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Baseline

Monitoring of impact of anthropogenic inputs on water quality of mangrove ecosystem of Uran, Navi Mumbai, west coast of India

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ABSTRACT

Surface water samples were collected from substations along Sheva creek and Dharamtar creek mangrove ecosystems of Uran (Raigad), Navi Mumbai, west coast of India. Water samples were collected fortnightly from April 2009 to March 2011 during spring low and high tides and were analyzed for pH, Temperature, Turbidity, Total solids (TS), Total dissolved solids (TDS), Total suspended solids (TSS), Dissolved oxygen (DO), Biochemical oxygen demand (BOD), Carbon dioxide (CO_2), Chemical oxygen demand (COD), Salinity, Orthophosphate (O-PO_4), Nitrite–nitrogen (NO_2–N), Nitrate–nitrogen (NO_3–N), and Silicates. Variables like pH, turbidity, TDS, salinity, DO, and BOD show seasonal variations. Higher content of O-PO_4, NO_3–N, and silicates is recorded due to discharge of domestic wastes and sewage, effluents from industries, oil tanking depots and also from maritime activities of Jawaharlal Nehru Port Trust (JNPT), hectic activities of Container Freight Stations (CFS), and other port wastes. This study reveals that water quality from mangrove ecosystems of Uran is deteriorating due to industrial pollution and that mangrove from Uran is facing the threat due to anthropogenic stress.

Mangroves are one of the biologically diverse ecosystems in the world, rich in organic matter and nutrients and support very large biomass of flora and fauna (Robin and Bazelevic, 1966). Mangrove forests are among the world's most productive ecosystems and cover an area of about 18×10^6 hectares (Spalding et al., 1997). Jitthaisong et al. (2012) have reported that mangrove forests can be used as an additional natural system to increase the efficiency of man-made wastewater treatment system. The conservation, management, and sustainable development of mangroves depend on the maintenance of hydro-geochemical characteristics of the system (Manju et al., 2012). Mangroves ecosystems create a suitable environment by removing and transforming pollutants in wastewater through the processes of sedimentation, filtration, microbial activity, plant absorption, etc. when water passes through mangroves (Wu et al., 2008; Wang et al., 2010).

In India, 0.14% of the country's total geographic area is under mangroves and it account for about 5% of world's mangrove vegetation (Jagtap et al., 2002). The Indian mangroves cover about 4827 Km^2, with about 57% of them along the east coast, 23% along the west coast, and 20% in Andaman and Nicobar Islands (Venkataraman and Wafar, 2005). Anthropogenic activities involving development projects have resulted in depletion of coastal resources, destruction of mangrove habitats, disruption of ecosystem processes, and loss of biodiversity (Vijay et al., 2005).

Mumbai, a major metropolis and one of the world's most populous cities called as the Urbs Prima of India, generates 0.85 millions m^3/d of liquid effluent and 14,600 t/d of solid waste, which without any treatment are discharged in the coastal region in and around Mumbai (Zingde, 1999). Estimates of area of mangroves in Mumbai varied from 248.7 Km^2 (Queshi, 1957) to 200 Km^2 (Blasco et al., 1975) to 92.94 Km^2 (Inamdar et al., 2000) to 26.97 Km^2 (Mukherji, 2002). Zingde (2002) reported that Mumbai has lost 40% of all its mangroves in the past decade because of overexploitation and unsustainable demand for housing, slums, sewage treatment, and garbage dumps.

The hydrobiology of marine ecosystem plays an important role in predicting, locating, and exploiting the marine fishery resources (Asha and Diwakar, 2007). Water quality is an indicator which provides basic information on the health of marine waters and their ability to support the diverse habitats and the wide array of marine species that live in the marine environment. It enables the identification of emerging trends of concern (population growth and pressure of urbanization) and also allows linking how activities on land affect marine water quality (Marine Water Quality, 2013).

The coastal environment of Uran has been under considerable stress since the onset of industries like Oil and Natural Gas Commission, Liquid Petroleum Gas Distillation Plant, Grindwell Norton Ltd., Gas Turbine Power Station, Bharat Petroleum Corporation Limited Gas Bottling Plant, Jawaharlal Nehru Port Trust (JNPT, an international port), Nhava-Seva International Container Terminal (NSICT), Container Freight Stations (CFS), etc. These activities affect

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the quality of mangrove ecosystems of Uran, Navi Mumbai. Although many studies have been undertaken to evaluate the water quality of mangrove ecosystems in India, no scientific studies have been carried out on the water quality of mangrove ecosystems of Uran, Navi Mumbai; hence, the present study is undertaken. Objective of the study is to evaluate the impact of anthropogenic inputs on water quality of mangrove ecosystems with respect to tidal and seasonal variability.

Geographically, Uran (Lat. 18°50′5″ to 18°50′20″ N and Long. 72°57′5″ to 72°57′15″ E) with the population of 23,254 is located along the eastern shore of Mumbai harbor opposite to Coloba. Uran is bounded by Mumbai harbor to the northwest, Thane creek to the north, Dharamtar creek and Karanja creek to the south, and the Arabian Sea to the west. Uran is included in the planned metropolis of Navi Mumbai and its port, the Jawaharlal Nehru Port (JNPT) (see Fig. 1).

The mangrove ecosystem of Uran is a tide-dominated and the tides are semidiuranal. The average tide amplitude is 2.28 m. The flood period lasts for about 6–7 h and the ebb period lasts for about 5 h. The average annual precipitation is about 3884 mm of which about 80% is received during July to September. The temperature range is 12–36 °C, whereas the relative humidity remains between 61% and 86% and is highest in the month of August. Four species of true mangroves representing three genera and three families were recorded during present study. The dominant species are *Avicennia marina*, *Avicennia officinalis*, *Acanthus ilicifolius,* and *Ceriops tagal.* The average tree height is 2.4 m and the canopy coverage is greater than 90%.

The present study was carried out for a period of two years, i.e., from April 2009 to March 2011. Two study sites, namely Sheva Creek, site I (Lat. 18°50′20″ N and Long. 72°57′5″ E) and Dharamtar Creek, site II (Lat.18°50′5″ N and Long. 72°57′10″ E) separated approximately by 10 km, were selected along the coast. At each site, three sampling stations separated approximately by 1 km were established for water sampling.

Surface water samples were collected fortnightly during spring low and high tides in a clean, leak-proof plastic container. Water samples were collected in triplicate from each station, and average value for each variable was reported. The depth of the water column in the study area varies from 2.5 to 3 m. Standard methods described by APHA (2005), Strickland and Parsons (1972) and Grasshoff et al. (1999) were followed for assessment of water quality variables.

pH and temperature of water samples were measured in situ. The pH was measured with an accuracy of ±0.02 pH unit on a battery operated portable Philips pH meter. Temperature of surface

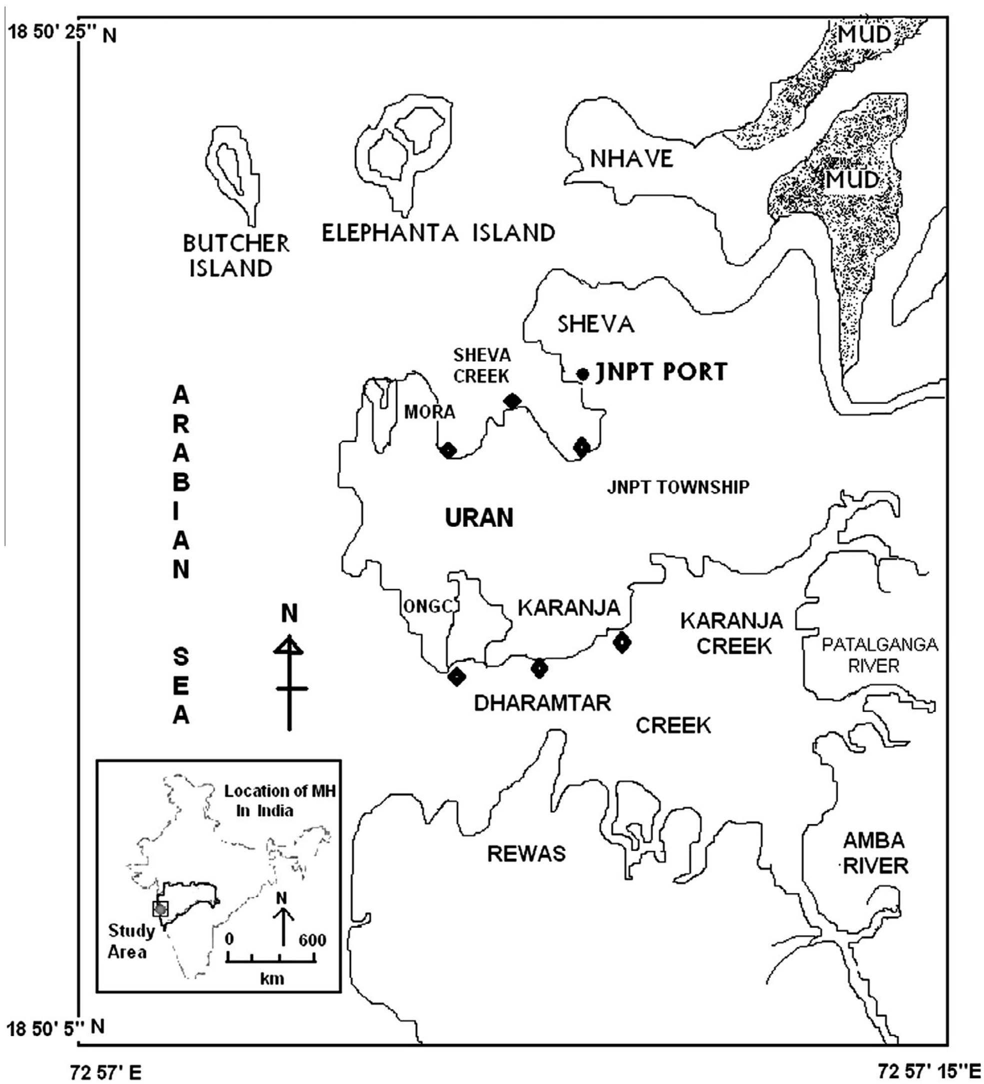

Fig. 1. Location map of study area representing various sampling stations along Sheva creek and Dharamtar creek.