* (2002). Coastal peninsula in Kerala contains the worlds highest level of natural radioactivity,in a densely populated area, offering an opportunity to characterize radiation associated DNA mutations. Radioactive areas are easily identifiable by the presence of black monazite sand. Radioactivity increases from Kayamkulam lake to Ashtamudi lake with peak activity in Chavra.

## FIELD SURVEYS

Collections have been made by five field surveys as follows :

1. Survey by Shri K. N. Nair and M. B. Raghunathan from 27.09.1988 to 6.10.1988 (Monsoon)
2. Survey by Dr. G. U. Kurup from 27.1.1989 to 5.2.1989 (Post-monsoon).
3. Survey by Dr. M. B. Raghunathan from 24.11.1989 to 5.12.1989 (Post-monsoon).
4. Survey by Dr. G. U. Kurup from 22.3.1990 to 29.3.1990 (Pre-monsoon).
5. Survey by Dr. M. B. Raghunathan and Shri. P. M. Sureshan from 7.2.1991 to 13.2.1991 (Pre-monsoon).

## COLLECTION LOCALITIES

Six collecting stations were selected representing all the important areas circumscribing the water spread area. These are described below.

**1. Sakthikulangara** : This collecting station is located on the southern periphery of the Lake nearer to the outlet to the sea. It is generally regarded as the main point of operation in the Lake as it is situated by the side of National Highway and the Neendakara road bridge spanning the water spread at this point. Fishing is mostly by stake netting of which this is the most important center. Country crafts and seagoing motor launches are noted here where fishing operations are also carried out.

**2. Mukkada** : This station is in the western portion of the Lake and north of Sakthikulangara. Here the Lake is mostly in the form of narrow channels. There are several islands inhabited by traditional fisherman families and people connected with fishing trade. Being channels these are also more intensively used as cruising routes by motor launches.

**3. Thekkumbagam** : It is situated further north of Mukkada and having much more open water spread than it. However water in certain areas are much shallower which makes these areas ideal for mussel fishing using metallic scapnets. The area is also said to be good for prawn fishing. Having plenty of weed growth on the bottom this area serve as good prawn spawning habitat.

**4. Chambranikadavu** : This is a fish landing and also trading center where fish catches of species of commercial importance are brought at about 3 AM by country canoes operating all over the south-western region of the Lake. Brisk bargaining and trading goes on here till 6 AM and basket loads of fishes are taken away by individual vendors for selling in the hinterland around Quilon and beyond. The catches brought by numerous canoes were examined and unrepresented and interesting species were collected.

**5. Kerettakadavu** : This station is on the northern part of the lake near Chavara. Coir husking, seasoning and other operations for the manufacture of coir threads and ropes are carried on here particularly around the mainland shore areas. Water spread is fairly open with shallower areas here and there. The area is said to be good for large species of crabs and prawns. The area is also having plentiful installation of Chinese net.

**6. Perumon** : This station is on the eastern part of the lake. Collection area involved the water spread on either side of the Perumon railway bridge (where one of the most terrible derailing tragedy in recent times occurred). The water-spread area is more inland, open and deep. Being further removed from the sea migrant species is also seemed to be less represented and the area also apparently less affected by seasonal flux.

## MATERIAL AND METHODS

For fish collections, two country boats were hired in each of the collecting stations with different types of castnets. By means of expert cast-netters operating from one boat traveling in front, extensive cast-netting operations were carried out through out the water front area in the region. The survey party traveling in the second boat, closely following the lead collection craft immediately transferred the catches to buildup the collections, preserving wherever immediate preservation in the field was called for. The department fiberglass boat fitted with the outboard engine was also engaged for collections. Fish landings in major areas namely, Sakthikulangara and Chambranikadavu were also examined and collections made for unrepresented and interesting species. Further, plankton, benthos and shore fauna were also examined. For plankton collection, a 0.30 m (diameter) nylon net (0.3 mm mesh size) was operated (length 1.0 m) with an attached rope (2.55 m). For each sample, four throws were made and the samples were preserved in 5% formalin. The benthic samples were collected by operating and Ekman's dredge and were sieved through different sieves (No. 1004, 500, 200). Water samples were analysed for pH, salinity, dissolved oxygen and temperature.

## RESULTS

During October 1988 salinity values ranged between 7.6 to 20.5‰ and temperature was between 29.5°C to 32.0°C. The dissolved oxygen values were in the range of 3.6 to 4.0 ml/l and the pH ranged between 7.4 to 8.1. In January–February 1989, salinity values were in the higher range of 27.2-32.1‰. Temperature was in the narrow range of 28.5 to 30.0°C. The dissolved oxygen values were between 3.5 to 4.2 ml/l and pH was with in the range of 7.9 to 8.3. During November–December 1989, salinity values were between 7.8 to 19.5‰ and the temperature was between 29.5 to 30.5°C with the dissolved oxygen values of 3.9 to 4.5 ml/l and pH of 7.9 to 8.1. Both during March 1990 and during February 1991 salinity values were always on the higher side between 28 and 33.1‰ and temperature was between 28.5 to 30.3°C. Dissolved oxygen values were between 2.8 to 4.2 ml/l and pH was in the range of 7.9 to 8.3.

**Material collected :**

1. First Survey from 27.9.1988 to 6.10.1988 :

**Coelenterata :**

Scyphomedusae ..... 1

**Arthropoda**

Crustacea ..... 31

**Mollusca**

Gastropoda ..... 9

Bivalvia ..... 6

**Chordata**

Pisces ..... 150

Amphibia ..... 2

Plankton sample ..... 1

2. Second Survey from 27.1.1989 to 5.02.1989 :

**Arthropoda**

Crustacea ..... 267

**Mollusca**

Gastropoda ..... 28

Bivalvia ..... 26

Cephalopoda ..... 5

**Chordata**

Pisces ..... 624

Plankton sample ..... 1

3. Third Survey from 24.11.1989 to 5.12.1989 :

**Arthropoda**

Crustacea ..... 95

**Mollusca**

Gastropoda ..... 43

Bivalvia ..... 10

Cephalopoda ..... 1

**Chordata**

Pisces ..... 368

Plankton sample ..... 1

4. Fourth Survey from 22.3.1990 to 29.3.1990 :

**Arthropoda**

Crustacea ..... 911

**Mollusca**

Bivalvia ..... 50

**Chordata**

Pisces ..... 560

Plankton sample ..... 1

5. Fifth Survey from 7.2.1991 to 13.2.1991 :

**Arthropoda**

Crustacea ..... 53

**Chordata**

Pisces ..... 401

Plankton sample ..... 1

**Total Collections :**

**Coelenterata**

Scyphomedusae ..... 1

**Arthropoda**

Crustacea ..... 1357

**Mollusca**

Gastropoda ..... 80

Bivaivia ..... 92

Cephalopoda ..... 6

**Chordata**

Pisces ..... 2103

Amphibia ..... 2

**Total ..... 3641**

## FAUNAL DIVERSITY OF ASHTAMUDI LAKE

(Based on earlier reports and recent study)

**(i) Polychaeta** : *Nereis sp., Diopatra sp., Prinospio sp., Goniada sp., Sthenelais sp., Ancistrosyllis sp., Lumbrinereis sp., Glycera sp., Perinereis sp., Polydora sp., Nephthys sp., Dendronereis sp.*

**(ii) Amphipoda** : *Corophium triaenonyx, Ampeliscs scabripes, Photis digitata, P. geniculata, Melita zeylonica and Quadrivisis bengalensis.*

**(iii) Isopoda** : *Cirolana willeyi, Sphaeroma terebrans and Xenanthura linearis.*

**(iv) Copepoda** : *Paracalanus sp., Acrocalanus sp., Undinula sp., Euchaeta sp., Centopages sp., Euterpina sp., Pseudodiaptomus sp., Acartia sp., Oithona sp., Paradiaptomus sp,, Diaptomus sp., Mesocyclops sp. and Cyclops sp.*

**(v) Cladocera** : *Evadne tergestina, Penilia avirostris, Ceriodaphnia cornuta, Moina micrura, Diaphanosoma sarsi, Bosminopsis deitersi and Chydorus barroisi.*

**(vi) Prawns** : *Parapenaeopsis stylifera, Metapenaeus affinis, M, dobsoni, M. monoceros, Penaeus indicus, P. canaliculatus, P. monodon, P. semisulcatus and P. latisulcatus.*

**(vii) Timber borers** : *Dicyathifer manni, Teredo furcifera, Nausitora hedleyi, Bankia carinata, B. campanellata, Martesia striata, Sphaeroma terebrans, S'. annandalei, S. walkeri and Lydorus pedicellatus.*

**(viii) Chaetognatha** : *Sagitta enflata, S, pulchra and S. bipunctata.*

**(ix) Pelecypods** : *Musculista arcuatula and Solen sp.*

**(x) Pisces** :

Order CLUPEIFORMES

Suborder CLUPEIDAE

Subfamily DUSSUMIERIINAE

1. *Dussumieria acuta* (Val.)

Subfamily CLUPEINAE

2. *Sardinella fimbriata* (Val.)

Subfamily PELLONULINAE

3. *Ehirava fluviatillis* Deraniyagala

Subfamily DOROSOMATINAE

4. *Anadontostoma chacunda* (Ham. & Buch.)
5. *Nematalosa nasus* (Bloch)

Subfamily COILINAE

6. *Stolephorus indicus* (Van Hasselt)
7. *S. commersonii* Lecepede
8. *Thryssa setirostris* (Broussonet)
9. *T. hamiltonii* Gray
10. *T. purava* (Ham. & Buch.)
11. *T. mystax* (Schneider)
12. *T. malabarica* (Bloch)

Suborder ELOPOIDEI

Family ELOPIDAE

13. *Elops machnata* (Forskal)

Family MEGALOPIDAE

14. *Megalops cyprinoides* (Broussonet)

Order ANGUILLIFORMES

Family OPHICHTHIDAE

15. *Opichthus microcephalus* Day

Order CYPRINIFORMES

Family CYPRINIDAE

16. *Rasbora daniconius* (Ham.)
17. *Danio aequiinnatus* (Me Clelland)
18. *Puntius filamentosus* (Val.)
19. *P. amphibius* (Val.)
20. *P. vittatus* Day
21. *Barbodes sarana* (Ham.)

Order SILURIFORMES

Family ARIIDAE

22. *Arius maculatus* (Thunberg)
23. *A. thalassimus* (Rupell)
24. *A. subrostratus* Val.
25. *A. dussumieri* Val.

Family SILURIDAE

26. *Callichorus* sp.

Family PLOTOSIDAE

27. *Plotosus lineatus* (Thunberg)

Order ATHERINIFORMES

Family HEMIRAMPHIDAE

28. *Zenarchopterus dispar* (Val.)
29. *Z. buffonis* (Val.)
30. *Hyporamphus xanthopterus* (Val.)
31 *H. limbatus* (Val.)

Family BELONIDAE

32. *Xenentodon cancila* (Ham.)

33. *Tylosurus crocodilus* (Peron & Lesueur)

34. *T. strongylurus* (Van Hasselt)

Family CYPRINIDONTIDAE

35. *Panchax lineatus* (Steindachner)

Order GASTEROSTEIFORMES

Family SYNGNATHIDAE

36. *Dorichthys cunculus* (Ham. & Buch.)

Order CHANNIFORMES

Family CHANNIDAE

37. *Channa punctatus* (Bioch)

38. *C. striatus* (Bloch)

Order SCORPOENIFORMES

Suborder PLATYCEPHALOIDIE

Family PLATYCEPHALIDAE

39. *Platycephalus cantori* Bleeker

40. *P. indicus* (Linn.)

Order PERCIFORMES

Family CHANDIDAE

41. *Ambassis commersoni* Cuvier

42. *A. gymnocephalus* (Lacepede)

Family SERRANIDAE

43. *Cephalopholis pachycentron* (Val.)

44. *Epinephelus malabaricus* (Schneider)

45. *E. diacanthus* (Val.)

46. *E. tauvina* (Forskal)

Family TERAPONIDAE

47. *Terapon puta* Cuvier

48. *T. jarbua* (Forskal)

49. *Pelates quadrilineatus* (Bloch)

Family SILLAGINIDAE

50. *Sillago sihama* (Forskal)

Family CARANGIDAE

51. *Alepes para* (Cuvier)

52. *Carangoides praeustus* (Bennett)

53. *Caranx carangus* (Bloch)

54. *C. sexfasciatus* Quoy & Gaimard

55. *C. ingnobilis* (Forskal)

56. *Scomberoides* sp.

Family LEIOGNATHIDAE

57. *Gazza minuta* (Bloch)

58. *Leiognathus bindus* (Val.)

59. *L. blochii* (Val.)

60. *L. equulus* (Forskal)

61 *L. lineolatus* (Val.)

62. *L. splendens* (Cuvier)

63. *Secutor insidiator* (Bloch)

64. *S. ruconius* (Ham. & Buch.)

Family LUTJANIDAE

65. *Lutjanus argentimaculatus* (Forskal)

66. *L. fulvifiammus* (Forskal)

67. *L. johni* (Bloch)

68. *L. russelli* (Bleeker)

Family GERRIDAE

69. *Gerres abbreviates* (Bleeker)
70. *G. filamentosus* (Cuvier)
71. *G. oblongus* (Cuvier)
72. *G. oyena* (Forskal)
73. *Gerromorpha setifer* (Ham.)

Family LETHRINIDAE

74. *Lethrinus nebulosus* (Forskal)
75. *Daysciaena albida* (Cuvier)

Family SCATOPHAGIDAE

76. *Scatophagus argus* (Linn.)

Family CHAETODONTIDAE

77. *Pomacanthus annularis* (Bloch)

Suborder MUGILOIDEI

78. *Mugil cephalus* Linn.
79. *M. cunnesius* Val.
80. *Liza macrolepis* (Smith)
81. *L. parsia* (Ham. & Buch.)
82. *L. tada* (Forskal)
83. *Valamugil buchanani* (Bleeker)
84. *V. seheli* (Forskal)

Suborder SPHYRAENOIDEI

Family SPHRAENIDAE

85. *Sphyraena jello* Cuvier

Family ACANTHURIDAE

86. *Acanthurus muta* (Cuvier)
87. *Ctenochaetus strigosus* (Bennett)

Family SIGANIDAE

88. *Siganus javus* (Linn.)

89. *S. canaliculatus* (Park)

Family SOLEIDAE

90. *Synaptura commersonii* (Swainson)

91. *Brachiurus orientalis* (Bloch)

Family CYNOGLOSSIDAE

92. *Cynoglossus lida* (Bleeker)

93. *C. bilineatus* (Lacepede)

94. *C. macrostomus* Norman

95. *C. puncticeps* (Richardson)

96. *C. lingua* Ham. & Buch.

97. *Paraplagusia bilineata* (Bloch)

Family CICHLIDAE

98. *Etroplus suratemis* (Bloch)

99. *E. maculatus* (Bloch)

Family ANABANTIDAE

100. *Anabas testudineus* (Bloch)

Family ATHERINIDAE

101. *Pranesus duodecimalis* (Val.)

Family APOGONIDAE

102. *Apogon thermalis* Cuvier

Family POMADASYDAE

103. *Pomadasys hasta* (Bloch)

Family POMACENTRIDAE

104. *Pomacentrtts cyanmos* Bleeker

Family GOBIIDAE

105. *Glossogobius giuris* (Ham.)

106. *G. biocellatus* (Val.)

107. *Acentrogobius reichei* (Bleeker)

108. *A caninus* (Val.)

109. *A. cynomos* (Bleeker)

110. *A. chlorostigmatoides* (Bleeker)

111. *Bathygobius fuscus* (Ruppell)

112. *Oxyurichthys microlepis* (Bleeker)

113. *O. tentacularis* (Val.)

114. *Oligolepis acutipennis* (Cuv. &Val.)

Family TAENIDIDAE

115. *Odontamlyopus rubicundus* (Ham. & Buch.)

116. *Brachyamblyopus urolepis* (Bleeker)

Family TRYPAUCHENIDAE

117. *Trypauchen vagina* (Bloch & Schneider)

Family BOTHIDAE

118. *Pseudorhombus triocellatus* (Bloch)

Family ELEOTRIDAE

119. *Eleotns fusca* (Schneider)

120. *Butis butis* (Ham. & Buch.)

Order TETRADONTIFORMES

Family TRIACANTHIDAE

121. *Triacanthus brevirostris* (Temm & Schleg)

Family OSTRACIANTIDAE

122. *Ostracion lentiginosa* Bloch

Family TETRADONTIDAE

123. *Tetradon immaculatus* (Bloch & Schneider)

124. *Arothron hispidus* (Lacepede)

125. *Chelonodon patoca* (Ham. & Buch.)

**(xi) Aves :**

Family PELECANIDAE

1. *Pelecanus philippensis philippensis* — Gmelin-Grey/Spotted billed Pelican

Family PHALACROCORACIDAE

2. *Phalacrocorax niger* (Vieillot) — Little Cormorant

3. *Anhinga rufa melanogaster* Pennant — Indian darter.

Family FREGATIDAE

4. *Fregata minor alotabrensis* Mathews — Lesser Frigate Bird

Family ARDEIDAE

5. *Ardea cinerata rectirostris* Gould — Eastern Grey Heron

6. *Ardea purpurea rectirostris* Gould — Eastern purple Heron

7. *Bubulcus ibis coromandus* (Biddaert) — Cattle Egret

8. *Egretta alba modesta* (Gray) — Eastern Large Egret

9. *E. intermedia intermedia* (Wagler) — Indian smaller Egret

10. *E. garzetta garzetta* (Linn.) — Little Egret

11. *E. gularis schistacea* (Hemprich & Ehrenberg) — Indian reef heron

12. *Nycticorax nycticorax nycticorax* (Linn.) — Night Heron

13. *Ixobrychus cinnamameus* (Gnielin) — Chestnut Bittern

14. *I. sinensis sinensis* (Gmelin) — Yellow Bittern

15. *Dupetor flavicollis flavicollis* (Latham) — Black Bittern

Family ANATIDAE

16. *Dendrocygna javanica* (Horsfield) — Lesser/Common Whistling Teal.
17. *Anas crecca crecca* Linn. — Common Teal
18. *A. querquedula* Linn. — Blue winged Teal
19. *Aythya nyroca* (Guldenstadt) — White eyed Pochard

Family ACCIPITRIDAE

20. *Haliboster indus indus* (Boddaert) — Brahminy Kite
21. *Haliaeius leucogaster* (Gmelin) — Whitebellied Sea eagle.
22. *Circus aeruginosus aeruginosus* (Linn.) — Marsh Harrier
23. *Pandion haliaetus haliaetus* (Linn.) — Osprey/Fish Hawk

Family FALCONIDAE

24. *Falco peregrinus japonensis* Gmelin — Eastern peregrine Falcon
25. *F. tinnunculus tinnunculus* Linn. — European Kestrel

Family RALLIDAE

26. *Amaurornis phoenicurus phoenicurus* (Pennant) — Whitebreasted waterhen.
27. *Porphyrio porphyrio poliocephalus* (Latham) — Purple cooler Gallinule

Family HAEMATOPODIDAE

28. *Haemotopus ostralegus ostralegus* Linn. — Oyster catcher/Seapie

Family CHARADRIIDAE

29. *Charadrius ostralegus leschenaultii* Lesson — Large Sand Plover
30. *C. dubius curonicus* Gmelin — Little ring Plover
31. *C. alexandrinus alexandrinus* Linn. — Kentish Plover
32. *C. mongolus atrifrons* Wagler — Pamirs Lesser Sand Plover

Sub Family SCOLOPACINAE

33. *Numenius phaeopus phaeopus* (Linn.) — Whimbrel

34. *N. arguata* (Linn.) — Curlew

35. *Tringa totanus eurhinus* (Oberholser) — Redshank

36. *T. stagnatilis* (Bechstein) — Marsh sandpiper

37. *T. nebularia* (Gunnerus) — Greenshank

38. *T. glareola* Linn. — Wood or spotted sandpiper

39. *T. hypoleucos* (Linn.) — Common sandpiper

40. *Capella stenura* (Bonaparte) — Pintail snipe

41. *C. gallinago gallinago* (Linn.) — Common or Fantail Snipe

42. *Calidris minutus* (Leisler) — Little stint

43. *C. testaceus* (Pallas) — Curlew stint/Pigmy sandpiper

44. *Limicola falcinellus falcinellus* (Pontoppidan) — Broad billed sandpiper

Family LARIDAE

45. *Larus ichthyaetus* Pallas — Great black-headed Gull

46. *L. brunnicephalus* Jerdon — Brown-headed Gull

47. *L. ridibundus* Linn. — Black-headed or Laughing Gull

48. *Chlidonias hybrida indica* (Stephens) — Indian whiskered tern

49. *Gelochelidon nilotica nilotica* (Gmelin) — Gull-billed Tern

50. *Hyproprogne caspia caspia* (Pallas) — Caspian Tern

51. *Sterna hirundo* Linn. — Common Tern

52. *S. albifrons* (Saundersi Hume) — Black shafted Ternlet

53. *S. bengalensis bengalensis* Lesson — Indian Lesser crested Sea Tern

54. *S. bergil velox* Cretzschmar — Large crested Sea Tern

Family PSITTACIDAE

55. *Psittacula krameri manillensis* (Bechstein) — Rose-ringed Parakeet

56. *P. cyanocephala cyanocephala* (Linn.) — Western blossom-headed Parakeet

57. *Loriculus vernalis rubropygialis* (Stuart Baker) — Malabar Lorikeet

58. *Surniculus lugubris dicruroides* (Hodgson) — Indian Drongo-Cuckoo

Family STRIGIDAE

Sub Family STRIGINAE

59. *Strix ocellata ocellata* (Lesson) — Mottled wood owl

Family ALCEDINIDAE

60. *Ceryle rudis travancorensis* Whistler — Travancore Pied Kingfisher

61. *Alcedo atthis taprobana* Kleischmidt — Common Ceylon Kingfisher

62. *Palargopsis capensis capensis* (Linn.) — Brownheaded stork-billed Kingfisher

63. *Halcyon smyrnensis fusca* (Boddaert) — Indian white-breasted Kingfisher

64. *H. pileata* (Boddaert) — Blackcapped Kingfisher

65. *H. chloris vidali* Sharp — Malabar white-collared Kingfisher

Family MEROPIDAE

66. *Merops philippinus philippinus* Linn. — Blue tailed Bee-eater

67. *M. orientalis orientalis* Latham — Common or small Green Bee-eater

Family PICIDAE

68. *Dinopiun benghalense tehminae* (Whistler & Kinnear) — Malabar Golden-backed Woodpecker

Family ALAUDIDAE

69. *Calandrella cinerea dukhunensis* (Sykes) — Rufous short toed Lark

70. *Alauda gulgula australis* Brooks — Small Nilgiri Skylark

Family HIRUNDINIDAE

71. *Hirundo rustica gutiuralis* Scopoli — Eastern Swallow

Family DICURIDAE

72. *Dicurus adsimilis macrocercus* Vieillot — Black Drongo

73. *D. arneus arneus* Vieillot — Bronzed Drongo

Family ARTAMIDAE

74. *Artamus fuscus* Vieillot — Ashy swallow Shrike

Family CORVIDAE

75. *Corvus splendens protegatus* Madarasz — Ceylon house Crow

Family CAMPEPHAGIDAE

76. *Coracina novaehollandiae macei* (Lesson) — large Indian Cuckoo-Shrike

77. *C. melanoptera sykesi* (Strickland) — Black-headed Cuckoo-Shrike

78. *Pericrocotus cinnamomeus malabaricus* (Gmelin) — Malabar small mini vet

Family MUSCICAPIDAE

79. *Rhipidura aureola compressiorostris* (Blyth) — Southern white-browned Fantail Flycatcher

80. *Terpsiphone paradisi leucogaster* (Swainson) — Paradise flycatcher

81. *Prinia subflava franklinii* Blyth — Nilgiri long tailed/Wren Warbler

82. *Orthotomus sutorius guzurta* (Latham) — Tailor bird

83. *Acrocephalus stentoreus brunnescens* (Jerdon) — Indian Great Red Warbler

84. *Copsychus sattlaris ceylonensis* Sclater — Southern Magpie-Robin

Family MOTACILLIDAE

85. *Anthus novaseelandiae richardi* Vieillot — Richard's Pipit

86. *Motacillaflava thunbergi* Billberg — Grey-headed yellow Wagtail

87. *M. flava simillima* Hartert — Short tailed Grey-headed yellow Wagtail

88. *M. flava beema* (Sykes) — Blue-headed yellow Wagtail

89. *M. madraspatensis* Gmelin — Large Pied Wagtail

Family PLOCEIDAE

90. *Petronia xanthocollis xanthocollis* (Burton) — Yellow throated Sparrow

91. *Ploceus philippinus travancorensis* Whistler — Travancore Baya/ Weaver bird

92. *P. manyarflaviceps* Lesson — Streaked Weaver bird

## DISCUSSION

Physico-chemical parameters recorded earlier from 1977 by various authors upto the present investigation in 1991 clearly indicate that temperature fluctuations are noted mostly during the monsoon period from July to September. The minimum temperature recorded was 26.5°C. During the rest of the period temperature values were in the range of 29°C – 32°C. With reference to salinity values, there is a sudden decline from August onwards extending upto December, ranging from 8 – 17‰. The rest of the period values were in the range of 26 – 30‰. pH values were always in the range of 7.4 to 8.2 with minor fluctuations during the monsoon months. With reference to dissolved oxygen values the range was between 4 and 4.6ml/l without much variations.

Thresamma Mathew and Balakrishnan Nair (1980) made detailed phytoplankton studies indicating 52 species of phytoplankton with *Pleurosigma* sp. being present throughout the year. *Fragilaria* sp. occurred throughout the monsoon months. Abundance of algae was during the monsoon months, characterized by low salinity. High salinity was recorded in April coinciding with very low phytoplankton crop. Lowering of salinity and enrichment of nutrients during the southwest monsoon are mainly responsible for the abundance of phytoplankton.

Zooplankton investigations made by Divakaran *et al.* (1982) indicated the presence of freshwater, brackish water and marine forms. Similar to phytoplankton they were subjected to wide seasonal fluctuations with a major density peak during the monsoon and a minor peak during the post monsoon periods. Crustaceans constituted the bulk of the community and others like coelenterates; polychaetes, Chaetognaths, tunicates, fish eggs and larvae were frequently obtained in small numbers. During the present investigations, the post monsoon survey and a pre-monsoon survey revealed the following copepods namely, *Mesocyclops* sp. and *Paradiaptomus* sp,, ostracods and amphipods, *Pseudodiaptomus* sp. and *Acartia* sp. with mysids, amphipods and crustacean larvae represented the post-monsoon survey sample. On the other hand during pre-monsoon survey plankton was represented with copepods like *Paracalanus* sp., and *Centropages*

sp., and Chaetognaths. During monsoon period few cladocerans like, *Moina micrura* and *Diaphanosoma sarsi* were encountered. Ranimary Jacob (1994) recorded the cladocerans, *Evadne tergestina, Penilia avirostris, Ceriodaphnia cornuta, Moina micrura, Diaphanosoma sarsi, Bosminopsis deitersi* and *Chydorus barroisi* from Ashtamudi Lake (Personal communication).

Benthic community was represented with polychaetes during the pre-monsoon period along with amphipods, isopods, pelecypods and oligochaetes in small numbers. However Divakaran *et al.* (1982) have made detailed studies on the distribution and seasonal variation of the benthic fauna of Ashtamudi Lake. As per their studies benthic faunal density ranged between 1480 to 195410/$m^2$ with peak abundance during monsoon. Polychaetes and amphipods constituted the bulk of the benthic population along with the isopods, pelecypods and oligochaetes. Among the polychaetes identified *Nereis* sp., *Diopatra* sp. and *Prionospio* sp. were common.

Studies pertaining to ecology of wood boring sphaeromatids and on the timber destroying organisms were also carried out by Dharmaraj and Balakrishnan Nair (1979, 1981).

As a result of the present investigation along with the earlier investigation of Balakrishnan Nair *et al.* (1983) revealed the occurrence of 125 species of fishes in Ashtamudi Lake. During the present investigation, based on the collections it is seen that only estuarine and marine forms are available indicating the saltwater domination in the lake. 15 species have been recorded during the monsoon period, 34 during post-monsoon and 27 species during pre-monsoon period. The maximum number of examples have been collected during the second survey (post-monsoon – 624). With reference to numbers of examples of each species maximum number was collected for *Etroplus maculatus* (151) followed by *Ambassis commersoni* (148). The other species that have a good number of examples are *Ariits maculatus* (89), *Gerres filamentosus* (93), *Liza parsia* (87), *Terapon puta* (69) and *Secutor insidiator* (63). Of the 97 species recorded by Balakrishnan Nair *et al.* (1983), 69 are commercially important, and among the 39 families, 12 contribute substantially to the fisheries. The pearlspot (*Etroplus suratensis*) and the mullets are the most abundant forms having considerable market value and contribute appreciably to the landings. *Etroplus* sp. and *Chanda* sp. are available all round the year. Mullets are most abundant during December – January. Gobiids are seasonal with a peak-fishing season during April – June. Anchovies are also seasonal and are landed in large quantities during July – October. Economically less important groups such as gobiids, anchovies, chandids, leiognathids, gerrids and theraponids constitute a rich raw material which can be utilized for the production of fish meal, fish protein concentrate.

Next to fishes crustaceans are represented in fairly good numbers by the occurrence of five species of prawns and two species of crabs. Among the prawns, *Penaeus indicus, P. semisulcatus, P. laticaudatus, Metapenaeus dobsoni,* and *Parapenaeopsis stylifera* are the major species encountered in the samples. On the whole, 1199 examples have been

collected. *P. indicus* and *M. dobsoni* have been collected from the samples during the period of pre-monsoon as well as post-monsoon. On the other hand *P. semisulcatus* was collected only during the pre-monsoon period. During the post-monsoon period *P. laticaudatus* was common. With reference to crabs, *Scylla serrata* and *Portunus pelagicus* were found and a total of 158 examples have been collected during the survey. Suseelan and Kathirvel (1982) recorded nine species of prawns with a major representation of *P. semisulcatus, P. indicus, P. latisulcatus, M. dobsoni* and *M. monoceros.*

Mollusca is represented with 80 examples of gastropods, 92 examples of bivalves and 6 examples of cephalopods in the present investigation. *Crassostrea madrasensis, Meretrix casta.Villorita cyprinoides, Gafrarium tunidium, Paphia malabarica, P. marmarata,* and *Donax cuneatus* were the common bivalves collected in the present study. *Trochus niloticus, Turbo murmoratus, Strombus canarium, Thais bufo* and *Oliva gibbosa* represented the gastropods. Cephalopods namely, *Sepia aculeata, S. brevimana* and *Loligo duvaucali* were also noted. The amphibia (2 numbers) collected belonged to the species of *Rana hexadactyla.* Coelenterates in general were limited in numbers with a representative of scyphomedusae. In the total number of examples the maximum was recorded during the fourth survey (pre-monsoon – 1521) followed by the second survey (post-monsoon – 950).

## CONCLUSION

1. The natural vegetation like mangroves and other estuarine plants are considerably depleted by human interference. Artificial silt-bunds are erected to cultivate coconut plantations.

2. Retting of coconut husk for coir industry is prevalent all along the backwaters. The toxic ret liquor from the coconut husk enters the wetlands in huge quantity,

3. The discharge of untreated effluents from industries situated nearby have to be treated.

4. Kallada River brings in effluents discharged into it by Punalur Paper mills. The quantitative and qualitative studies on these effluents have to be investigated to know the impact on the fauna and flora.

5. Pollution from oil spillage from several mechanized fishing boats plying in this area is quite alarming. In one particular area (Karettakadavu) many fishes (*Arius* sp.) smelling with kerosene have been collected, which are unfit for consumption where many kerosene-operated boats are plying.

6. Complaints regarding letting of effluents by Titanium complex in Chavara area are to be investigated.

7. Recent studies on radioactivity and mutations are of serious concern.

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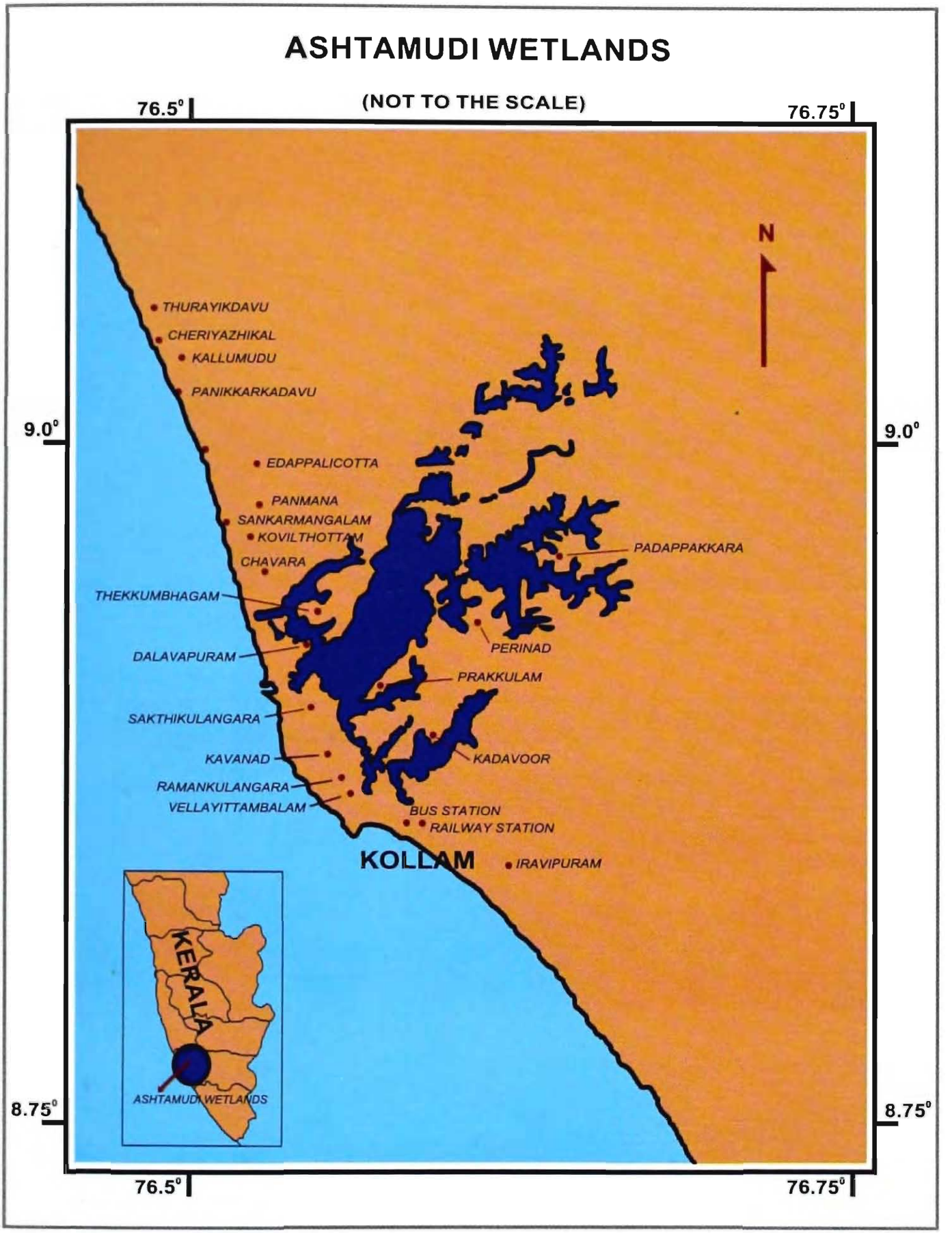


**Fig. 1 :** Location map of Ashtamudi Wetlands

## COLLECTION LOCALITIES

Chambranikadavu

Karettakadavu

## COLLECTION LOCALITIES

Thevalli Road Bridge

Departmental Boat

## FISHING ACTIVITIES IN ASHTAMUDI WETLANDS