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Advances in Applied Science Research, 2013, 4(6):173-177



Studies on the physico-chemical status of Kottakudi Mangrove Estuary, Thiruppullani, Ramanathapuram district, Tamil Nadu

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ABSTRACT

The present study was conducted on the physico-chemical parameters of the Kottakudi Mangrove Estuary, Thiruppullani, Ramanathapuram District, Tamil Nadu. Mangrove and estuaries are the fertile ecosystem serving nursery and feeding ground to the many marine organisms. However the water quality parameters of the particular environment are prime factor which determining the growth of mangroves, breeding and spawning periodicity of the many marine shell and fin fishes. The present investigation the water quality parameters (Temperature, pH, salinity, dissolved oxygen, biochemical oxygen demand, total dissolved solids, total suspended solids, nitrite, nitrate, phosphate and ammonia) showing seasonal variation and it is pertinent to say that the variations recorded during the present study may be due to the environmental fluctuations in relation with season.

Keywords: Mangrove, estuary, seasonal variation, Physico-chemical and species impact.

INTRODUCTION

Estuarine and coastal areas are complex and dynamic aquatic environment. When river water mixes with seawater, a large number of physical and chemical processes take place, which may influence of water quality. The quality of surface water is a very sensitive issue. The natural processes, such as precipitation inputs, erosion, weathering of crustal materials, as well as the anthropogenic influences viz., urban, industrial and agricultural activities, calling for increasing exploitation of water resources, together determine the quality of surface water in a region. Gemma Evangeline [1] has studied the hydrobiology of the estuaries and backwaters of Ramanathapuram district, Tamil Nadu. Rivers play a major role in assimilation or carrying off of municipal and industrial wastewater and runoff from agricultural land, the former constitutes the constant polluting source whereas the later is a seasonal phenomenon. To establish the spatial and temporal variations in water quality, regular monitoring programs are required.

MATERIALS AND METHODS

Study area

The area under present study is Kottakudi Mangrove estuary [KME] lies between latitude which is $9^{0}15'05.81$ "North and Longitude $78^{0}49'50.43$ " East in Thiruppullani, Ramanathapuram, Tamilnadu. The location map of the selected station is presented in the [Figure 1]. The average depth of the three stations is about 1.5 to 3.5m.Four species of mangrove were recorded from KME. In terms of overall abundance, *Avicenna marina* species was the most

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dominant followed by *Lumnitzera recemosa and Pemphis acidula*. Surface water samples were collected at four seasons (Premonsoon- July, August and September; Summer-April, May and June; Post monsoon-January, February and March; Monsoon-October, November and December) from KME in the year of 2012 for the estimation of various physico-chemical parameters.



Figure 1. View of Kottakudi mangrove estuary (source: www.earthgoogle.com)

Collection of the water samples and analysis

The study was carried out over a period of 12 months i.e. from January 2012 to December 2012. Four seasons have been recognized in calander year viz. pre monsoon (July-September), Monsoon (October-December), Post monsoon (January-March) and summer (April-June). Throughout the study period, sampling of water was carried out on the basis during the last week of every month. Sampling was done usually during the morning hours between 8.30-10:30 am. The samples were collected monthly on 3rd of every month between 9.00 to 10.00 am. Water samples were taken from both stations by using acid washed polypropylene containers of 1 liter capacity from depth of 15-30 cm below the surface water, by gently wading the polythene cans into the water. Samples were analyzed by adopting the procedures outlined by standard methods. Water temperature was measured by mercury thermometer. pH was measured by digital pH meter (Elico pH-13 model). Salinity was estimated by Argentometric titration method. Total Solids a well mixed sample is evaporated in a pre-weighed dish and dried on a hot plate at 98°C. The increase in weight over that of the empty dish represents the total solids. The total dissolved solids a well mixed sample is filtered and the filtrate is evaporated to dryness in a weighed dish at 98°C. The increase in dish weight represents the total dissolved solids the TDS was calculated and expressed in mg/L. Dissolved oxygen, particulate organic carbon, inorganic nitrate, nitrite, phosphate, BOD and ammonia were determined by standard procedures by Trivedy and Goe [2]; APH [3].

RESULTS AND DISCUSSION

Temperature and p^H

When the river water mixes with sea water, some changes take place, which may influence the water quality [4]. The physico-chemical parameters showed noticeable seasonal variations, which may be attributed to the local climatic conditions and water exchange mechanism. Variations in nutrient contents and other physico-chemical characteristics of the study stations depend on several factors such as days of sampling, time of sampling and nature of effluents discharged to the sampling stations before or during the sampling. Temperature is one of the important factors in the ecosystem, which may influence the distribution and abundance of flora and fauna. The water

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temperature values varied from 20°C to 33.5°C. The highest and lowest values were observed during pre-monsoon (August) and monsoon (November) seasons, respectively. Higher temperature values recorded in the dry season may be because of heat raising temperature of surface water. In monsoon season cloudy sky and rainfall brought down the temperature to the minimum [5].

The pH values showed no marked fluctuations. It remained alkaline (6.3-7.8) throughout the study period in all the seasons. Highest and lowest values were observed during pre-monsoon (July) and monsoon (December) seasons, respectively. Higher acidity during pre-monsoon was due to the uptake of CO2 by photosynthesizing organisms. Lower acidity during the monsoon season may be due to the influence of fresh water influx, low temperature and organic matter decomposition [6]. The observed salinity values ranged from 0.1ppt to 2.3ppt. The highest value was noticed during monsoon (June) and lowest value during post-monsoon (December) seasons.

Salinity and Dissolved Oxygen

The observed salinity values ranged from 0.1 ppt to 2.3ppt. The highest value was noticed during monsoon (October) and lowest value during post monsoon (March) seasons. In the present study, the lower salinity was recorded during post-monsoon season which may be due to large quantity of freshwater inflow resulting in the dilution of water and hence causes reduction in salinity [7]. The salinity of water indicates the presence of ionic substances that may come from the reaction of metals and acids containing in water. A marked seasonal change in salinity was observed throughout the study period. Minimum salinity (5.6%) was recorded during monsoon and was slowly increased during post monsoon and attained maximum (33%) during summer seasons. Salinity of the KME showed positive correlation between temperature and pH while it showed negative correlation with dissolved oxygen . The salinity act as a prime factor among the most important environmental parameters in the distributions of living organisms. The salinity variation in the exchange of ions and nutrients because of the tidal flow and low during the monsoon season in the KME. The intrusion of neritic water and low river discharge may be responsible for high salinity, the monsoonal rain and continuous flow of the freshwater of the rivers may be responsible for low salinity in the present study in conformity with the earlier reports from Vellar estuary [8].

Dissolved oxygen (DO) in KME was varied between 3.5 and7.2 ml/L. Minimum DO was recorded during Summer(June) the and maximum in Monsoon (December). Statistical analysis showed that dissolved oxygen had a negative correlation with water temperature, salinity and pH. Dissolved oxygen (DO) contents showed well marked seasonal variations in the study area. It seemed to be controlled by various factors such as rainfall, temperature, phytoplankton photosynthesis and salinity. Dissolved oxygen content was high during monsoon period in the study area could be due to the influx of fresh water during the monsoon, higher solubility and low salinity. Similar observations in DO values have also been reported from the Vellar estuary August 2011[9].

Biochemical Oxygen Demand

Biochemical Oxygen Demand (BOD) depends on temperature, extent of biochemical activities, concentration of organic matter and such other related factors. During the study period, BOD was observed to be in the range 1.982.61mg/l. Maximum value of BOD was recorded in pre monsoon (July) period and the minimum was observed in monsoon (November) period. In postmonsoon period due to low temperature prevailing in winter and low bacterial activity, higher levels of DO were encountered. This indicates a fall in BOD levels. So the observed BOD value was < 3mg/l, which is within the permissible limit. Maximum value of BOD was observed in pre monsoon period due to the maximum biological affinity at elevated temperature and low in winter [10] and reduced flow of river water.

Total Dissolved Solids and Total suspended solids

Total Dissolved Solids (TDS) of surface water varied from 12.55 to 63.85 mg/l, which is within the permissible limits. The TDS value was maximum in pre monsoon (September) period and minimum was observed in post monsoon (January) period. TDS value is higher in summer than the rainy and winter seasons due to fishery waste water inflow into the study area. Total Suspended Solids (TSS) varied from 0.38 to 1.48 mg/L. The maximum value was observed in monsoon (December) period and the minimum was observed in post monsoon (March) period. In monsoon period the TSS value was high due to floating materials like fine silt and detritus carried by rainwater from the catchment.

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Nitrite, Nitrate, Phosphate and Ammonia

Nutrients are considered as one of the most important parameter in the estuarine environment. It influences the growth, reproduction and metabolic activities of the living beings. Distribution of nutrients is mainly based on the seasons, tidal condition and fresh water inflow from land sources. During the monsoon season the nutrients (both nitrogen and phosphorus) were added mainly from the irrigation run off, river discharge rainfall and tidal conditions [11]. But during the non- monsoon season nitrogen derivatives were coming more from the retting zones through fishery form waste and entry of sea water into study area. The nitrite value fluctuated between 13 mg/L to 28 mg/L in the study area. Higher value of nitrite concentration was recorded during the monsoon (October) season and low values are observed during the Summer (April) season.

Nitrate is an essential nutrient but at high concentration is toxic and is capable of disturbing the aquatic environment. Nitrate level less than 0.5 mg/L will not pollute the water [12]. A nitrate value varies from 2 to 6 mg/L. The higher nitrate value recorded during monsoon (December) season may be due to heavy rainfall, land runoff contaminated with fertilizers from the surrounding coconut gardens and paddy fields and rubber plantations. Inorganic nitrite concentration was found to be lower than nitrate probably due to its very stable nature and it perhaps gets immediately converted to ammonia or nitrate and evaporated and its seasonal distributions was similar that of nitrate [13]. Its concentration was high during the monsoon season and low during the summer (May) season. Peak value of nitrate during the monsoon season may be attributed to the influence of seasonal flood similar to Pennar estuary, Nellore, and low value during summer season might be due to the lesser amount of freshwater inflow and high salinity [14].

The phosphate content was recorded between 3.7 mg/l to 8.6 mg/L. Inorganic phosphate registered its peak value during the monsoon (December) season and low during summer (April). Low value during summer (April) could be attributed to the limited flow of fresh water and high salinity similar to Uppanar estuary. Higher monsoonal value may be due to heavy rainfall, land run off from agricultural fields contaminated with super phosphates and from soap and detergents used by the public for bathing and washing clothes [14]. Free Ammonia a registered a minimum value 0.6 mg/L during monsoon (October) seasons and the maximum 1.8 mg/L during summer (May) season. Regarding ammonia nitrogen maximum was observe in the summer and monsoon seasons due to entry of sea water and the estuary run off carrying large amount of detritus [14].

CONCLUSION

The physico-chemical condition of the Kottakudi Mangrove estuarine waters of Thiruppullani, using this methodology is good quality in general. The present study Water temperature, pH, Salinity, Dissolved oxygen, Biochemical Oxygen Demand, Total Dissolved Solids ,Total suspended Solids, Nitrite, Nitrate, Phosphate and Ammonia was found to be slightly monthly-wise variation. However in general, this variation will not affect the growth mangrove species. The variation in physico-chemical parameters mainly depends on monsoon rains. The fluctuations in physico-chemical parameter influence the natural activity and efficiency of marine organism.

Acknowledgements

Authors are indebted to Mohamed Sathak Educational Institutions-Kilakarai and the Principal, Syed Hameedha Arts and Science College- Kilakarai, for providing all the financial/ technical/ practical support & friendly guidance for this experimentation.

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