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# STUDY ON BIODIVERSITY OF SOME MACROPHYTE INFESTED LAKES FROM THANE CITY, MAHARASHTRA

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## ABSTRACT

Different species of flora and fauna exhibit variation in their response to any alteration in the environment and have indicator values. Hence, the high degree of aquatic pollution results in dominance of pollution tolerant species, which leads to change in biodiversity of the specific lake. The three lakes studied showed abundance of three different species of macrophytes namely *Lemna minor, Pistia stratiotes* and *Eichhornia crassipes*. High fluctuation in DO (1.53-9.69 mg/L), $CO_2$ (0-28.16 mg/L), $PO_4$-P (0.0029-0.3000 mg/L) and $NO_3$-N (0.086-0.330 mg/L) were found. Similarly, from total 35 species of phytoplankton observed, 19 were common to uninfested and infested lakes but 16 species were seen only in infested lakes and 12 only in uninfested lakes. Similarly, among the zooplankton rotifers, which are considered the pollution indicators, 10 species were found in infested lakes out of which 4 were common to infested and uninfested lakes, proving the change in biodiversity.

## INTRODUCTION

Certain ecological factors of the environment have pronounced influence in determining the habitat. In freshwater bodies nutrients play a major role, as excess of them lead to eutrophication. The macrophytic vegetation is indicative of the eutrophication status of any water body.

Dense monospecific patches of macrophytes are known to control discharge conditions, regulate carbon and mineral influx, and abundance of invertebrates and fishes (Sand Jenson et al. 1989). Macrophytes exert a multisided effect on the development of the littoral macrozoobenthos. The changes induced in water by macrophytes affect the growth and development of other organisms. The submerged portion of emergent macrophytes and the submerged aquatics may form an enormous substrate for colonization.

Changes in the plant species affect the aquatic vegetation directly and indirectly its associated organisms. These aquatic plants also form an important component of food web. In Thane city out of 15 to 16 existing lakes, few are heavily infested with macrophytes, while others have comparatively clear water due to some remedial measures taken. Some researchers have surveyed these clear lakes for the phytoplankton and zooplankton abundance. However, no survey has been conducted in macrophyte infested lakes. Hence, it was thought to be essential to study the flora and fauna associated with these macrophytes.

## MATERIALS AND METHODS

The three lakes namely Ambegosale, Makhmali and Rewale were selected, which show the dominance of three different macrophytes. The water samples from these lakes were collected fortnightly; the data were pooled together and represented seasonally. The physico-chemical analysis of water samples was performed as per the procedures described in the Standard Methods (APHA 1981) and Trivedy and Goel (1984). The samples for phytoplankton and zooplankton were collected and preserved in 4% Lugol's iodine for further analysis. Macrophytes from above three lakes were also noted down.

## RESULTS AND DISCUSSION

The data on physico-chemical properties of the three lakes are given in Table 1, while Tables 2, 3, 4 provide the occurrences of macrophytes, phytoplankton and rotifers in these lakes. Aquatic macrophytes contribute considerably to the productivity of lakes and play an important role in regulation of the metabolism of aquatic ecosystems (Pieczynska 1976, Marshall & Westlake 1978). The macrophytes increase diurnal variability of ecologically important physico-chemical variables.

The seasonal variation show that the pH of Lake Ambegosale and Lake Rewale was more towards alkaline side than Lake Makhmali. The DO fluctuations in all the three lakes were greatly varied. In Lake Ambegosale, the DO was comparatively higher than other two lakes, i.e. 3.06 to 9.69 mg/L, while in Lake Makhmali it varied from 1.53 to 3.72 mg/L and in Lake Rewale from 2.43 to 7.04 mg/L. In summer the free $CO_2$ was very low in all the lakes, but in other seasons it was very high, ranging from 12.20 to 28.16 mg/L (except in monsoon in Lake Ambegosale).

According to Wilcock et al. (1998) the weed choked streams typically show wide diurnal variations in DO, temperature and pH, extreme values of which can influence the habitat. The macrophytes also inhibit the mixing process, which may lead to variations in different parameters in different pockets. Odum (1957) concluded that when weeds or phytoplankton are abundant the DO in water undergoes wide fluctuations, sometimes, even reaching lower limits. During the present study, continuous weeding was done by TMC authorities in Lake Ambegosale, which might have resulted in high DO and less free $CO_2$ during that period.

Silicates of all three lakes were comparatively towards higher side. Overall silicates of these lakes were lower in monsoon, but in other seasons fluctuations of silicates were more in Lake Ambegosale and Makhmali than in Rewale. Phosphates were much higher in Lake Ambegosale (ranging from 0.0100-0.3000 mg/L) than other two lakes under study (Makhmali- 0.0029-0.0074 mg/L and Rewale 0.0380-0.1840 mg/L). Nitrates were at high range in Makhmali lake (0.150-0.330 mg/L) compared to Lake Ambegosale (0.086-0.160 mg/L) and Lake Rewale (0.085-0.150 mg/L).

Thus, all the three lakes, though situated in nearby localities, show a large variation in the physico-chemical parameters including nutrients. The nutrients from any waterbody decide the type of macrophytes occurring in them. The macrophytes absorb large quantities of inorganic nutrients for their growth and thereby control the nutrient loading of the waterbody. With decay these contribute to the organic detritus pool.

The macrophytes listed in these lakes are given in Table 2. All the three lakes show the dominance of different macrophytes. Lake Ambegosale is predominantly covered by *Pistia stratiotes* while *Ipomoea aquatica* forms the subdominant group. Makhmali Lake shows predominant infestation of *Eichhornia crassipes* while lake Rewale shows predominant growth of *Lemna minor.*

These macrophytes are found to be widespread in India as observed by Sharma & Singhal (1988), Tripathi (1992), Patil (1996), Salaskar (1998), Dahiya (2000) and Rose (2002).

Macrophytes also compete with phytoplankton for nutrient requirement and their presence may result in change in phytoplankton community. During the present study 28 genera and 35 species of phytoplankton were identified belonging to 4 classes (Table 3). These phytoplankton were compared

Table 1: Physico-chemical parameters of Lake Ambegosale, Lake Makhmali and Lake Rewale.

| | Summer | | | Monsoon | | | Post Monsoon | | | Winter | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | M | R | A | M | R | A | M | R | A | M | R |
| pH | 8.47 | 7.77 | 7.45 | 7.98 | 7.92 | 8.50 | 8.71 | 7.21 | 8.32 | 8.16 | 7.23 | 7.85 |
| DO | 5.51 | 3.72 | 2.43 | 9.69 | 3.06 | 5.48 | 7.98 | 1.53 | 6.06 | 0.06 | 3.26 | 7.04 |
| Free $CO_2$ | 0.51 | 0.00 | 0.44 | 0.77 | 14.66 | 20.60 | 22.00 | 28.16 | 12.20 | 26.40 | 12.32 | 22.45 |
| $SiO_2$-Si | 18.15 | 19.68 | 32.80 | 18.25 | 03.13 | 08.14 | 80.67 | 49.83 | 27.00 | 41.98 | 86.25 | 49.85 |
| $PO_4$-P | 0.30 | 0.003 | 0.062 | 0.240 | 0.005 | 0.038 | 0.220 | 0.007 | 0.184 | 0.010 | 0.007 | 0.055 |
| $NO_3$-N | 0.160 | 0.310 | 0.150 | 0.086 | 0.264 | 0.100 | 0.090 | 0.330 | 0.110 | 0.102 | 0.150 | 0.085 |

A: Lake Ambegosale; M: Lake Makhmali; R: Lake Rewale. All values are in mg/L except pH.

Table 2: List of Macrophytes.

| No. | Name of plant | Habitat |
|---|---|---|
| 1. | *Alternanthera* spp. | Anchored |
| 2. | *Amaranthus viridis* | Bank Shrub |
| 3. | *Calliandra* spp. | Bank Shrub |
| 4. | *Chloris* spp. | Bank Weed |
| 5. | *Chorchorus capsularis* | Bank Herb |
| 6. | *Crtrullus* | Climber, Trailer |
| 7. | *Cynodon* spp. | Bank weed |
| 8. | *Eclypta alba* | Bank weed |
| 9. | *Eichhornia crassipes* | Floating |
| 10. | *Euphorbia hirta* | Bank weed |
| 11. | *Ficus religiosa* | Bank tree |
| 12. | *Heliotropium indicum* | Herb on a bank |
| 13. | *Holoptelea integrifolia* | Tree on a bank |
| 14. | *Ipomoea aquatica* | Floating |
| 15. | *Lemna minor* | Floating |
| 16. | *Malachra capitata* | Herb |
| 17. | *Pedalium* spp. | Bank weed |
| 18. | *Pistia stratiotes* | Floating |
| 19. | *Portulaca oleracea* | Trailing herb |
| 20. | *Rhoeo discolor* | Bank herb |
| 21. | *Solanum xanthocarpum* | Bank herb |
| 22. | *Tagetes* spp. | Bank herb |
| 23. | *Urena lobata* | Bank herb |

with the previous study (Somani 2002) performed on lakes with clear water or uninfested lakes. Out of total genera observed, 19 were common in macrophyte infested and uninfested lakes, while 11 were seen only in macrophyte infested lakes during the present study.

Palmer (1969) has listed 60 most pollution tolerant genera of phytoplankton (Trivedy & Goel 1984) found in eutrophicated water bodies. Out of the total phytoplank-

Table 3 : List of Phytoplankton.

| Class | Genus | Lake |
|---|---|---|
| Chlorophyta | *Chlorella* spp. | A |
| | *Crucigenia* spp. | R |
| | *Kirchneriella* spp. | A-R |
| | *Monoraphidium* spp. | A-R |
| | *Pediastrum tetras* | A-M-R |
| | *Pediastrum boryanum* | A-M |
| | *Scenedesmus quadricauda* | R |
| | *Scenedesmus acuminatus* | A-M-R |
| | *Tetrastrum* spp. | A |
| | *Koliella* spp. | R |
| | *Gonium* spp. | A-M |
| | *Spirogyra* spp. | M |
| | *Mougeotia* spp. | R |
| | *Closterium* spp. | A-R |
| Cyanophyta | *Merismopedia* spp. | R |
| | *Microcystis* spp. | A-M-R |
| | *Anabaena spiroides* | A-M-R |
| | *Spirulina* spp. | A-M-R |
| | *Oscillatoria* spp. | R |
| Bacillariophyta | *Cyclotella* spp. | A-R |
| | *Thalassiosira* spp. | A-M-R |
| | *Melosira* spp. | R |
| | *Fragilaria* spp. | A |
| | *Synedra ulna* | A-M-R |
| | *Cocconeis* spp. | A-M-R |
| | *Navicula* spp. | A-M-R |
| | *Nitzschia acicularis* | A-M-R |
| | *Nitzschia hungarica* | R |
| | *Nitzschia linearis* | R |
| | *Nitzschia paradoxa* | R |
| | *Gomphonema* spp. | R |
| | *Pinnularia* spp. | A |
| Euglenophyta | *Euglena viridus* | A-M-R |
| | *Phacus longicauda* | A-M-R |
| | *Phacus pleuronectes* | A-M |

A-Ambegosale, M-Makhmali, R-Rewale.

Table 4 : List of Rotifers.

| Family | Genus | Lake |
|---|---|---|
| Philodinidae | *Philodina* sp. | A-M-R |
| Filinidae | *Filinia* sp. | A-M |
| Testudinellidae | *Testudinella* sp. | A-R |
| Synchaetidae | *Polyarthra* sp. | M |
| Gastropodidae | *Ascomorpha* sp. | M-R |
| Asplanchnidae | *Asplanchana* sp. | A-M-R- |
| | *Harringia* sp. | A |
| Brachionidae | *B. budapestinensis* | R |
| | *B. calyciflorus* | A-M-R |
| | *B. diversicornis* | M |
| | *B. quadridentatus* | M |
| | *B. rubens* | R |
| | *B. patulus* | M |
| | *B. plicatilis* | R |
| | *Euchlanis* sp. | M |
| | *Keratella* sp. | A |
| Colurinae | *Lapadella* sp. | M-R |
| Lecaninae | *Lecane* spp. | M-R |
| | *Monostyla* sp. | A-M-R |

A-Ambegosale, M-Makhmali, R-Rewale

ton found in these three lakes almost all genera are included in this list except 6 namely *Thalassiosi Kirchneriella, Monora-phidium, Tetrastrum, Koliella* and *Mougeotia* indicating high eutrophicated state of lakes. Class Xanthophyceae and Dinophyceae, which were noted by Somani (2002) in uninfested lake, were not seen during the present study. Thus, the total classes of phytoplankton were found to be less during the present study, proving that the diversity of species reduces in eutrophicated waters. Due to pollution, number of species decreases drastically while the number of few species, which are pollution tolerant, increases (Trivedy & Goel 1984).

The macrophytes provide a food source and refuge for aquatic animals. They harbour microorganisms thereby protecting them from excessive light and predatory enemies besides serving as the primary link of energy transfer in an aquatic ecosystem. Increased nutrients in waterbody often results directly in increase in bacterial association with macrophytes which in turn increase the food for zooplankton.

During the present study zooplankton observed were mainly from 4 groups namely Rotifera Cladocera, Copepoda and Ostracoda. However, species diversity was mainly found in group Rotifera with 19 species belonging to 9 genera. In the study of uninfested lakes from Thane, Somani (2002) observed total 10 species belonging to 6 genera, out of which only 4 genera were common in the present study.

Thus, it can be seen that the phytoplankton as well as rotifer population varies in the eutrophic and meso/oligotrophic lakes. The pollution tolerant genera increase in the eutrophic lakes changing the diversity. By regular monitoring of lakes for physico-chemical parameters, flora and fauna of the indicator species can be noted which would help in some remedial measures to be taken (Trivedy & Goel 1984).

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The report ranks 122 countries according to the quality of their water as well as their ability and commitment to improve the situation.

Belgium is considered the worst due to low quantity and quality of its groundwater combined with heavy pollution and poor treatment of wastewater.

It is followed by Morocco, India, Jordan, Sudan, Nigeria and Burkina Faso. The list of countries with the best quality water is headed by Finland followed by Canada, New Zealand, United Kingdom, Japan and Norway.

Of the 180 countries ranked for water availability, the poorest is Kuwait followed by Gaza Strip, United Arab Emirates, Bahamas, Qatar and Maldives. The list of water rich countries is topped by French Guiana, Iceland, Guyana, Suriname and Congo.

The report warned that the water crisis is set to worsen despite continuing debate over the very existence of such a crisis.

About two million tonnes of waste are dumped every day into rivers, lakes and streams. One litre of wastewater pollutes eight litres of freshwater. The poor are the worst affected with 50 per cent of the population in developing countries exposed to polluted water sources, the report said. Asian rivers are the most polluted in the world, with three times as many bacteria from human waste as the global average. These rivers also have 20 times more lead than those of the industrialized countries.

By 2050, at worst seven billion people in 60 countries will be faced with water scarcity at best two billion in 48 countries, depending on factors like population growth and policy making. Climate change will account for an estimated 20 per cent of this increase in global water scarcity.

UNESCO Director-General Koichiro Matsuura said, "Of all the social and natúral crises humans face, the water crisis is one that lies at the heart of their survival on earth."

*Indian Express 6-2-2003*

**Water forum focuses on desert agriculture**

Recycling wastewater, practising deficit irrigation and planting genetically-modified seeds that need less water are among ideas to help desert agriculture proposed at the Third World water forum. How to make the desert bloom is a problem most pressing on arid countries in North Africa, Central Asia and West Asia, where agriculture consumes 90 per cent of available water yet contributes just 10 per cent of the region's gross domestic product.

"There is a need to change perspective and stop thinking about yield in terms of tonage per hectare but in terms of kilogram for cubic metre of water", said Ismael Serageldin, a top World Bank official for agriculture research.

Supplemental techniques such as drip irrigation can increase productivity of a crop to 2.2 kg per cubic metrecompared to the 0.8 kg per cubic metre produced using traditional methods of irrigation, he said.

Crops that depend on rain water, by contrast, produce only 0.3 kilograms per cubic metre of water. To prepare a crop for supplemental irrigation, the planting season can be extended by one month, moved for example, from November to October, to ensure that crops are well watered before the first frosts.

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