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CHANGING STATUS OF URBAN WATER BODIES AND ASSOCIATED HEALTH CONCERNS IN PUNE, INDIA

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Abstract

Increasing urbanization coupled with industrialization during the past few decades are depleting water ecosystem goods and services irreparably in Pune City, Western India, as indicated by high LPI (Living Planet Index). The present paper assesses the impact of urbanization on the water quality of the rivers Mula, Mutha and Pashan Lake, with a focus on ongoing changes in biotic communities. Habitats and habitat characteristics such as physico-chemical parameters were linked to the occurrence of different species such as mosquitoes. The paper also discusses the 'environmental cost' of nuisance species such as Eichhornia and comments on allied health related aspects. A randomized survey was conducted by interviewing medical practitioners for assessing water borne and vector-borne human disease risks. 'Target species' were identified for easy monitoring and management point of view.

INTRODUCTION

For over thousands of years, human settlements and civilizations have originated, concentrated and thrived around different types of water bodies. It is known that water bodies have played a crucial role in growth and development of human society. However, it is paradoxical that they have undergone degradation in modern times due to various anthropogenic activities. Urban growth, increased industrial activities, intensive farming and over use of fertilizers in agricultural production were identified as drivers responsible for these changes (12). The present paper discusses the impact of urbanization on the water quality of the rivers Mula and Mutha flowing through Pune City, Western India (18 ^{0} 31' N latitude & 73 ^{0} 51' E longitude.). An attempt is made to link occurrence of different species to particular habitats and habitat characteristics such as physico-chemical parameters. The present paper also comments on the water borne and vector borne disease risks associated with degenerating ecosystem health.

Water is an important resource besides being a specialized ecological niche for thousands of different organisms. Monitoring the status of biota as indicators of environmental conditions, detecting threat alarms and adopting mitigating strategies, is both interesting and important (3). 'Urban watch' can be developed by formulating simple, user friendly guidelines to monitor condition and trends in the environment.

MATERIALS AND METHODS

Description of test sites

Pune City is situated on the banks of the rivers Mula and Mutha. These rivers originate along the eastern flank of the Western Ghats of Maharashtra. In their upper reaches, the rivers flow through an environment unaffected by human activities. However, in the downstream urban reaches they are grossly polluted (10). Considering this contrasting environmental situation, sampling stations were established along the course of these rivers to evaluate spatio-temporal variations in water quality. These stations were selected in relation with the point sources of pollution such as outfalls discharging domestic effluents, the industrial effluent release points and the non-point sources such as agricultural runoff areas. The surface water samples were collected as per the standard procedures mentioned and subjected to the different physico-chemical analyses (1).

Identification of target species

Our approach stemmed from the belief that living organisms serve as reliable ecosystem indicators (4). The habitat types were characterized through extensive literature surveys and linked with human impact. Perceptions about the changing environment of the city were noted down by interviewing knowledgeable individuals. Both 'utility' as well as 'nuisance' species were identified by conducting targeted interactions with academicians, researchers, amateur naturalists and local community members. Trends and indicator species were noted in relation to water quality in order to assess the condition and health of aquatic ecosystems.

Documenting health concerns

A randomized survey of medical practitioners and hospitals was conducted. For assessing water borne and vector borne disease risks, government hospital records were referred. Private medical practitioners were interviewed to reveal the health status regarding waterborne diseases.

RESULTS AND DISCUSSION

The population increase in Pune city during the last two decades has been particularly rapid with a consequent effect on the extent of water pollution by sewage. The data available from the Pune Municipal Corporation substantiates this (Fig. 1). To serve the vast population, Pune City has only one sewage treatment plant, which has a capacity of 90 MLD (million litres per day). It was observed during this work that the plant operates with 50% efficiency and remaining untreated effluents are usually

discharged into the rivers directly. Figure 2 shows spatial variations in profile of indicator parameters of water quality. This heavy load of organic waste is known to affect aquatic ecosystem health drastically as evident by gradual changes in species composition (Table 1). During present study, various actors and drivers were identified responsible for depleting ecosystem goods and services. It was found that ecosystem health has deteriorated on the parameters of Biodiversity (10-30%). Kharat et al, 2000-01 (6) and reported changes in the long-term distribution of fish in relation to water quality. Out of 66 species reported, 18 were found to be locally extinct while 11% showed decline in population. This is a more precarious situation considering the Living Planet Index (LPI) (13), which essentially describes declining percentages in populations. Construction activities in flood plains of rivers destroyed breeding grounds of molluscs, amphibians and reptiles. Habitat loss also involves encroachment of ditches and temporary rainwater pools by housing colonies. Study of Pashan lake also provided insight to the changing status of waterbodies. Exotic aquatic weeds like *Ipomoea carnea* have covered the banks, nearly invading the natural ground vegetation. Pollution tolerant birds like little cormorant (*Phalacrocorax niger*) and black winged stilt (*Himantopus himantopus*) have increased; just as have introduced fishes like *Tilapia sp.* that outcompete native fish species (9). Bivalve species preferring unpolluted water are now replaced by pollution tolerant *Bellamya bengalensis* (11).

Figure 1. Population Change and Sewage Generation

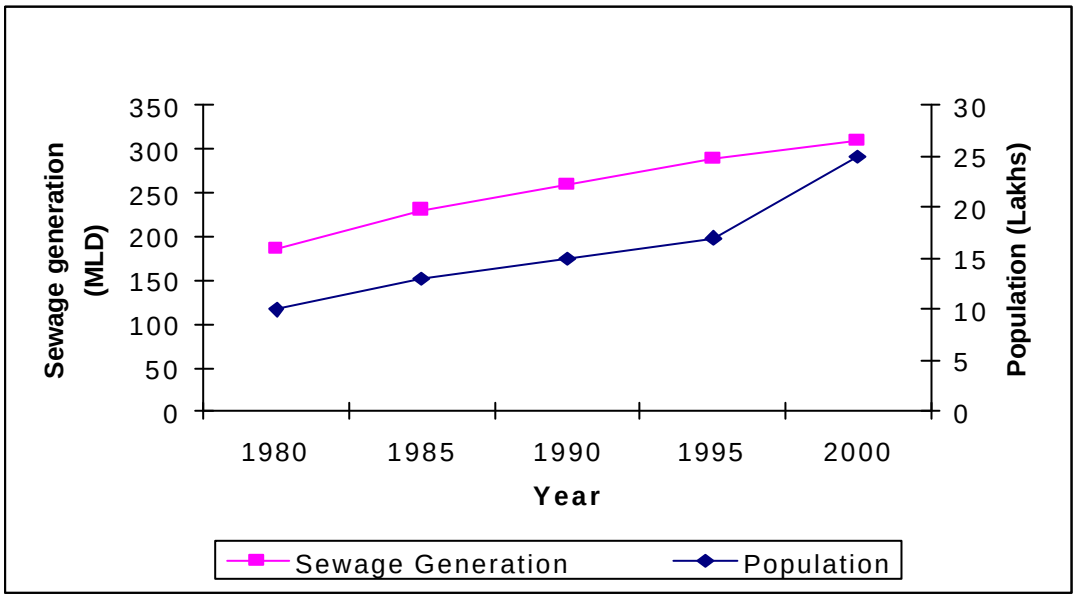


Figure 2. Profile of dissolved oxygen and free carbon dioxide

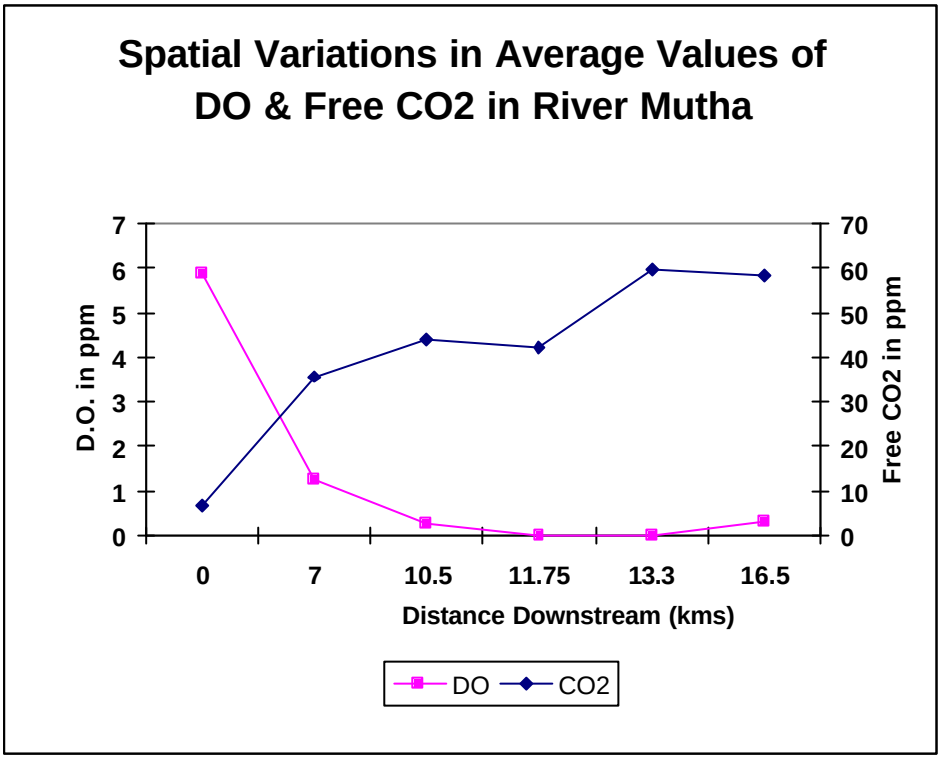


Table 1. Indicator Organisms and Water Quality (2)

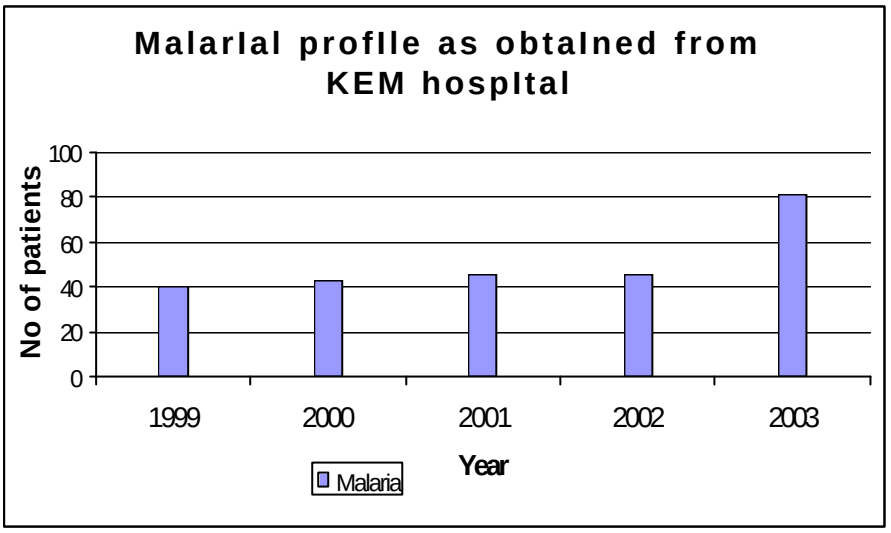
Macroinvertebrates	**Expected BOD level**	**Water quality**
Ephemeroptera (e.g. May fly nymph)	1 or <1	Clean
Odonata (e.g. Dragon fly and Damsel fly nymph)	1 – 5	Slightly polluted
Coleoptera (e.g. Water beetles) Crustacea (e.g. Prawn) Annelida (Leech in particular) Mollusca	5-10 10-15	Moderately polluted Highly polluted

(*Bellamya bengalensis*)		
Annelida (e.g. Sludge worm) Diptera (e.g. Chironomus larvae)	20-30	Excessively polluted
FISHES[1] (e.g. *Ompok pabo, Proeutropiichthys takree takree*)	-	Slightly polluted
FISHES[1] *Heteropneustus fossilis*	-	Highly polluted

[1] Observations based on present study.

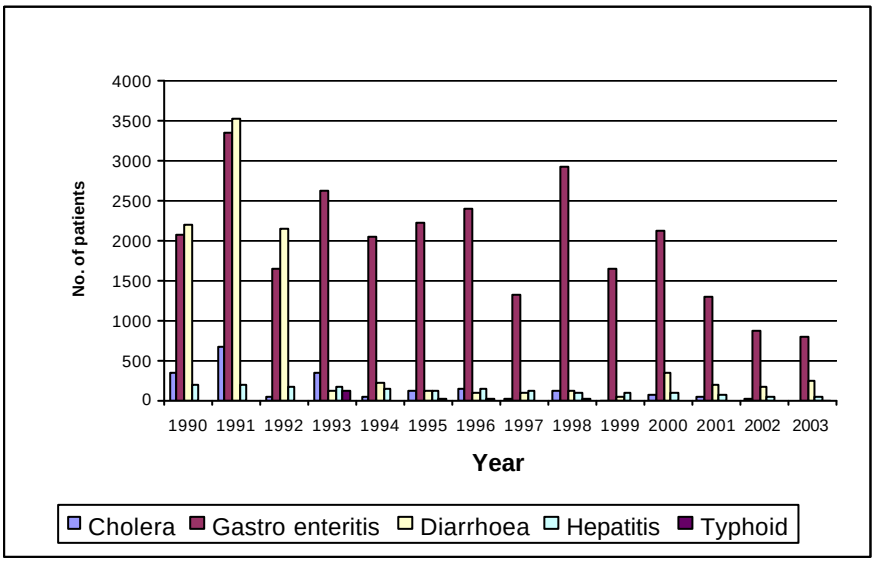
Changes in water chemistry parameters resulted in an increase in nutrient status of water bodies, which in turn supports profuse growth of nuisance species such as *Eichhornia* besides providing suitable habitat for disease vectors. Such nuisance species exert unnecessary economic pressure (1.2 lakh/yr) on local management for its control. There is a hidden cost involved in such cases, where people have to spend money for the control of mosquitoes. The estimated cost for control of the mosquito menace by using commodities such as mosquito repellents is approximately 6 crores/yr for Pune's population. Organically polluted waters of all types are known to support human disease vectors such as *Culex quinquefasciatus* (5,8) which is generally an urban problem and demands constant treatment. Mosquitoes of *Anopheles* genus are not prevalent in urban areas. Still increased incidences of malarial cases have been observed. This might be because malaria is acquired in peri-urban or fringe areas and cases are treated in city hospitals. It is also noticed that this disease is generally associated with lower economic classes. About a two-fold increase in the occurrence of malaria has been observed during last five years as evident by a hospital record (Figure 3). Another potential health hazard for urban population is Dengue fever. A noticeable observation is that the cases of mixed infection of malaria and dengue have been reported this year. A sample survey of two hospitals recorded about 250 cases of dengue this year in Pune. One of the reasons for this could be increased tendency towards water storage coupled with inappropriate storage practices providing breeding grounds for vectors like *Anopheles stephensi* and *Aedes aegypti.* Similar observations were reported by Kumar et al. (7). Areas under vegetation such as hill tops and hill slopes were encroached upon by habitation which further increased exposure risk of different vectors to humans.

Figure 3. Incidences of Malaria over past five years



Interviews with medical practitioners revealed the following trends. Generally, waterborne diseases constitute 20-30 % of all diseases. Peri-urban areas were found to be more prone to amoebiasis and giardiasis (60 % of waterborne diseases) than city areas. Diseases like cholera and diarrhoea showed decreasing trends (Figure 4). While increased incidences of vector borne diseases have been reported over the past few years.

Figure 4. Trends in waterborne diseases



Unfortunately, in developing countries, public health concerns are usually raised on the institutional setting and people participation in monitoring ecosystem health is generally lacking. Focussing on living organisms as indicators of ongoing changes in the environment will ensure people's participation by forming a network of biologists, researchers, amateur naturalists and urban planners. Such decentralized assessment can generate strong scientific arguments which can help, if not guarantee, environmental protection.

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