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Nutrient dynamics in the sediments of Kerala coast

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ABSTRACT

Kerala is one of the smallest states in India which is situated in the south west coast of the country. Sediment samples from four prominent areas of Kerala Coast were collected and analyzed for nutrients. Variation of nutrients was highlighted according to the distributional characteristics of the designated sites. Nutrient trend in Cape, Trivandrum, Kollam was in the order as Ammonia > Nitrite >Nitrate, where as Cochin showed the trend as Ammonia > Nitrate > Nitrite. Greater concentration of ammonia in the entire sediments showed the ammonification of nitrogen compounds.

Keywords: Kerala Coast, nutrient, ammonia, nitrite, nitrate.

1. Introduction

Nutrients are the important constituents of living things necessary for the survival and growth of aquatic plants which are the base of the food chain for all other aquatic organisms. The nutrients that limit plant growth in most aquatic systems. Nutrient concentrations in aquatic systems are influenced by both natural and human sources. Natural sources of nitrogen include decomposition of organic matter, nitrogen fixation of atmospheric nitrogen by certain bacteria and algae, and geologic formations rich in nitrogen. Human sources include discharges from wastewater treatment plants, storm water runoff, livestock wastes, fertilizer runoff from lawns and agricultural fields, groundwater seepage from failing septic systems, planting of nitrogen fixing plants in agricultural fields, and atmospheric deposition from the burning of fossil fuels.

Coastal and estuarine environments are the most productive ecological systems on earth. The coast is ever changing and is inhabited and pressurized by a relentlessly growing and increasingly demanding human society. The industrial establishments and human settlements along the west coast of India necessitate an evaluation of the type and quantum of inputs to the Arabian Sea as well as the regional assimilative capacities. The physiographic setting of Kerala presents a variety of gradients between the Western Ghats and the nearly 600 km of shoreline. About 320 km of the coast is subjected to dynamic processes of land erosion and accretion. The coastal waters are not only rich in biodiversity but also support the livelihood of a large number of people dependent on the coastal ecosystem, particularly the fishing communities.

The quantum of pollution caused by untreated sewage in the coastal marine system is alarming since rivers, backwaters and the sea are interconnected. Pollution of one water body naturally gets transmitted to next one ultimately resulting in coastal pollution. Also industrial and wastewater discharge in to the coastal area drastically affect the overall biological health

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of coastal area. Since occurrence and abundance of phytoplankton indicate water quality in terms of pollution and is thus significant in the exploitation of fishery potential. Measurement of primary productivity is essential for the estimation of fish production and potential of exploitable fisheries (Boyd *et al.,* 1979). Chemical characteristics, especially nutrient prevailing in the water column play crucial role in biological characteristics Malone (1980). Nutrients are necessary for adequate growth and production of phytoplankton. Studies on primary productivity, chlorophyll *a* and plankton characteristics at certain areas of west coast of India are studied by Rajagopalan *et al* (1992), Varsheny *et al.,* (1983), Rany Mary *et al.,* (1987), chlorophyll *a* by Saraladevi *et al.,*(1997), Desai *et al.,* (1984) and plankton distribution was studied by Subramanyan (1959).The present study focus on the distribution of nutrients(Ammonia, Nitrate and Nitrite)in selected stations of Kerala coast.

2. Materials and methods

2.1 Study area and sampling

Eleven sediment samples were collected in cruise no. 267 in FORV Sagar Sampada on 29th May 2009 to 4th June 2009 from Tuticorin to Cochin. Sediments were collected from four identified stations [Cape (1), Trivandrum (4), Kollam (4) and Cochin (2)] of Kerala coast, India (Figure. 1). Description of the location sites were given in Table1. Surficial sediment samples were collected using a Van veen grab, sealed, transported to the lab and stored in deep freezer. Sediments were air dried, finely powdered and used for chemical analyses. Textural characteristics and nutrient distribution were analysed.

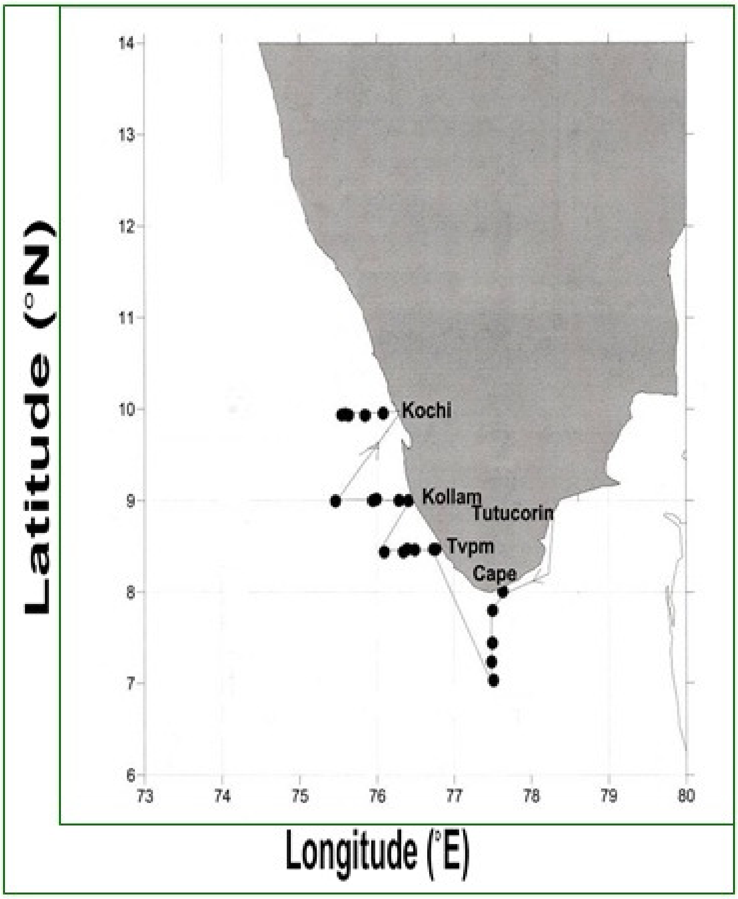

Figure 1: Location map of sampling site

Table 1: Description of sampling sites

Transect	Depth(m)	Location
Cape1(M1)	50	0747.64^{0}N,7730.177^{0}E
Trivandrum1(M2)	30	0830.048^{0}N,7650.874^{0}E
Trivandrum2(M3)	50	0830.040^{0}N,7643.831^{0}E
Trivandrum3(M4)	100	0828.117^{0}N,7629.712^{0}E
Trivandrum4(M5)	200	0827.902^{0}N,7624.012^{0}E
Kollam1(M6)	50	099.010^{0}N,0756.851^{0}E
Kollam2(M7)	90	0859.353^{0}N,0756.043^{0}E
Kollam3(M8)	100	0900.034^{0}N, 7617.013^{0}E
Kollam4(M9)	200	0900.084^{0}N,07623.524^{0}E
Cochin1(M10)	<200	957.77^{0}N,7616.919^{0}E
Cochin2(M11)	<100	959.213^{0}N,7616.084^{0}E

2.2 Analytical procedure

Texture was determined using pipette analysis (Lewis. 1984). All the nutrients were estimated sphectrometerically (using UV-Vis Hitachi 150-20). Nitrite was converted to an azo dye with sulphanilamide and N- (1-naphthyl) ethylene diamine dihydrochloride (Grasshoff, 1983). Nitrate was reduced to nitrite and estimated as nitrite. (Grasshoff, 1983). Ammonia was determined by indophenols blue method using citrate buffer (Koroleff, 1983).

3. Results and discussion

Nutrient levels in an aquatic system vary depending upon temperature, rainfall, runoff, biological activity, and the flushing of the aquatic system. Nutrients enter aquatic ecosystems via the air, surface water, or groundwater (Figure 2). The mechanisms that control the dispersal and fate of land-derived nutrients discharged to coastal waters must be understood if the risks to marine ecosystems (i.e. sedimentation, turbidity and eutrophication) are to be identified and managed.

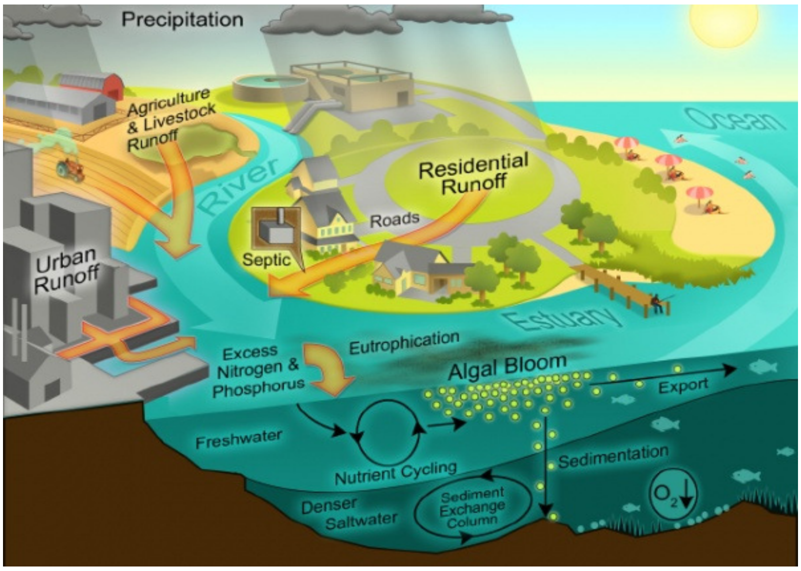

Figure 2: Nutrient Sources

The productivity of many coastal marine systems is limited by nutrient availability, and the input of additional nutrients to these systems increased primary productivity.In moderation in some systems. The biologically available nutrient component (e.g. dissolved inorganic nitrogen) is rapidly taken up by phytoplankton as the reduced turbidity increases light availability for primary production (Dagg et al., 2004; Davies, 2004; Rabalais et al., 1996; Robertson et al., 1993; Turner et al., 1990). Particulate nutrients in fine terrestrial sediments are also an important component in biogeochemical cycles (Brodie et al., 2011; Furnas et al., 2005) and account for 60–80% of the total terrestrial nutrient load to the water body (Furnas,2003; Kroon et al., 2012).Nutrient dynamics gives the measure of quality of the system. The site profile of nutrient (Figure 3) and texture (Figure 4) revealed a negative correlation between them. In the stations Cape, Trivandrum and Kollam the distribution of nutrient was in the order as ammonia > nitrite >nitrate. But at Cochin it was ammonia > nitrate > nitrite. The concentration of ammonia is greater in all the analyzed region.This is due to the reduction of nitrogen compound to ammonia.Sediment may provide transport and removal of nutrient by means of adsorption, ionexchange, coprecipitation, complexation and chelation.Neither of the nitrite and nitrate are precipitated as adsorption compound,they all converted to ammonia by disimilatory reduction.C/N ratio and Total organic carbon values from the previous study in this area (Manju.P.Nair and Sujatha C.H 2012) also agree with these results.

The social and economic consequences of nutrient over-enrichment include aesthetic, health, and livelihood impacts.Nutrient enrichment can have beneficial impacts such as increasing fish production; however, more generally the consequences of nutrient enrichment for coastal marine ecosystems are detrimental. Many of these detrimental consequences are associated with eutrophication.The increased productivity from eutrophication increases oxygen consumption in the system and can lead to low-oxygen (hypoxic) or oxygen-free (anoxic) water bodies. This can lead to fish kills as well as more subtle changes in ecological structure and functioning, such as lowered biotic diversity and lowered recruitment of fish populations. Current work reveals the ammonification of sediments in the studied sites , this will in turn lead to the lethal effect on these ecosystem.

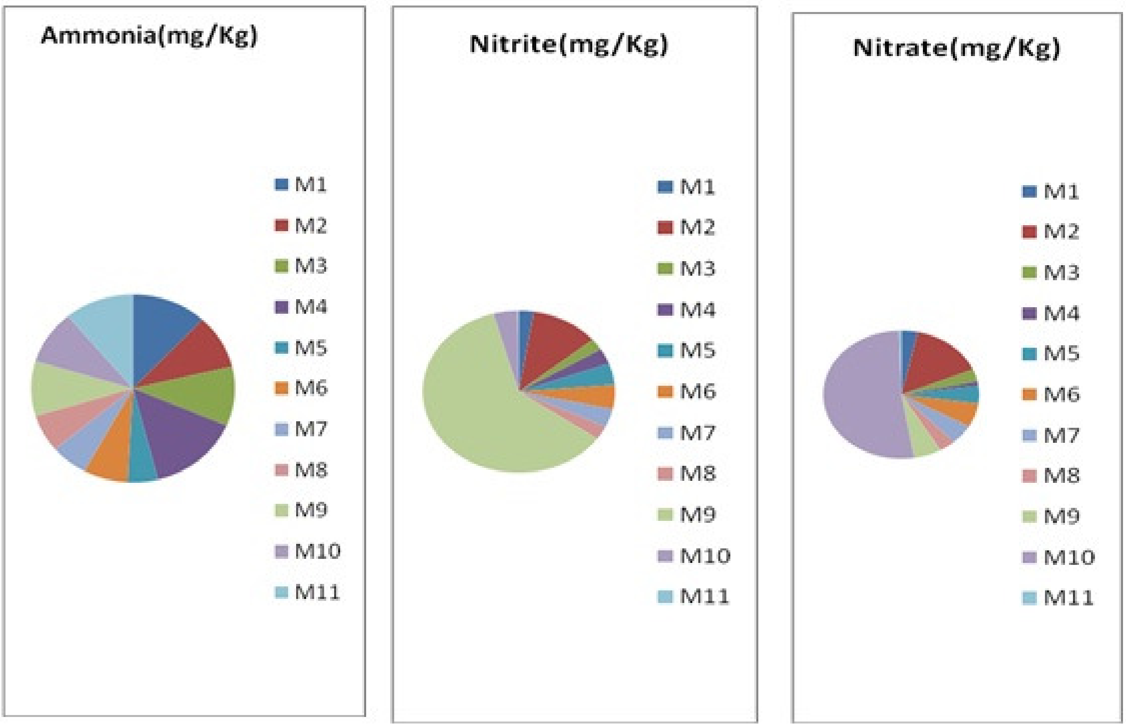

Figure 3: Nutrient Distribution

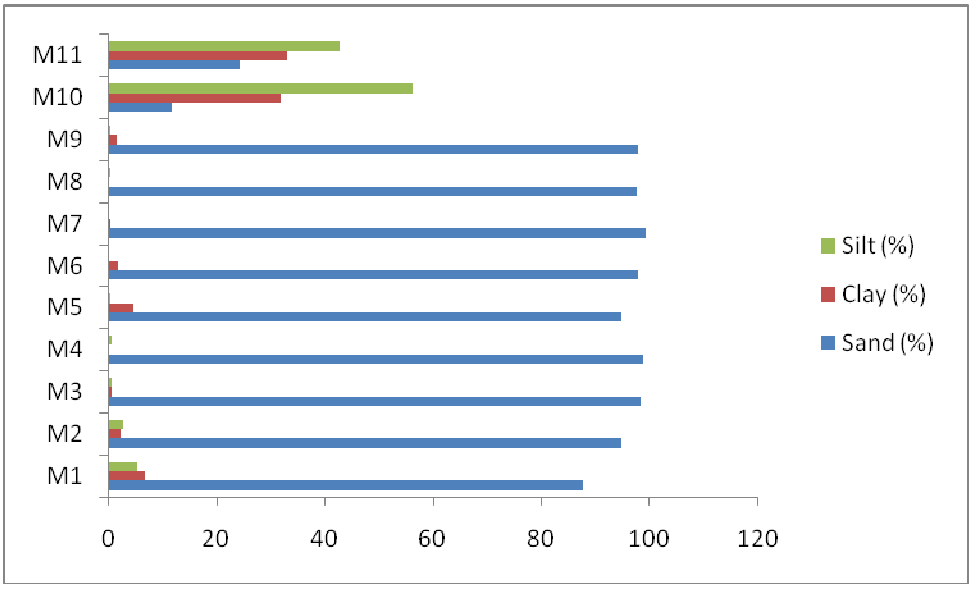

Figure 4: Site profiles of Texture

4. Conclusion

From the studies conducted revealed a negative correlation between nutrient and texture. Trend of nutrient in Cape, Trivandrum.Kollam was in the order as Ammonia > Nitrite >Nitrate. But at Cochin it showed as Ammonia > Nitrate > Nitrite. The concentration of ammonia is greater in all the analyzed regions. This is due to the reduction of nitrogen compound to ammonia by disimilatory processes. Ammonification of sediments in the studied sites will in turn lead to the lethal effect on this ecosystem. C/N ratio and Total organic carbon values from the previous study in this area also agree with these results.

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