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Trophic status of Porur lake of Chennai city, south India

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Abstract
This study was aimed to investigate the trophic status of Porur lake of Chennai city. Physico-chemical parameters for unfiltered surface water samples were analyzed by the methods of APHA (2005). The sample was collected from 1999 to 2001. By determining the water quality status from the result we can come to a conclusion that the Porur lake was at rim to be eutrophicated. This study will give a special emphasis on the determination of the levels of pollution and the identification of polluted lakes and providing some probable remedial measures for polluted lake of Chennai city.

Keywords: Trophic status, eutrophication, Porur lake, Chennai city, Freshwater.

1. Introduction

Water is one of the abundantly available substances in the nature which man has exploited more than any other resources for the sustenance of his life. Water is perhaps the most valuable intake necessary for man's survival. It is an essential constituent of all animals and plants and forms about 75% of the matter of the earth's crust. The levels of hydrological pollution of Chennai zone have been increased in the recent years by an uncontrolled disposal of wastewater and pollutants due to human activities. This study gave a special emphasis on the determination of the levels of pollution probable remedial measures for severely impacted coastal zone of Chennai city.

In limnological studies the assessment of various environmental parameters and the identification of specific factors whose intensity of frequency of disturbance may give solutions towards the reduction of the above factors. In this context a holistic study comprising all abiotic and biotic components of an ecosystem is beyond the scope of a single investigator and also incomprehensible.

The industrial growth and consequent pollution let in to the freshwater systems are a challenge for the fragile freshwater ecosystems. The ability of water bodies to clean themselves is affected by the sheer quantity of water generated. (Ghosh, 1992 and Zahearudin and Khurshid, 1998) [11].

Tamilnadu represents one of the most important states with the natural resources of inland water bodies. Since 1960 the hydrological parameters of various fresh water ponds and lakes have been investigated by Srinivasan (1970). These studies revealed the importance of freshwater characteristics namely Temperature, pH, Dissolved Oxygen, Salinity, Total Alkalinity, Total Hardness, Phosphate and Silicate in augmenting productivity.

Freshwater habitats occupy relatively small portion of the earth´s surface, when compared to marine and terrestrial habitats, but their importance to man is far greater than their area because they are most convenient and cheapest waste disposal systems. Over exploitation and misuse of these unique systems results in the environmental degradation, depletion and pollution causing health hazards.

2. Materials and Methods

2.1 Porur lake

The Porur lake is situated in an area that lies in the urban zone of the Chennai city. It is maintained by Tamil Nadu Water Supply and Drainage Board (TWAD). It is located on the way of National Highway 4, Chennai, Bangalore trunk road. It is the main water reservoir, supplies drinking water for the lives in West Chennai. It receives the drainage water from domestic and also from nearby industries. The study period comprises from November 1999 to October 2000(first year of study period) and November 2000 to October 2001 (the second year of study period).

Fig 1: Statelite view of study area- Porur lake

2.2 Methods of sampling

Various physic-chemical and biological parameters of Porur and Retteri from August 1999 to July 2001. The water samples are collected from to selected sites of the lake, twice in every month at regular intervals.

The collection of water samples from all the sites are collected directly for the seasonal analysis from March to June were considered as summer, July to October were considered as monsoon, November to February were taken as winter. The air and water temperature, pH and transparency were recorded in the field. Dissolved Oxygen were fixed at the field. For the

other physico-chemical parameters water samples were collected in plastic bottles and transported in to ice bags to the laboratory. The samples were incubated for 5 days at 20 ºC in BOD incubator of the laboratory. The physico-chemical parameters like Dissolved Oxygen, Salinity, Alkalinity, Silicate, Phosphate, Hardness were analysed following standard methods (APHA, 2005) [2].

3. Results

The seasonal variation in water temperature and physico chemical parameters of water at sampling site at Porur lake during November 1999 to October 2000 study period are presented in the table. During November 1999 to October 2000 the highest water temperature was found during Pre summer (35.81 °C) followed by summer (33.75 °C), monsoon (29.18 °C), winter (27.31 °C), post monsoon (26.93 °C) and lowest water temperature was recorded in pre summer (24.37 °C). During November 2000 to October 2001 the maximum water temperature was recorded during pre monsoon (31.75 °C), during summer (30.93 °C), winter (30 °C), followed by monsoon (29.81°C), pre summer (28.87 °C) and the minimum was recorded during post monsoon (25.93 °C).

During November 1999 to October 2000 the pH was highest during pre monsoon (8.04 mgl^{-1}), followed by post monsoon (7.97 mgl^{-1}), winter (7.59 mgl^{-1}), monsoon (7.51 mgl^{-1}) and the lowest pH was recorded in pre summer (7.48 mgl^{-1}). During November 2000 to October 2001 the maximum pH was recorded pre monsoon (8.35 mgl^{-1}), followed by post monsoon (8.13 mgl^{-1}), summer (8.08 mgl^{-1}), winter (7.82 mgl^{-1}), monsoon (7.60 mgl^{-1}) and the minimum pH was recorded in pre summer (7.56 mgl^{-1}).

During November 1999 to October 2000 the highest Dissolved Oxygen was recorded in Pre monsoon (8.84 mgl^{-1}), followed by Post monsoon (7.123 mgl^{-1}), Pre summer (7.01 mgl^{-1}), summer (6.67 mgl^{-1}), Monsoon (4.93 mgl^{-1}) and the lowest Dissolved Oxygen was recorded in winter (2.03 mgl^{-1}). During November 2000 to October 2001 the maximum Dissolved Oxygen was recorded in Pre monsoon (8.69 mgl^{-1}), followed by summer (6.20 mgl^{-1}), Post monsoon (5.65 mgl^{-1}), Winter (5.13 mgl^{-1}), Pre summer (4.83 mgl^{-1}), the minimum Dissolved Oxygen was recorded in Monsoon (4.34 mgl^{-1}).

During November 1999 to October 2000 the Salinity was found to be highest during Pre monsoon (0.28 psu), followed by Post monsoon (0.24 psu), Summer (0.23 psu), Pre summer (0.22psu), Monsoon (0.21psu) and the lowest was recorded in winter (0.16 psu).During November 2000 to October 2001 the maximum salinity was recorded in Pre monsoon (0.30 psu), followed by Monsoon (0.27 psu), Post monsoon (0.26 psu), Pre summer (0.25 psu), Summer (0.25 psu) and the minimum Salinity was recorded in winter (0.24 psu).

During November 1999 to October 2000 the highest Total Alkalinity was recorded at Post monsoon (413.18 mgl^{-1}), followed by Pre monsoon (389.75 mgl^{-1}), Summer (310.18 mgl^{-1}), Pre summer (183.87 mgl^{-1}), Monsoon (173.37 mgl^{-1}) and the lowest Total Alkalinity was recorded in Winter (146.37 mgl^{-1}). During November 2000 to October 2001 the Maximum Total Alkalinity was recorded in Pre monsoon (440.87 mgl^{-1}), followed by Post monsoon (356.56 mgl^{-1}), Summer (349.18 mgl^{-1}), Winter (284.56 mgl-1^{-1}), and the Minimum was recorded in Pre summer (182.00 mgl^{-1}).

During November 1999 to October 2000 the highest Total Hardness was recorded in Pre monsoon (303.125 mgl^{-1}), followed by Post monsoon (247.25 mgl^{-1}), Summer (238.50 mgl^{-1}), Winter (207.37 mgl^{-1}), Pre summer (204.87 mgl^{-1}) and the lowest was recorded in Monsoon (183.56 mgl^{-1}). During November 2000 to October 2001 the Maximum was recorded in Pre monsoon (282.93 mgl^{-1}), followed by Summer (221.50 mgl^{-1}), Winter (218.87 mgl^{-1}), Monsoon (194.56 mgl^{-1}), Pre summer (189.31 mgl^{-1}) and the Minimum was recorded in Post monsoon (177.93 mgl^{-1}).

During November 1999 to October 2000 the Maximum Phosphate was recorded in Pre monsoon (0.22 mgl^{-1}), followed by Post monsoon (0.20 mgl^{-1}), Summer (0.17 mgl^{1}), Monsoon (0.14 mgl^{-1}), Winter (0.12 mgl^{-1}) and the Minimum was recorded in Pre summer (0.09 mgl^{-1}). During November 2000 to October 2001 the highest was recorded in Pre monsoon (0.220 mgl^{-1}), followed by Summer (0.19 mgl^{-1}), Post monsoon (0.19 mgl^{-1}), Winter (0.17 mgl^{-1}), Pre summer (0.13 mgl^{-1}) and the lowest was recorded in Monsoon (0.10 mgl^{-1}).

During November 1999 to October 2000 the Maximum Silicate was recorded in Pre monsoon (1.07 mgl^{-1}), followed by Summer (0.96 mgl^{-1}), Post monsoon (0.66 mgl^{-1}), Pre summer (0.52 mgl^{-1}), Winter (0.44 mgl^{-1}) and the Minimum was recorded in Monsoon (0.29 mgl^{-1}). During November 2000 to October 2001 the highest was recorded in Pre monsoon (1.08 mgl^{-1}) followed by Post monsoon (0.93 mgl^{-1}), Summer (0.90 mgl^{-1}), Pre summer (0.86 mgl^{-1}), Monsoon (0.83 mgl^{-1}).

In the Porur lake, the Dissolved Oxygen content determined during November 1999 to October 2000 and November 2000 to October 2001, revealed minimum value of (1.535 mgl^{-1}) maximum of (9.361 mgl^{-1}) in the months of December and August respectively. During 2000 to 2001 the dissolved value showed similarly a lower value of (1.396 mgl^{-1}) and a higher value of (9.82 mgl^{-1}) during December and August respectively. The seasonal variation in the Dissolved Oxygen was observed lowest during winter (2.03 mgl^{-1}) for the study period November 1999 to October 2000 and for study period November 2000 to October 2001 the lowest was found during monsoon (4.34 mgl^{-1}), the highest Dissolved Oxygen was observed during premonsoon (8.846 mgl^{-1}), for the period of study during November 1999 to October 2000 and for the period of November 2000 to October 2001 the highest Dissolved Oxygen was recorded during premonsoon (8.69 mgl^{-1}).

The Pearson's coefficient of correlation of pH in this lake revealed positive correlation to Temperature Salinity, Total Alkalinity, Total Hardness, and it shows negative correlation with Phosphates and Silicates. The Dissolved Oxygen showed insignificant correlation.

4. Discussion

Moore (1939), Dye (1952) and Thatcher (1960). Dissolved Oxygen is one of the most important abiotic factors that could affect the survival of individuals both in air and water and is treated as a prime ecological parameter of the existence of aquatic life. Temperature facilitates dissolution of oxygen from air in water and photosynthesis also leads to the saturation of oxygen in still water is due to the respiratory activities of the flora and fauna and the decomposition of the organic matters Clarke (1954) [3].

The temperature of a water body depends upon the time of collection, season and depth of water body (Saxena, 2012). Major difference was noticed between the seasonal wise. Maximum temperature observed during summer and minimum during monsoon. This may due to intensity of solar radiation

during summer and rainfall during monsoon (Makode *et al*., (2012) [7]. The present results were coincides with work done by Ansari *et al*., (2008) [1]; Chinnaiah and Rao (2011); Garg *et al*., (2010) and Khan *et al*., (2012) [6].

The silicate content varied from a minimum of (0.40 mgl^{-1}) to a maximum of (1.29 mgl^{-1}) (seasonal measurement). According to Literature survey, a Silicate ranges from 2 to 25 ppm in both rivers and lakes (Cole, 1983). However in extreme cases, in land waters the value of 4000ppm has also been reported. The level of silicate is also an indicator of phytoplankton bloom and eutrophication. Thus the lower levels of the silicate observed in the present analyses of cyain indicate the oligotrophic condition and the absence of eutrophic factors due to anthropogenic influence.

In the present study amount of nitrate was fluctuated noticed in the study area. The increased nitrate content will favour for growth of nuisance algae pollution (Trivedy and Goel, 1986) [10].

5. Conclusions

From the observed results, the present study concludes that Porur lake in the rim eutrophication. And it is tending fast towards eutrophication. Necessary action as to be taken by the government or by the Non Governmental organisation's. People should be made aware of its significance so that reclamation and conservation of these water bodies be taken up effectively.

Table 1: Pearson's Correlation of Co-Efficient for Physico Chemical Parameters of Water Samples at Porur Lake

Parameters	Ph	Do	Salinity	Total Alkalinity	Total Hardness	Phosphate	Silicate
Temperature	0.5417**	0.5188**	0.3421**	0.4559**	0.490**	0.5300**	0.5329**
Ph		0.6801**	0.6171**	0.8945**	0.6753**	0.8538**	0.5556*
Do			0.6604**	0.7962**	0.6929**	0.7352**	0.4904**
Salinity				0.7434**	0.6154**	0.7131**	0.6333**
Total Alkalinity					0.7883**	0.9406**	0.6243**
Total Hardness						0.7665**	0.5669**
Phosphate							0.5778**

Table 2: Pearson's Correlation of Co-Efficient for Physico Chemical Parameters of Water Samples at Puzhal Lake

Parameters	Ph	Do	Salinity	Total Alkalinity	Total Hardness	Phosphate	Silicate
Temperature	0.2290**	0.1872**	0.4704**	0.1248**	0.2672**	0.4811**	0.3227**
Ph		0.1057	0.4629**	0.4657**	0.4474**	-0.0643	-0.0829
Do			0.1090	0.3518**	0.7801**	0.4989**	0.5108**
Salinity				0.1398	0.2550**	0.2394**	0.0511**
Total Alkalinity					0.6950**	0.0519	0.1387
Total Hardness						0.3051**	0.3093**
Phosphate							0.5778**

Table 3: Pearson's Correlation of Co-Efficient for Physico Chemical Parameters of Water Samples at Retteri Lake

Parameters	Ph	Do	Salinity	Total Alkalinity	Total Hardness	Phosphate	Silicate
Temperature	0.3953**	0.0103	0.1282	0.1335	0.0371	0.4388**	0.1372
Ph		0.0284	0.3657**	0.2938**	0.3505**	0.0233	0.3299**
Do			-0.0662	0.5811**	0.8017**	-0.5762**	-0.3024**
Salinity				-0.1195	-0.0622	-0.1439*	0.2430**
Total Alkalinity					0.7877**	0.1366	0.0120
Total Hardness						0.3213**	-0.1095
Phosphate							-0.2341**

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