Article

An Assessment of Seasonal Variation in Phytoplankton Community of Mahi River (India)

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ABSTRACT

Algae are an ecologically important group in most aquatic ecosystems but are often ignored as indicators of aquatic ecosystem change. Biological assessment is a useful alternative tool for assessing the ecological quality of aquatic ecosystems since biological communities integrate the environmental effects of water chemistry. The physico-chemical parameters of Mahi river, Gujarat, India were investigated during March-2006 to February-2007. Along with the physico-chemical parameters water samples were also characterized for Phytoplankton community composition and density. Result from water analysis showed by reduction in temperature, TS, TDS, TSS, BOD, COD, total hardness, total alkalinity, chloride and oil & grease whereas pH, DO, nitrate, phosphate and silicate were found to be increased. The dominance groups among phytoplankton community were Blue green algae and diatoms. Agmenellum sp., Oscillatoria sp., Lyngbya sp., Anabena sp., Microspora sp. Navicula sp., Anacystis sp., Phormidium sp. encountered abundantly during the study period. Beside, Green algae like Pandorina sp., Scenedesmus sp., Stigeoclonium sp. also occurred frequently. Rise in DO and nutrient levels of nitrate, phosphate and silicate suggested favorable conditions for plankton growth. The most tolerant genera and species of four groups of algae were recorded. The phytoplankton encountered in the water body reflects the average ecological condition and therefore, they may be used as indicator of water quality.

Key words: Environmental monitoring, algal indicators, environmental change, phytoplankton, physico-chemical quality.

INTRODUCTION

Studies of pollution in natural ecosystem have many aspects, physical, chemical and biological. The physical aspects include the distribution of potential contaminants within the ecosystem. The chemical aspects include the level and chemical form of contaminants found within both the biotic and the abiotic components of ecosystem. But, it is recognition of the biological effects of contamination that defines the true significance of the physical and chemical contamination. Chemical analyses of water provide a good indication of the chemical quality of the aquatic systems, but do not integrate ecological factors such as altered riparian vegetation or altered flow regime and therefore, do not necessarily reflect the ecological state of the system (Karr et al., 2000). Biological assessment is a useful alternative for assessing the ecological quality of aquatic ecosystems since biological communities integrate the environmental effects of water chemistry of Rivers and lakes (Stevenson and Pan, 1999). Phytoplankton encountered in the water body reflects the average ecological condition and therefore, they may be used as indicator of water quality (Bhatt, et al., 1999; Saha et al., 2000). Beside, phytoplankton are very suitable organisms for the determination of the impact of toxic substances on the aquatic environment because any effect on the lower level of the food chain will also have consequence on the higher level (Joubert, 1980). Phytoplankton were used for assessing the degree of pollution or as indicator of water pollution of different water bodies (Trivedy, 1986; Sudhaker et al., 1994; Dwivedi and Pandey, 2002). Thirugnanamoorthy and Selvaraju (2009) revealed that the distribution and population density of phytoplankton species depend upon the physico-chemical parameters of the environment. Present study was carried out to examine the potential use of phytoplankton as bio-indicator in Gas processing effluent holding pond by studying seasonal variation in phytoplankton community along with physico-chemical parameters.

MATERIALS AND METHODS

The water samples for phytoplankton analysis were collected from phase I and Guard pond (treated wastewater reservoir) during March 2005 to March 2007. The sample was preserved with 4 % formalin. The methods described in the 'Standard Methods for the Examination of Water and Wastewater (1985) as prescribed by American Public Health Association (APHA), American Water Works Association (AWWA), and Water Pollution Control Federation (WPCF) was adopted. The identification of phytoplankton was done with the help of standard books and monographs (Smith, 1950; Prescott, 1954; Ward and Whipple, 1959; Prescott, 1951). Phytoplankton was counted by drop count method and the results were converted to organisms per ml of water. In the present investigation tolerant genera and species were recorded.

RESULT AND DISCUSSION

The occurrence of plankton population is presented in table 2. The phytoplankton represented by 61 genera and zooplankton represented by 9 genera were encountered in river during study period. Green algae which accounted for 69.5% of the phytoplankton density were represented by 10 genera, this is followed by diatoms represented by 12 genera (26.75%), others were desmid (1.94%) and blue green algae (1.84%). The zooplankton consisted of rotifers, (51.8%), crustaceans (36.5%), and protozoans (11.7%). In the pond of plankton density was higher (mean=947 ± 624.36 units/l). Downstream (zeropoint), plankton density (mean = 101.5 ± 105.36 units/l) was least during study period. Green algae were found to dominate among all the groups.

Water quality of river has been depicted in the table 1. Water temperature and total dissolved solids were observed to be significantly different in the river. The biota differs greatly with changes in physicochemical conditions in aquatic ecosystems. According to Reid (1961) the successful development and maintenance of a population of organism depends upon harmonious ecological balance between environmental conditions and tolerance of the organisms to variations in one or more of these conditions. Temperature is of outmost importance for its effect on controlling metabolism, species composition and reproduction of aquatic organisms. According to FWPCA (1967), temperature, a catalyst, a depressant, an activator, a stimulator, a controller, a killer is one of the most important and influential water quality characteristics to life in water. In this study, higher values of water temperature during summer and lower in winter in all the sampling sites indicate a sharp seasonal variation.

The river water become more turbid in monsoon due to rain. This pattern in transparency was also observed by Agarwal & Thapliyal (2005). The lesser turbidity of river can be attributed to the water velocity been reduced in these parts.

The water velocity can affect distribution of phytoplankton. Downstream water velocity was higher in winter due to discharge of water. The higher pH recorded in winter in some sites and lower in others may be attributed to increase and decrease in biogenic activities of the system. The pH of 7.4 to 8.1 of river is within safe range for aquatic life.

Higher dissolved oxygen recorded in winter is due to lower water temperature compare to monsoon and lentic part, since dissolved oxygen showed inverse relationship with temperature as observed in this study and by several others (Gurumahum et al ,2000:Agarwal and Thapliyal (2005). Higher dissolved oxygen during winter might also be due to photosynthetic activities at upper level.

According to Moyle (1946), water bodies having total alkalinity above 50 mg/l can be considered productive and this present findings showed lentic portion of river as being productive during both seasons. Lower calcium and magnesium hardness in monsoon may be attributed to dilution by rainwater. Similar observation was made by Gurumahum et al (2000).

The maximum fauna density in winter and minimum in monsoon season may be due to water temperature, water velocity, and turbidity been lower in winter months and these provide favourable environment for the growth of plankton. This has been confirmed by Agarwal et al (2005). The higher planktonic population density and fauna diversity in of river is due to favorable environment. The least floral diversity and density could be explained by the wide fluctuation in the water level brought about by flow regime of water from reservoir as regulated by Authority. Thus, the overall effect of the of river has been to cause changes in physicochemical parameters that led to increase in plankton density and fauna diversity.

Conclusion

In conclusion the present study exposed that the distribution and population density of phytoplankton and zooplankton depend upon the physico-chemical parameters of the environment. It is clear from the results that the nutrient present in the river are present in appropriate amount for the plankton’s growth. In addition the data generated in the form of chronicle are essential so that this information may be used as the assessment creator for conservation and effective utilization of water bodies.

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Table 1: The Range and Mean Values of Water Quality Parameters of river

Sr. No	Parameters	Summer			Monsoon			Winter		
		Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average
1	Temp. (oC)	22	25	23.5	22	26	24	22	24	23
2	TS (ppm)	228	322	275	344	500	422	212	224	218
3	TDS (ppm)	218	316	267	328	478	403	204	212	208
4	pH	7.3	7.8	7.55	7.4	7.5	7.45	7.8	8.1	7.95
6	DO (ppm)	6.1	7.3	6.7	8.9	11.7	10.3	6.1	6.9	6.5
7	BOD (ppm)	3.2	7.4	5.3	3.2	10.6	6.9	3.4	4.2	3.8
8	COD (ppm)	9.8	20.2	15	10.4	16	13.2	14	18	16
9	Total hardness (ppm)	150	212	181	148	184	166	120	132	126
10	Total alkalinity (ppm)	58	86	72	68	112	90	76	88	82
11	Chloride (ppm)	224	329	276.5	58.9	163.3	111.1	82.4	90.9	86.65
12	Oil and Grease (ppm)	0	1.2	0.6	0.4	0.8	0.6	0.8	1.2	1
13	Nitrate (ppm)	1.2	1.8	1.5	0.85	1.27	1.06	1.12	1.18	1.15
14	Phosphate (µg/l)	0.18	0.28	0.23	26	38	32	32	36	34
15	Silicate (ppm)	0.18	0.4	0.29	0.02	0.07	0.05	0.03	0.04	0.04

Table 2: Pollution Tolerant Genera of Phytoplankton From river.

(+) present and (-) shows absent

Sr. No.	Phytoplankton	Summer	Monsoon	Winter
1	*Anisonema sp.*	+	+	-
2	*Euglena sp.*	+	+	+
3	*Lepocynclis sp.*	+	+	+
4	*Actinastrum sp*	+	+	-
5	*Ankistrodesmus sp.*	+	+	-
6	*Chaetophora sp*	+	+	+
7	*Chlorella sp.*	+	+	+
8	*Chlorococcum sp.*	+	-	-
9	*Chlorosarcina sp.*	+	-	+
10	*Chodatella sp.*	+	-	-
11	*Cladophora sp.*	+	-	+
12	*Closteridium sp.*	+	-	+
13	*Closteriopsis sp.*	+	-	+
14	*Closterium sp*	+	+	+
15	*Coelastrum sp.*	+	+	+
16	*Cosmarium sp.*	+	+	+
17	*Dictyosphaerium sp.*	+	+	-
18	*Dispora sp.*	+	+	+
19	*Excentrosphaeria sp.*	+	+	-
20	*Micractinium sp.*	+	-	-
21	*Microspora sp.*	+	+	-

22	*Oocystis sp.*	+	+	+
23	*Pandorina sp.*	+	+	+
24	*Pediastrum sp.*	+	+	+
25	*Phytoconis sp.*	+	+	+
26	*Planktosphaeria sp.*	+	+	+
27	*Scenedesmus sp.*	+	+	+
28	*Sphaerocystis sp.*	+	+	+
29	*Sphaeroplea sp.*	+	-	+
30	*Staurastrum sp.*	+	-	+
31	*Stigeoclonium sp.*	+	-	+
32	*Tetradesmus sp.*	+	-	+
33	*Tetraedron sp.*	+	-	+
34	*Tetrastrum sp.*	+	+	+
35	*Ulothrix sp.*	+	+	+
36	*Achnanthes sp.*	+	-	+
37	*Anomoeoneis sp*	+	-	+
38	*Arachnochloris sp.*	+	-	+
39	*Caloneis sp.*	+	-	+
40	*Centritractus sp.*	+	-	+
41	*Chlorobotrys sp.*	+	-	+
42	*Cocconeis sp.*	+	-	+
43	*Cyclotella sp.*	+	+	+
44	*Denticula sp.*	+	+	+
45	*Diatoma sp.*	+	+	+
46	*Fragillaria sp.*	+	+	+
47	*Gomphoneis sp.*	+	+	+
48	*Gomphonema sp.*	+	+	+
49	*Melosira sp.*	+	+	+
50	*Navicula sp.*	+	+	+
51	*Nitzchia sp.*	+	+	+
52	*Pinnularia sp.*	+	+	+
53	*Stauroneis sp.*	+	+	+
54	*Synedra sp.*	+	+	+
55	*Agmenellum sp.*	+	+	+
56	*Anabaena sp.*	+	+	+
57	*Anacystis sp.*	+	+	+
58	*Lyngbya sp.*	+	+	+
59	*Oscillatoria sp.*	+	+	+
60	*Phormidium sp.*	+	+	+
61	*Spirulina sp.*	+	+	+

Table 3: Pollution Tolerant Genera of Zooplankton From river.

(+) present and (-) shows absent

Sr. No.	Zoo Plankton	Summer	Monsoon	Winter
1	*Daphnia sp.*	+	+	+
2	*Cyclops sp.*	+	+	+

3	*Brachionus sp.*	+	+	+
4	*Lepadella sp.*	+	+	-
5	*Pompholyx sp.*	+	+	-
6	*Keratella sp.*	+	+	-
7	*Philodina sp.*	+	+	+
8	*Euchlanis sp.*	+	+	+
9	*Notholca sp.*	+	+	+