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SEASONAL VARIATION IN NUTRIENT LOAD OF WATER ALONG THE RATNAGIRI COAST, MAHARASHTRA, INDIA.

KEYWORDS: Environment, Nitrate, Nitrite, Nutrient, Phosphate, Pollution.

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ABSTRACT *It is well known that the seasonal climatic changes in the marine environment play a significant role in the ecological cycle of the Indian seas, especially the Arabian Sea. The nutrient contents in any coastal water determine its potential fertility and therefore, it is important to gather information about their distribution and behavior in different coastal ecosystems. The nutrients like nitrogen, phosphorus, are considered to be more important than the others, as they play a key role in phytoplankton abundance, growth and metabolism. Therefore studies pertaining their seasonal variation become important part.*

In present study the water samples were collected from five selected sampling stations along the Ratnagiri coast for the monsoon, pre monsoon and post monsoon period during February 2011 to January, 2012. Various nutrients like sulphate (SO4-) phosphate (PO4-), Nitrate (NO3-) and Ammonia (NH3) were analyzed to assess the spatial and temporal variation in the quality of sea water. Present study revealed that Ratnagiri coastal water is polluted from diffuse and direct sources ofagricultural, urban and industrial pollutants.

Introduction:
Domestic sewage and industrial effluents are discharged in the water courses in and around India in untreated or partially treated form. These, add a variety of pollutants which include certain toxic heavy metals and metalloids (Sankpal and Naikwade, 2012a). India is predominantly an agricultural country hence large quantities of pesticides, herbicides, fungicides, etc. are used in agriculture which indirectly causes water pollution.

Hydro biological studies by Sinha and Shrivastava (1992), have shown that urbanization is the root cause of water pollution. Rapid industrialization and tourism related activities in the coastal zone, disposal of municipal wastes, industrial wastes and numerous recreational and commercial activities that not only degrade the quality of coastal water but also pose a serious health hazard to marine biotas and human (Rama Devi et al., 1996). The fluxes of trace elements that have been modified biogeochemically in estuaries and coastal waters are transported to the open ocean and the original composition of seawater is altered (Ackroydet al., 1986; Saageret al., 1997). Nutrients are the dissolved inorganic forms of Sulphate, Nitrates, Phosphates etc. utilized by photosynthetic organisms in the formation of organic matters (Sahaet.al., 2001). Nitrogen and phosphorus are described as being biolimiting elements because the concentrations of these elements limit biological growth (Ghoshet. al., 1992).

Material and Methods:
Ratnagiri district is one of the most important maritime districts of the Maharashtra state. Most of the activities in this area are connected with sea. Recently several chemicals, pharmaceuticals companies and some power plants are grown up along the coastal region. Developmental activities like Konkan Railway Project, Enron electricity project, proposed marine highway, Cargo Ports are attracting more tourism industries in this region which directly or indirectly causes Environmental Pollution. The marine area is presently the receiving waters for a variety of effluents which may be potentially contaminating, including elevated levels of pollutants. Hence it is necessary to evaluate water quality and aquatic life of Ratnagiri coast.

Four sampling stations were selected along the Ratnagiri coast based on the different activities carried out in the areas. Water samples were collected in plastic containers from the selected sites seasonally, (Pre-monsoon – February to May, Monsoon – June to September and Post-monsoon – October to January) and stored in a refrigerator at 4oC temperature prior to their analysis.The dissolved nutrients such as Nitrate, Nitrite, Ammonia, Phosphate and Silicate were analyzed according to APHA (1995) and Trivedi and Goel (1986).

The distribution and behavior of nutrients in the coastal environment exhibit considerable variations depending upon the local conditions such as rainfall, quantum of fresh water inflow, tidal incursion and also biological activities like phytoplankton uptake and regeneration.

Results and Discussion:
In present study the Nitrate values are lower during pre-monsoon and post monsoon period and high during monsoon season (Table 3.15). The highest value was 23.97 mg/l at S1 during monsoon and lowest was 11.12 mg/l at S4 during pre-monsoon period. The nitrate values are high during monsoon period; it is attributed to the mixing of solid runoff which contains the amount of fertilizers used in the vicinity for mango, cashew and rice agriculture land.

Levels of nutrients, such as nitrogen, affect the overall health of an aquatic ecosystem and can have both positive and negative effects (Caffreyet al, 2003), depending on their concentrations. The increased nitrates level was due to fresh water inflow,mangrove leaves litter fall decomposition (Karuppasama and Perumal, 2000) and terrestrial run off duringthe monsoon season. Anotherpossible way of nitrates entry is through oxidation of ammonia form ofnitrogen to nitrite formation (Rajasegar 2003)

Sulphate values observed higher during monsoon season while lower during post monsoon period. Value ranges from 1.34 to 5.17 mg/l during pre-monsoon, 1.65 to 2.72 during post monsoon and 2.07 to 4.73 during monsoon period. High value was observed at site S4 throughout the study period. The port activity take place at this site may be responsible for the high

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values. In the present study Sulphate showed irregular trend over the period. It is an important constituent of hardness with calcium and magnesium. Trace amount of sulphide are present in surface water due to reduction of sulphate. The present study revealed that there is no statistical significant variation between selected stations.Temporal variation in sulphate in coastal waters can be attributed to several factors, more importantly the proportional physical mixing of seawater with freshwater (Ghoshet al, 1992), adsorption of reactive sulphate into suspended sedimentary particles (Praus, 2005).

During pre-monsoon, the phosphate values ranged from 0.11 to 0.15 mg/l and 0.06 to 0.09 mg/l during post-monsoon and 0.38 to 0.27 mg/l during monsoon period. The higher concentration of phosphate in coastal waters might be enriched by freshwater drainage. The addition of super phosphates applied in the agricultural fields as fertilizers and alkyl phosphates used in households, as detergents (Tiwari and Nair, 1993) can be other sources of inorganic phosphates during the season.High concentration of inorganic phosphates observed during monsoon season might possibly be due to intrusion of upwelling seawater into the creek, which increased the level of phosphate (Nair and Ganapathy, 1983). The recorded low phosphates value during summer could be attributed to the limited flow of freshwater, high salinity and utilization of phosphate (Senthilkumaret al. 2002,Rajasegar, 2003) by phytoplankton. The variation may be due to the various processes like adsorption and desorption of phosphates and buffering action of sediment under varying environmental conditions(Rajasegar 2003).

Ammonia is important as the predominant excretory product of aquatic animals and in high density culture high ammonia levels can develop, through NH3 excreted directly and also by degradation of fecal matter and uneaten feed. The effect of ammonia toxicity is high at higher pH, the proportion of unionized ammonia being higher at higher pH.The highest value was 0.09 at site S2 during monsoon period and lowest was 0.02 mg/l at site S4 during pre monsoonperiod. Higher concentration observed during monsoon season for both years. The recorded higher concentration could be partially due to the death and subsequent decomposition of phytoplankton and also due to the excretion of ammonia by planktonic organisms as reported by Sager and Hariharan (1989).

From above study it is concluded that Ratnagiri coastal water is polluted withnutrients from diffuse and direct sources ofagricultural, urban and industrial pollutants.Thismay, consequently, affect aquatic life therefore; proper precaution should be taken to minimize the pollution.

Observation tables:

Table No. 1.1: Seasonal Variation of Sulphate in mg/l.

Sampling Stations	2011-12			2012-13		
	Pre Monsoon	Monsoon	Post Monsoon	Pre Monsoon	Monsoon	Post Monsoon
S_1	11.21	22.50	14.25	14.67	23.97	13.78
S_2	11.29	21.25	12.92	13.8	22.43	13.08
S_3	11.23	23.62	12.88	14.05	23.63	12.85
S_4	11.12	19.67	14.92	10.14	18.57	17.45
S_5	19.12	21.77	13.82	17.78	21.52	15.59
S_6	20.52	20.25	13.42	23.25	19.72	17.53

Table No. 1.2: Seasonal Variation of Sulphate in mg/l.

Sampling Stations	2011-12			2012-13		
	Pre Monsoon	Monsoon	Post Monsoon	Pre Monsoon	Monsoon	Post Monsoon
S_1	2.9	2.0	2.52	3.52	1.65	2.87
S_2	2.57	2.47	2.17	2.45	1.85	2.07
S_3	2.92	1.72	2.27	2.85	1.34	2.03
S_4	3.87	2.72	3.47	4.73	2.65	3.29
S_5	6.47	2.65	3.30	3.20	1.72	2.60
S_6	5.17	2.32	3.40	3.45	2.73	2.32

Table No. 1.3: Seasonal Variation of Phosphate in mg/l.

Sampling Stations	2011-12			2012-13		
	Pre Monsoon	Monsoon	Post Monsoon	Pre Monsoon	Monsoon	Post Monsoon
S_1	0.11	0.28	0.09	0.18	0.30	0.09
S_2	0.14	0.29	0.08	0.21	0.27	0.11
S_3	0.13	0.38	0.11	0.18	0.39	0.14
S_4	0.14	0.29	0.06	0.16	0.38	0.06
S_5	0.15	0.28	0.10	0.16	0.40	0.13
S_6	0.15	0.27	0.09	0.17	0.32	0.13

Table No. 1.4: Seasonal Variation of Ammonia in mg/l.

Sampling Stations	2011-12			2012-13		
	Pre Monsoon	Monsoon	Post Monsoon	Pre Monsoon	Monsoon	Post Monsoon
S_1	0.01	0.06	0.07	0.02	0.05	0.07
S_2	0.04	0.09	0.06	0.04	0.05	0.06
S_3	0.03	0.04	0.06	0.04	0.06	0.05
S_4	0.02	0.04	0.02	0.04	0.04	0.05
S_5	0.03	0.05	0.06	0.03	0.06	0.06
S_6	0.03	0.05	0.05	0.04	0.05	0.05

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