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Original Research Paper

A Comparative Study of Some Chemical and Biological Characteristics of Coastal and Estuarine Waters of Three Regions Along Coastal Maharashtra

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ABSTRACT

The 720 km long indented coastline of Maharashtra, that comprises the coastal districts of Thane, Raigad, Greater Bombay, Ratnagiri and Sindhudurg, is marked by the presence of major estuaries and narrow creeks. These coastal waters receive huge volumes of treated and untreated industrial waste, sewage, etc., thus depleting the water quality along the stretches. In the present study carried out at Mumbai, Dharamtar and Guhagar coast, it was observed that the Mumbai coast is highly affected showing low values of dissolved oxygen and high total dissolved content thereby affecting the productivity of the region.

INTRODUCTION

The coastal cities mostly use the ocean as a site of waste disposal. The pollutant loading in the coastal waters degrades its quality. The waters along the coast of India have witnessed changes due to urbanization, industrialization and tourism (Subramaniam 2011). It has been reported that discharge of untreated and partially treated wastewaters from sewage and effluents from diverse industries have degraded the marine environment along the coast extensively (Zingde & Govindan 2000, NIO Report 1999, NEERI Report 1985, Pereira 1986). Maharashtra has a long coast line extending from Mumbai to Sindhudurg. The present study was carried out to assess the water quality at three locations along the Maharashtra coast. The study is important as coastal and estuarine environments are the most productive ecological systems of the earth and recognized as important to human society and also for human settlement (Jonge & Elliot 2001).

Mumbai is a thoroughly urban city and this island discharges around 2200 MLD of waste to the coastal waters (Zingde & Govindan 2001). The wastewaters discharged in the Mumbai city receive partially treated effluent from wastewater treatment facilities as well as wastewater/sewage from various open drains and nallahs (Khobragade & Sohony 2010). In addition, a large number of industries established in the drainage zones also contribute to pollution loads. The Dharamtar region-lies on the eastern side of the Mumbai harbour. At its entrance lays the Dharamtar creek, which is formed by confluence of Amba river, Karanja creek and Patalganga river on the west coast of Maharashtra. The creek does not receive pollutants through direct discharges though its water quality is largely influenced by the harbour water, which receives domestic wastewaters and industrial effluents. In addition Patalganga river receives a variety of pollutant waters through industrial inputs, and joins the Amba river (Zingde et al. 1989). Guhagar is a city in Ratnagiri district in Konkan region of Maharashtra state. It is a typical Konkani town with beautiful clean beach comparatively unpolluted.

In the present paper an attempt has been made to evaluate the chemical and biological water quality along the coastal region of the three regions, i.e., Mumbai, Dharamtar and Guhagar.

MATERIALS AND METHODS

Sample collection: Water samples were collected from the coast during high tide, and brought to the laboratory for analysis of various biological and chemical characteristics.

Chemical analysis: The pH values of water were measured using pH meter. For suspended solids, 100 mL of sample water was filtered through preweighed millipore filter paper, dried and weighed again. The difference in the weight gave the amount of suspended solids in sample.

Dissolved oxygen was estimated by Winkler's method. BOD, COD and heavy metal contents were analysed using standard methods described by APHA (1998).

Biological analysis: Water samples (500mL) were preserved with Lugol's solution, and analysed later under Nueber's chamber to estimate population density of phytoplankton.

The various species of phytoplankton were noted and identified.

RESULTS AND DISCUSSION

Chemical characteristics: The details of the chemical characteristics of the coastal waters are given in Table 1. Pollution status of any given environment can be assessed either through monitoring of specific pollutant or changes in inherent biotic and abiotic parameters. In case of pollution caused by domestic wastewater including sewage, the degree of pollution can be assessed through changes in some biological and environmental factors, especially enrichment of nutrients (Sawant et al. 2007).

The pH values observed in the Mumbai coast varied from 7.6 to 7.9. The maximum pH observed was in the waters of Dharamtar, which was 8.27. This must be due to influx of effluents entering the waters from the industrial zone around. The waters at Guhagar were slightly acidic with a range in the pH from 6.1 to 6.7 indicating a good quality of water that can sustain life. Though pH value ranging from 5-9 is not directly lethal to fish and other organisms but the toxicity of many pollutants is affected by pH changes. The increasing acidity or alkalinity may make the poisons more toxic (Llyod 1960).

Dissolved oxygen is the most essential component for the marine life. Dissolved oxygen is an important parameter in water quality assessment and it reflects physico-chemical and biological processes prevailing in water. Decrease of DO level in harbour waters suggests higher rate of utilization, which could be due to increase of organic load (Sawant et al. 2007). Its depletion is a limiting factor for many aquatic forms and is probably the most frequent reasons of many water pollution problems (Andrade et al. 2011). In the present study, the DO levels at Mumbai are 3.35 mg/L, at Dharamtar 3.108 mg/L, and at Guhagar 5.6 mg/L respectively.

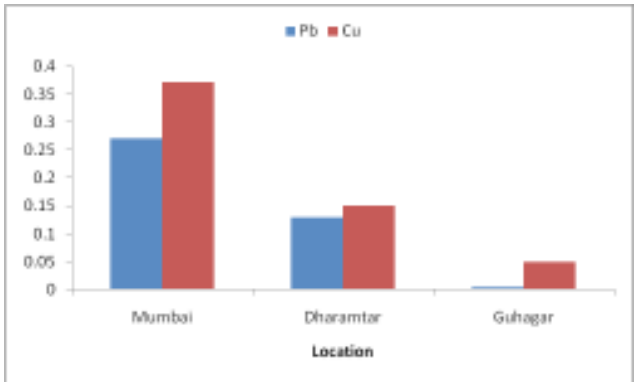

Fig. 1: Average values of heavy metal content in water.

The BOD in the water samples reveal the microorganisms present and their organic load in the water. COD is the measure of the oxygen equivalent of the organic matter susceptible to oxidation by chemical oxidant. Thus, COD can be a reliable parameter for judging the pollution of water (Keramatt 2008). In the present study, BOD and COD levels of the waters in Mumbai are comparatively higher than the waters at Dharamtar and Guhagar indicating a high organic load in the waters. The values range at Mumbai are for BOD 23.25 mg/L and COD 69 mg/L; at Dharamtar, BOD 17 mg/L and COD 40.5 mg/L; at Guhagar, BOD 50 mg/L and COD 18.2mg/L respectively.

Biological parameters: The details of the biological characteristics of the coastal waters are given in Table 2. The productivity of the aquatic ecosystems is determined by the biological characteristics of the water body. The primary productivity plays a vital role in the maintenance of diverse array of organisms in aquatic ecosystems. The phytoplankton or primary producers of the waters trap solar energy and transform it to potential biochemical energy that sustains life in water. The phytoplankton community determines the quality of estuarine waters because they respond quickly to environmental changes and in turn influence the environment (Chavan 2009). They are the food for zooplankton and some fishes, therefore, making their presence obvious with respect to the ecological food chain. Their presence or absence can picture the quality of a whole water body. Thus, the population density and diversity of phytoplankton and zooplankton were studied.

Mumbai waters showed lower population density than Dharamtar and Guhagar waters. The waters along Guhagar coast were most productive with a population density of 2500 to 6350 cells per litre. The phytoplankton cell count at Mumbai was in the range of 190/L to 380/L while that of Dharamtar waters was 979 to 1038 cells per litre. The lower productivity in Mumbai waters coincided with the higher dissolved solids content in the waters that might be obstructing the light penetration resulting in low productivity. Also the nutrients nitrate and phosphate are low. The waters along Dharamtar are also turbid with solid contents of 1270 mg/L and 1490 NTU. The phosphate content in the Dharamtar waters is high indicating a high runoff from the industrial wastes in the waters. The *Skeletonema costatum* and *Nitzschia closterium* are good indicators of pollution. The presence of these species in Mumbai and Dharamtar waters is indication of the deteriorated water quality along the sector. The dominant species present along the Guhagar waters are *Chaetoceros* spp. and *Nitzschia* spp.

The population of secondary producers, i.e., zooplankton was also low in the Mumbai waters. At Dharamtar, the spe-

Table 1: Chemical characteristics of the coastal waters.

Parameters	Mumbai	Dharamtar	Guhagar
pH	7.68-7.93 (7.815)	7.78-8.27 (7.955)	6.1-6.7 (6.4)
TDS (mg/L)	1490-4820	27-480	156-396
DO (mg/L)	<1-4.6 (3.35)	< 1-4.8 (3.108)	5.4-5.8 (5.6)
BOD (mg/L)	5-60 (23.25)	2-28 (17.00)	50-50(50)
COD (mg/L)	16-173 (69)	8-110 (40.5)	7-45 (18.2)
NO_3 (µg/L)	0.034-0.531 (0.38825)	0.037-0.419 (0.0197)	0.044-0.061 (0.052)
PO_4 (µg/L)	1-6 (3)	1.0-18.0 (6.75)	<0.50 -0.50 (0.50)

Table 2: Biological parameters in the coastal waters.

Parameters	Mumbai	Dharamtar	Guhagar
Phytoplankton	190/L to 380/L, *Skeltonema costatum, Nitzschia closterium, Nitzschia ovate, Navicula* spp.	979/L to 1038/L, *Skeletonema* spp., *Nitzschia indicus, Coscinodiscus* spp., *Thallasionema* spp.	2500/L to 6350/L, *Chaetoceros* spp., *Nitzschia* spp., *Navicula* spp. *Coscinodiscus* spp.
Zooplankton	15/L-25/L *Calanus* spp.	45/L-196/L, *Cladocera, Copepoda,* Gastropod larvae, *Globegerina* spp.	67/L-256/L, *Calanus* spp., *Chaetognaths* spp., Mysids, *Zoea* larva, Fish egg, Fish larvae

Table 3: Heavy metal content in the coastal waters.

Parameters	Mumbai	Dharamtar	Guhagar
Pb (µg/L)	< 0.005 - 0.38 (0.26975)	0.005 - 0.290 (0.12825)	0.005 - 0.005(0.005)
Cu (µg/L)	< 0.002 - 0.73 (0.37225)	< 0.002 - 0.56 (0.15525)	< 0.001 - 0.11 (0.05)
Zn (µg/L)	< 0.05 - < 0.05 (< 0.05)	< 0.05 - < 0.05 (< 0.05)	0.05 - 0.005 (< 0.05)
Hg (µg/L)	< 0.0005 - < 0.0005 (<0.0005)	< 0.0005 - 0.0005 (< 0.0005)	<0.0005 - 0.0005 (< 0.0005)

cies observed were Cladocerans, Copepods and Gastropod larvae with a population varying from 45 /L to 196/L. At Guhagar, the population density of zooplankton observed was in the range of 67/L to 256/L with *Calanus* spp., *Chaetognaths* and mysids being the most dominant species. The secondary production in the sectors coincided with the low primary production.

Fig. 1 and Table 3 show the heavy metal content in the waters along the study area. The progress of industries has led to increased emission of pollutants into ecosystems. Metals accumulate in water and move up through food chains. Therefore, the study of the level of heavy metals in environment is necessary to determine potentially hazardous levels for human (Tabari et al. 2010). The average content of lead and copper in the Mumbai waters is high followed by the accumulation in Dharamtar waters and the Guhagar waters. The average values of zinc and mercury in the study area are well below the permissible values.

From this study, it is observed that the pollution load in Mumbai waters is high. The low oxygen content, high BOD, COD content and high solid content coinciding with the low productivity, i.e., low phytoplankton and zooplankton count indicates a deteriorated water quality. The parameters along Dharamtar waters are also high. The presence of the industrial areas around the region may further degrade the water quality if proper mitigation methods are not implicated in time. Conservation of the waters along the Guhagar region is required to sustain the quality of waters along the transect.

Overall, there is an alarming increase in the marine water pollution along the industrial areas. To avoid further deterioration of the waters, timely steps are to be taken by the authorities.

REFERENCES

Andrade, Francis, Aravinda, A.B. and Puttaiah, E.T. 2011. Studies on Mangalore coastal water pollution and its sources. Indian J of Science and Technology, 5(5): 553-557.

APHA 1998. Standard Methods for the Examination of Water and Wastewater. American Public Health Association, Washington DC.

Chavan, Monica R. 2009. Impact of Bombay High Crude Oil on Primary Productivity of Phytoplankton; An Experimental Study. Ph.D. Thesis, University of Mumbai.

de Jonge, V.N. and Elliott, M. 2001. Eutrophication. In: Steele, J., Thorpe, S. and Turekian, K. (Eds.), Encyclopedia of Ocean Sciences, Vol. 2, Academic Press, London, pp. 852-870.

Keramatt, A.A. 2008. Environmental impact of nutrient discharge by aquaculture wastewater on the Haraz river. J. Fish. Aqu. Sci., 3: 275-279.

Lloyd, R. 1960. The toxicity of zinc sulphate to rainbow trout. Ann. Appl. Biol., 48: 84-94.

National Institute of Oceanography 1999. Marine Environmental Studies: Environmental Quality Along the Northwest Coast of India (Coastal Ocean Monitoring and Prediction System) 1997-98 Results. Regional Centre, NIO, Mumbai.

NEERI 1985. Environmental Impact Study for Bombay Port Trust. National Environmental Engineering Institute, Nagpur.

Pereira, Lancelot S.J. 1986. Quality of ocean waters around Mumbai. Caius Laboratory, St. Xaviers College, Mumbai.

Sawant, S.S., Prabhudesai, L. and Venkat, K. 2007. Report on Eutrophication Status of Marine Environment of Mumbai and Jawaharlal Nehru Port Trust. National Institute of Oceanography, Dona Paula, Goa.

Subramaniam, B.R. 2011. Long-term data on coastal pollution and dissemination to academic and research communities. Current Science, 100(1).

Tabari, Sahel, Seyed Soheil, Saeedi Saravi, Gholamali, A., Bandany, Atena Dehghan and Mohammad Shokrzadeh 2010. Heavy metals (Zn, Pb, Cd and Cr) in fish, water and sediments sampled form Southern Caspian Sea, Iran. Toxicol. Ind. Health, 26: 649-656.

Vijay, R., Khobragade, P.J. and Sohony, R. A. 2010. Water quality simulation of sewage impacts on the west coast of Mumbai, India. Water Sci. Tech., 62(2): 279-87.

Zingde, M.D. and Govindan, K. 2000. In: Sharma, V. K. (Ed.) Environmental Problems of Coastal Areas in India, Bookwell Publ., New Delhi.

Zingde, M.D. and Govindan, K. 2001. Health status of coastal waters of Mumbai and regions around. In: Sharma, V. K. (Ed.) Environmental Problems of Coastal Areas in India, Bookwell Publ., New Delhi.

Zingde, M.D., Bhosale, N.B., Narvekar, P.V. and Desai, B.N. 1989. In: Environmental Strategies and Biosciences. Edited by R. Prakash, Society of Biosciences, Muzaffarnagar.