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Present Status of Maniyampattu and Puliyanthangal Lakes Ranipettai, Tamilnadu, India

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Abstract: Rivers and Lake are most important water resource in India for purpose like drinking water supplies, irrigation and fisheries. The inland fresh water ecosystem, both lentic and lotic contributes a greater fraction towards the available water resource on the planet which, is now being increasingly subjected to greater stress from various human activities. Present investigation indicated that, Puliyanthangal and Maniyampattu Lake of Ranipettai, water samples were highly polluted and were not safe for drinking water purpose as the values for different parameters; especially toxic heavy metals evaluated high concentrations (Cu, Zn, Mg, Cr, Pb and Cd were 35.00, 19.99, 145.50, 0.143, 3.00 and 1.50 mgl^{-1} respectively at both the stations for above the acceptable limits. In addition to the phytoplankton, biomass, species composition and biodiversity are decreasing from month to month. Therefore, it is concluded from the present study, the Puliyanthangal and Maniyampattu Lakes of Ranipettai is rapidly getting polluted with these domestic and industrial sources thus substantiating the view of other workers, who reported that the Ranipettai areas are definitely the biodiversity of phytoplankton should be affected in those Lakes. So these results clearly, indicated that local hydrograph, monthly variability, physico-chemical and plankton biodiversity state are factor which cannot be neglected in studies of the occurrence of phytoplankton biodiversity in Lake waters.

Key words: Lake water · Phytoplankton · Nutrients · Chloride · Fluoride · Heavy metals

INTRODUCTION

Indian subcontinent is very rich in fresh water resources. The Indian fresh waters are under considerable threat owing to the fast pace of development the country is under going in past on or two decades. A survey by NEERI shows that 70% of India's fresh waters are polluted by conventional standards [1]. Although rivers and Lake are most important water resource in India for purpose like drinking water supplies, irrigation and fisheries. Fresh water Lakes and reservoirs are also very an important water resource in this country and in many areas constitutes the only available water [2]. The inland fresh water ecosystem, both lentic and lotic contributes a greater fraction towards the available water resource on the planet which, is now being increasingly subjected to greater stress from various human activities. The physico-chemical and biological characteristics of water depends upon several factors including the location of water body, type of sewage and domestic waste disposal, localized human population in surrounding and their activities [3]. As a result large quantities of organic and inorganic nutrients are added. The enrichment of nutrients also occurs due to disposal of domestic and in industrial effluents from surrounding from surrounding areas, which supports the growth of a variety of macrophytes and microbes in aquatic system. Some of these organisms in aquatic systems assume paramount significance either as biological indicator or as an agent in self in self-cleaning process [4].

Ranipettai area Lakes and mosques have several small and big water bodies. The Puliyanthangal Lake is locates on a slightly lower elevation. The Maniyampattu Lake famous Lake and has historic importance. Man's increasing utilization of aquatic systems as supplies and recipients of water used for industrial or municipal purposes, combined with undesirable contributions from cultivated land and streets contaminated atmospheric fallout, transport as well as excessive recreational use have subjected lentic and lotic waters to perturbations of considerable magnititude within the recent decades.

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The effect of excessive foreign materials drastically change water with clean and pure becomes eutrophic waters with high nutritive and polluted, through mesotrophic waters in the short span of time. The assessment of water quality reflects it‘s physical chemical and biological properties. In actual fact, the biological and physico-chemical data together provide converging lines of evidence that supplement each other, but are not mutually exclusive. Few attempts have been made to study the biological characters of different lentic water bodies [5, 6]. Further, the tropic state of any aquatic ecosystem basically refers to its soluble nutrients and resultant biotic productivity along its natural succession from oligotrophic to eutrophic state. Surprisingly, however, there is no generally accepted singular definition of a Lake's trophic status, nor is there a quantitative measure [7]. Among most of waste from various industries ranks among the most polluting of all the aquatic ecosystems. In addition, the Tamil Nadu, chromate and chemical factory, a chromium feeder industry to tanneries has caused further damage in the Ranipet industrial area. Moreover, the different type of pollutants, which is increasing in recent times in these areas especially the sources of pollutions from chromium feeder industry [8]. Hence, the present study was carried out to gather more information on the ecological events of the Puliyanthangal and Maniyampattu Lakes of the Ranipettai areas to collect information of the "*state of the art*" by recording the monthly variations in local hydrobiology, biomass (phytoplankton) and heavy metals distribution in Lake water with special reference to some phytoplankton diversity.

MATERIALS AND METHODS

Origin of Lake: Lakes from the transitional zone has been between land water, where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in and on it. They are usually formed in the depression (subjected to flooding and ground water seeps. Enhanced appreciation of Lakes in the recent past has led to the signing of many international agreements for protecting them, among which the Ramsor convention is the most important. Hence, at present our water resources are under disaster conditions our rivers, lakes, ponds and pools are badly polluted. The various ways of pollution are sewage civil garbage, industrial effluent, burnt and half burnt dead bodies and agricultural chemicals like pesticides, herbicides and insecticides.

Description of the Study Areas: The Vellore district occupies almost a top position on the map Tamil Nadu and wears by BHEL (Bharat Heavy Electrical Limited). Ranipet about 115 kms from west of Madras and has wide water spread area suitable for inland fish culture. At present study, Puliyanthangal Lake (*Lat*. 12.20'N; *Long*. 78.83'E: Station I) and Maniyampattu Lake (*Lat*. 12.20'N; *Long*. 78.79'E: Station II) were Chosen for assessing the present status of these Lakes at Ranipettai (Fig. 1). Puliyanthangal Lake is situated in the near of Puliyanthangal village. It is large, everlasting, shallow area and its cover an areas of 29.92 hectectares. This water body receives many industrial and domestic wastes from these villages. Human settlement of this village is very high each and every year.

Maniyampattu Lake is situated in the near of Maniyampattu Village. It is a big, temporary, shallow, reined area and its cover an area of about 42.695 hectares. It is the under the control of Thengal Panchayats. The Maniyampattu Lake is the only water source for Maniyampattu village there are about 2,000 people living in this area. Yearly two times fishing harvest taking place here. Finally, both the Lakes play an important resource for fishing and agriculture purposes.

RESULTS AND DISCUSSION

Physical Parameters: The inland fresh water ecosystem, both lentic and lotic contributes a greater fraction towards the available water resource on the planet which, is now being increasingly subjected to greater stress from various human activities [2]. The physico-chemical and biological characteristics of water depends upon several factors including the location of water body, type of sewage and domestic waste disposal, localized human population in surrounding and their activities. As a result large quantities of organic and inorganic nutrients are added. Atmospheric temperature ranged from 17 to 29°C during the present study. Minimum (21°C) and maximum (29°C) was recorded during June and May 2006 at Station I (Table 1). Thus the atmospheric temperature during the present study recorded to be light in both the stations. During summer solar radiation and clear sky condition enhanced the atmospheric temperature. Light extinction co-efficient varied from 0.93 to 2.48 during the study period. At station II, minimum (0.93) and maximum (2.48) were recorded during the June and June 2006 respectively. High extinction co-efficient was noticed at Station II than at station I. Lower values of water transparency (1.24), which could be attributed to rich phytoplankton density and higher lode of organic matter [9].

Table 1: Summer variation of environmental variables (mg l^{-1}) at Puliyanthangal and Maniyampattu Lakes at Ranipettai area during the study period 2006

	June		May		June	
	Stations					
Parameters	I	II	I	II	I	II
Physical parameters						
Atmospheric temperature (°C)	21.00	17.00	29.00	26.00	26.00	29.00
Water temperature (°C)	24.00	22.00	30.00	28.00	28.00	30.00
Light extinction co-efficient (K)	1.86	2.48	1.55	1.86	1.24	0.93
Total Dissolved Solids (TDS)	6909	7510	6923	7560	7742	8680
Electrical Conductivity (EC) mic mho^{-1} cm^{-1}	9870	10732	9890	10800	11060	12400
Chemical parameters						
PH	7.31	7.03	7.44	7.04	7.16	7.40
Total Alkalinity	740	292	752	322	354	450
Total Hardness	2814	3000	2714	3819	3116	3819
Calcium (Ca)	579	760	973	1005	804	965
Magnesium (Mg)	328	264	68	314	265	338
Sodium (Na)	664	980	662	720	810	790
Potassium (K)	62	90	124	190	62	94
Iron (Fe)	0.08	0.0	0.02	0.02	`0.06	0.01
Free Ammonia (NH_3)	0.73	0.0	0.76	0.03	0.87	0.48
Nitrite (NO_2)	0.03	0.0	0.04	0.0	0.04	0.06
Nitrate (NO_3)	258	274	258	282	285	301
Phosphate (PO_4)	0.07	0.0	0.07	0.02	0.14	0.13
Chloride (Cl)	1812	2900	1851	2970	2624	2621
Fluoride (Fl)	0.4	0.4	0.4	0.4	0.4	0.8
Sulphate (SO_4)	837	964	847	1015	765	734
Dissolved Oxygen (O_2 mg l^{-1})	1.68	2.02	2.02	1.68	2.36	2.02
Biological Parameter						
Phytoplankton Biomass ($Cell^{-1}$)	260	245	301	298	291	312

Chemical Parameters: Total dissolved solids showed from 6909 to 8680 during the study period at Station I, minimum of 6909 (February) and maximum of 7742 (April) were recorded at station I. High total dissolved solid was noticed at station II than at station I. The higher valued of total dissolved solids is due to influence domestic sewage [10]. Electrical conductivity varied from 9870- 12400mic mho^{-1}cm during the study period. Minimum 9870mic mho/cm and maximum 11060 mic mho^{-1}cm were recorded during the study period in June and June respectively at Station I (Table 1). High electrical conductivity was noticed at stations II than at I. The importance of Electrical conductivity is its measure of salinity, which greatly affects the tastes and thus has a significant impact on the user's acceptance of the water as potable [11]. Dissolved oxygen is one of the important parameter in water quality assessments. Its presence is essential in aquatic ecosystem in bringing out various biochemical changes and its effects on metabolic activities of organisms. The dissolved oxygen concentration showed from 1.688-2.36mgl^{-1}. Hydrogen ion-concentration varied from 7.03-7.44 during study period. The higher pH values (7.44) at was recorded during the month of May at station I coinciding with high productivity of phytoplankton with the removal of carbon dioxide by photosynthesis.

Alkalinity was ranged from 120-740mgl^{-1} at both the stations. The desirable limit for alkalinity was found to be 120mgl^{-1} as per ISI standards. The results indicates higher alkalinity of both stations are due to the receiving the domestic waste waters. Further, total hardness was ranged from 2714-3819mgl^{-1} in the minimum of 2714mgl^{-1} was recorded in May station I and the maximum 3819mgl^{-1} was recorded in June at station II (Table 1). Hardness is mainly due to the presence of carbonates and

bi-carbonates and magnesium abundant expressed as an equivalent amount of calcium carbonate. Moreover, the study area has problem for domestic use in washing, clearing and laundering. Calcium concentration ranged from 579-1005mgl^{-1}. The minimum concentration (579mgl^{-1}) was recorded in June at station I, while the maximum concentration (1005mgl^{-1}) was recorded in May 2006 at station II. This moderate variation in the calcium concentration may due to the decomposition of bones and skeletal matters of dead organism resulting from undesirable condition in drinking water [12].

Magnesium concentrations showed from 68-338mgl^{-1} (Table 1) during the study period. Minimum (68mgl^{-1}) and maximum (338mgl^{-1}) were recorded during the month of May 2006 (station I) and June (station II) respectively. Magnesium concentration was high at Station II than at station I. The World Health Organization in 1997 [11] reported that high and low value of magnesium during summer and monsoon seasons respectively. Excessive the concentration of magnesium it is undesirable in domestic waste and sewage becomes of the problems of scale formation and pitting (338mgl^{-1}). Sodium is one of an important cat ions occurring in the ground water required for the natural softening of water. Sodium concentrations ranged from 662-980mgl^{-1} during the study period. The higher concentration was noted sodium acts as a deflocculating agent and displaces the divalent cat ions like Ca and Mg and cumulatively the soil loses its productivity [13].

Potassium concentration was high (190mgl^{-1}) at station II. Potassium found in small amounts it plays a vital role in metabolism of freshwater environments and considered to be an important macronutrient [14]. Ammonia concentration was high Station II than at Station I. Ammonia in the form of ammonium salts is one of the most important nitrogenous plant nutrients, the concentration of which is known to determine fertility of the pond [2]. In general Ammonia values were found to decrease with increasing depth and the monthly variations is more pronounced and than that of the spatial variations. However, Reddy [15] working in the pond water and he reported that higher values in shallow depth and the monthly variations are attributed this is due to be discharge of terrestrial raw water.

Nitrite concentration ranged from not detectable - 0.06mgl^{-1}. The nitrite concentration was high during the study period at both the stations and this might be due to the influence of turbulence as a recorded for phosphate and Nitrate during study. These features could be attributed to the oxidation of organically derived ammonia or to the cellular production of nitrite by phytoplankton production during assimilation of nitrate [16]. Further, nitrate concentration ranged from 258- 301 mgl^{-1}. This was due to addition of nitrogenous nutrients mainly by terrestrial run off during all the three months at both the stations. In addition, oxidation of ammonia from Nitrate and subsequently to Nitrite [17]. In general, high concentration of phosphate was recorded at station I. Heron [18] has indicated that the phosphate increase may be due to deceased phytoplankton and concentration of zooplankton excreta. Lower concentration during summer may be due to higher consumption by macrophyte. High phosphate content might be attributed to drainage in the Lake [19, 2].

Chloride concentration ranged from 1812 - 2970mgl^{-1}. High concentration of chlorides during summer months might be due to decomposition of organic matter as advocated [20]. Fluoride concentration ranged from 0.4 - 0.8mgl^{-1} (Table 1). Minimum (0.4mgl^{-1}) were recorded all the Stations and the maximum (0.8 mgl^{-1}) were recorded during the June at station II. Thus the fluoride concentration was remained same during the investigation. Low concentration of fluoride below 0.5 mgl^{-1} courses dental caries and higher concentration beyond 1.5 mgl^{-1} causes dental and skeletal fluoric, [4]. Surface waters generally contain less than 0.5 mgl^{-1} fluorides. However, when present in much greater concentration, it becomes a pollutant [19]. Sulphate concentration was showed from 734 - 1015mgl^{-1} (Table 1). Sulphate is ecologically important for growth of plants and its short supply may inhabit the development of plankton [21].

Heavy Metals: Concentration of Cu and Zn in water ranged from 12.20 - 35.60 mgl^{-1}and 11.00 - 19.90mgl^{-1} (Table 2). Maximum (Cu: 35.60mgl^{-1}; Zn 19.90mgl^{-1}) concentration were recorded at station II. In general, high concentrations were recorded at station II. Cu and Zn metals has a tendency to from complexes with suitable organic species present in water [22] and also coating on iron, steel and brass alloys, pesticides containing zinc etc., are ultimately added to the sewage and municipal wastes. Cu and Zn concentrations were toxic to human health in high doses zinc is very essential micronutrient in human beings and only at very high concentration it may caused toxic effects were reported [23]. Manganese can concentration showed from 44.00-125.5mgl^{-1}. Its deficiency lends to central nervous system and mucous linings and respiratory diseases. In generally, affects plant tops than roots and also least toxic effect to plant [1].

Table 2: Summer variation of heavy metals (µg l^{-1}) in Puliyanthangal and Maniyampattu Lakes at Ranipettai area during the study period 2006

	June		May		June	
	Stations					
Metals	I	II	I	II	I	II
Cu	13.50	35.00	15.20	35.60	12.20	22.60
Zn	16.60	17.90	19.90	11.00	7.70	18.00
Mn	54.60	125.50	44.00	44.00	69.60	84.00
Cr	0.142	0.143	0.043	0.056	0.067	0.123
Pb	1.30	2.00	2.00	0.50	3.00	1.50
Cd	0.60	0.80	0.80	0.70	ND	1.50

Concentration of Cr in water ranged from 0.043 - 0.143µgl^{-1} (Table 2). Minimum concentration (0.043µgl^{-1}) was recorded during the May 2006 at Station II and the maximum concentration (0.143µgl^{-1}) was recorded during the June at Station II thus concentrations (0.143µgl^{-1}) were recorded at Station II. The chromium present in the waste water due the ceramics, paints, pigments, photography and wood polishes are delivered in waste water channels. The present data indicated that the permissible under limits of 0.143µgl^{-1} [24]. Chromates are used in the dye and pigment industry in the electrical cell production, imprinting the lithographic industries explosives and in the rubber industry and leather tannery. Spent - chrome liquors and waste from tanneries contain 2,900-4,500 mgl^{-1} and 10-50 mgl^{-1} of chromium respectively were reported by [25]. Chromium diseases cause carcinogens producing cancer in the body of all parts.

Concentration of Pb in water varied from 0.50 - 3.00mgl^{-1}. Minimum (6.50mgl^{-1}) and maximum (3.00mgl^{-1}) were recorded at stations II and I respectively. The high concentration of lead in last four sites is because of the several industries located in the adjoining visibility [26]. Contamination of lead in water is potential problem. The major bio-chemical effect of lead is its interface with haemo synthesis, which heads to hematological damage. Lead plays an important role in biomethylation [26, 27, 28].

Cadmium concentration was showed from not detectable - 1.50mgl^{-1}. Minimum (0.7 mgl^{-1} concentration here recorded May at station Ii and the minimum (1.50mgl^{-1}) were recorded June at station II. Thus was due to accumulation of waste water from the Batteries, PVC production and plastic industries. The higher concentration of cadmium may be due to more input of sewage, cadmium toxicity may result in the rowel hypertension, hepatic injury. Lung cancer teratogenicity and bone defects Shark.

Table 3: Checklist of phytoplankton groups and species were recorded from at Stations I and II during the study period 2006

Name of Species	Station I	Station II
Chlorophyceae		
Pediastrum duplex	+	-
Scenedesmus sp.	+	+
Bacillariophyceae		
Bacillaria sp.	+	+
Cymbella leptoceros	+	+
Gamphonema sp.	+	-
Melosira sp.	+	+
Navicula cryptocephla	+	+
N. cuspidata	-	+
N. viridula	+	+
Nitzrchia obtusa	+	+
Pinnaularia sp.	+	+
Synedra ulna	+	+
Cyanophyceae		
Chloriva sp.	-	+
Osicillatoria curviceps	+	-
O. limosa	+	+

+ denotes presence; - denotes absence

Biological Parameters: A total number of 15 species of phytoplankton were recorded in Puliyanthangal and Maniyampattu Lakes in Ranipettai area during the study period (Table 3). Of these three groups and 15 species of *Pediastrum duplex, Scenedesmus sp., Bacillaria sp., Cymbella leptoceres, Gamphonema sp., Melosira sp., Navicula crptocephla, N. cuspidata, N. viridula, Nitzrchia obtusa, Iinnaularia sp., Synedra ulna, Chloriva sp., Oscillatoria curviceps and O. limposa* were observed at all the collections. The genuses *Navicula* and *Oscillatoria* were dominate with more species at both the Stations. Among different groups, *Navicula* ranked first out of 15 species followed by *Oscillatoria* with 2 species. There was a fairly group population of phytoplankton from June to June were registered.

Further, the biomass of phytoplankton dominant at station II when compared to station I. This is clearly indicate that station II have higher biomass, species composition and diversity. Relation between physico-chemcial parameters and plankton diversity of phytoplankton are important component in many aquatic ecosystems as they participate in natural purification of water and also mainly act as a primary and secondary producer [2]. It has been observed that phytoplankton constitute the main food of fish and fish larvae. Thus phytoplankton has a direct bearing on the secondary and tertiary producers. During the present investigation, it was observed that phytoplankton mainly comprised of Chlorophyceae, Bacillariophyceae and Cyanophyceae (Table 3). Bacillariophyceae were the largest group and its contribute in the form of density (68.89%) followed by Cyanophyceae (19.71%) and Chlorophyceae (11.38%) in order of abundance at Station I (Fig. 2). At station II, Bacillariophyceae were the largest group contribute in the form of density (60.91%) followed by Cyanophyceae (21.83%) and Chlorophyceae (17.21%) in order of abundance.

At both the stations, Bacillariophyceae (64.86%), Cyanophyceae (20.78%) and Chlorophyceae (14.34%) were present during the study. The wide distribution, spatial abundance of phytoplankton diversity because of abstraction structures being under direct control of the user, ground water and rain water has become to stay as preferred sources for meeting the water demands for various user sectors. It is visible because human interference as become endangered resources in many parts of Tamil Nadu especially in Pulianthangal and Maniyampattu Lakes in Raipettai, Lakes water reservoirs once contaminated or polluted cannot be restore to its present state. Plankters should become zero percent of diversity.

CONCLUSIONS

As in Puliyanthangal and Maniyampattu Lakes of Ranipettai, in the present investigation also, the physico-chemical and biological variables are higher at both the stations when compared to the BIS standard. The above data on physico-chemical and biological parameter clearly indicated that water samples were highly polluted and were not safe for drinking water purpose as the values for different parameters; especially toxic heavy metals evaluated high for below the acceptable limit [24]. Moreover, the phytoplankton, biomass, species composition and biodiversity are decreasing from month to month. Therefore, the end result, the Puliyanthangal and Maniyampattu Lakes of Ranipettai are rapidly getting polluted with these domestic and industrial sources thus substantiating the view of other workers, who reported that the Ranipettai areas are definitely the biodiversity of phytoplankton should be affected in those Lakes. So these results clearly, indicated that local hydrograph, monthly variability, physico-chemical and plankton biodiversity state are factor which cannot be neglected in studies of the occurrence of phytoplankton biodiversity in Lake waters.

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