

Studies on the sediment characteristics of the estuaries around Madras in relation to environmental degradation ✓

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SUMMARY

Studies on the role of sediments in a natural water body in element cycles, transportation of nutrients and contaminants and preservation of water quality are important for the understanding of an aquatic ecosystem. In estuaries, the distribution of macrofauna is mainly dependent on the nature of sediment characteristics. Hence, a detailed study was undertaken on the sediment chemistry of the Pulicat, Ennore and Adyar estuarine systems in Madras region during 1984-85. The present in-

vestigation included the texture, pH, total P & N, available P & N and organic carbon of these estuarine sediments. The specific objective was to assess the degree of environmental degradation in these ecosystems.

The study revealed that environmental deterioration was evident from various sediment characteristics in Adyar and Ennore estuaries when compared to pollution free Pulicat lake.

Key Words : Sediment, Adyar, Ennore, Estuaries, Pulicat.

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Introduction

The lake Pulicat, one of the few large coastal lagoons in the country and the comparatively small Adyar and Ennore estuaries exhibited unique ecological features. The general physical and topographical features of the lake Pulicat (Raman, *et. al.*, 1975), Adyar estuary (Chacko and Ganapati, 1949)

and Ennore estuary (Evangeline and Subbiah, 1968) are fairly well documented.

A few observations on selected physico-chemical features of waters of these ecosystems are available (Sreenivasan and Pillay, 1972; Kaliyanurthy, 1974; Raman, *et. al.*, 1975, 1977; Joseph, *et. al.*, 1982, 1984). But no comprehensive account on studies made

simultaneously on the physico-chemical features of soil of these biotopes is available. So an attempt was made in this study to arrive at a clear picture of the variations in the physico-chemical characteristics of soil of these ecosystems. The specific objective was to assess the level of environmental deterioration of these ecosystems which are major source for several commercially important brackishwater species of fish and prawn.

Materials and Methods

Sediment samples were collected from the three estuaries once in three months during 1984-85. A portion of the sample was oven dried at 100-105°C over-night for physical and chemical analysis. The dried samples were ground and sieved initially through a 2 mm and then through an 80 mesh sieve. Organic carbon was estimated by taking 0.5 g of the sediment (Atkinson, *et. al.*, 1958). Sample preparation for the estimation of total phosphorus and total nitrogen was done by double acid fusion method using sulphuric acid and perchloric acid. Total phosphorus was determined by colorimetric method using aminonaphthal sulfonic acid-reduced molybdo-phosphoric blue colour method. Total nitrogen was determined by modified Kjeldahl method (Jackson, 1967). The mechanical analysis of sediment was done following the International pipette method (Piper, 1966).

The pH of the soil (1:2.5 soil water suspension) was measured by a pH meter. The sediment samples were analysed for extractable phosphorus (available) using 0.002 NH_4SO_4 solution as extractant (Trouw, 1930). The available nitrogen was determined by

alkaline permanganate distillation method (Subbiah and Asija, 1956).

Observations and Discussion

Results of the analysis of sediments collected from Pulicat, Ennore and Adyar estuaries are given in Table I. The soil texture was found to be 'sandy loam' in Pulicat and Ennore while the Adyar sediment was 'sandy clay loam' in texture. The clay content was

TABLE 1. Physico-chemical features of sediments of Pulicat, Ennore and Adyar estuaries during 1984-85. (Average values are given in parenthesis).

Parameters	Estuaries		
	Pulicat	Ennore	Adyar
Sand (%)	68.0-79.0 (74.8)	68.0-76.0 (72.2)	50.0-60.0 (55.0)
Silt (%)	14.0-20.5 (16.5)	14.0-16.5 (14.8)	12.5-20.0 (18.2)
Clay (%)	6.25-11.5 (8.7)	9.5-18.0 (13.0)	21.5-35.5 (26.8)
pH	8.0-8.2 (8.1)	7.6-7.9 (7.7)	6.1-6.5 (6.3)
Organic carbon (mg. g^{-1})	2.4-6.0 (3.8)	6.6-12.8 (8.7)	11.2-19.2 (13.8)
Total nitrogen (mg. g^{-1})	0.12-0.29 (0.17)	0.19-0.97 (0.55)	0.53-1.65 (0.93)
Total phosphorus (mg. g^{-1})	0.70-1.75 (1.06)	1.41-3.08 (2.48)	3.08-5.56 (4.13)
Available nitro- gen (mg. g^{-1})	0.06-0.09 (0.067)	0.06-0.09 (0.069)	0.08-0.12 (0.093)
Available phos- phorus (mg. g^{-1})	0.02-0.03 (0.036)	0.11-0.15 (0.125)	0.15-0.18 (0.163)

higher in Adyar sediment compared to other estuaries. This may be due to the effluxion of sewage into the Adyar estuary and the existence of more or less static condition in this estuary due to the closure of lake mouth by sand bar. The black alluvial deposits and decaying organic matter at the bottom of the estuary also merits mention here.

The sediment was found to be acidic in reaction in Adyar showing the influence of sewage accumulation in this estuary. Both for sediment and for water a slightly alkaline pH has been considered favorable for fish production (Banerjee, 1967; Joseph, *et al.*, 1981; Ramakrishna, *et al.*, 1982). The higher pH values observed at Pulicat indicated the highly buffered and uncontaminated nature of the system, while a near neutral range of pH values at Ennore indicated a slight deviation from the proper balance of the estuarine system.

The bottom of Adyar estuary was covered by a thick layer of sludge formed probably due to disintegration of precipitated suspended materials. A complete deoxygenation caused by disintegration of putrescible settled sludge is possible as there is no fast currents to replenish oxygen deficiencies due to the closure of bar mouth, preventing tidal action in this estuary. Putrescible organic matter which settle at the bottom undergo decomposition intensely during summer thereby liberating various gases depending upon the intensity of disintegration. Ammonia along with hydrogen ions (ionised from different sources) are the main products of such organic substances. The exchangeable cations such as calcium, magnesium, sodium, potassium,

etc., already present in the sediment (linked with humus) are exchanged, depending upon the nature of cations or anions available and their concentration, thereby allowing free cations to be consumed by aquatic life for their growth (Ray and David, 1966). This fact is evidenced by the dense growth of algal population observed in Adyar particularly during summer.

Sediments in Adyar had higher content of total phosphorus and available phosphorus compared to other estuaries. This can be explained further by the fact that phosphorus of marine origin dominated in the estuary with almost no freshwater influx during the high saline period and this is similar to the results observed by Rochford, (1951), according to whom, in a normal estuarine system, phosphorus will be at the maximum in both freshwater and marine zones although their derivatives in these zones are quite different. In sediments, phosphorus can exist as calcium phosphate, organic phosphate, orthophosphate dissolved in the interstitial water, iron phosphate and phosphate absorbed on silicates (Serruya, 1971). In all the three estuaries, total phosphorus showed a direct correlation with organic carbon of sediments ($r=0.9284$ at 1% level) and this highly significant positive correlation suggest that detrital phosphorus is another fraction of the phosphorus in the estuarine sediment.

The available phosphorus content was lowest in Pulicat while it was highest in Adyar. The values observed in the Adyar and Ennore estuarine sediments for total and available phosphorus are comparable to those reported by Nair, *et al.*, (1987), for sediments of polluted estuaries in India.

In Pulicat the observed values for organic carbon from the sediments were generally low. Higher values in Adyar and Ennore sediments revealed that allochthonous input of organic matter through sewage into these two systems were high.

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