Biolife 1(2):-1-7, 2013
AN INTERNATIONAL QUARTERLY JOURNAL OF BIOLOGY & LIFE SCIENCES
ISSN (online): 2320-4257
www.biolifejournals.com
BIOLIFE ORIGINAL ARTICLE

Physico-Chemical Characteristics and Phytoplankton of Morna Lake, Shirala (M.S.) India

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ABSTRACT

Morna Lake is largest Lake of Shirala Tahsil in Sangli District, Maharashtra. It is constructed over Morna River in the basin of Krishna. Present study was undertaken to investigate the physic – chemical characteristics and phytoplankton composition of the Morna Lake. Physico – chemical analysis of lake water exhibited richness in nitrogen (nitrite and ammonia) and orthrophosphates which favored the growth of phytoplankton. Dominance of Cyanophyceae in summer and rainy season and Bacillariophyceae in winter revealed distinct seasonal variation in the distribution of phytoplankton. The Lake was found to be moderately polluted and showed a trend of increasing eutrophication.

Key words : *Eutrophication, Physico – chemical characteristics, Phytoplankton, Pollution,Morna Lake*.

INTRODUCTION

Eutrophication is a global phenomenon associated with nutrient enrichment of aquatic ecosystem. In natural course it is slow process of lake aging ultimately lead to succession. Lakes have a more complex and fragile ecosystem as they do not have a self-cleaning ability and therefore readily accumulate pollutants. The increasing anthropogenic influence in recent years in and around aquatic systems and their catchment area have contributed to a large extent to deterioration of water quality and dwindling of water bodies leading to their accelerated eutrophication.

Several lakes were made ever green Shirala Tahsil. They were famous for religious and cultural significance. Some of these lakes are already on the verge of disappearance due to eutrophication. These lakes therefore demand concerted attention towards a clear understanding of their ecosystem in order to mitigate further deterioration. Hence the purpose of this study was to investigate the present status of Morna Lake in term of its water quality and distribution of phytoplankton.

Morna Lake is the largest Lake of Shirala constructed over Morna River in Krishna basin, having a historical, ethno-cultural, and religious and irrigation importance. It lies about 1 Km West of Shirala. The Lake occupies an area of about 85.5Km^2 and has an irregular octagonal outline. Actual length 1015 m. Height 31.2 m and nature of Lake is shallow and deep.

The Lake is surrounded by farmland and there are a few flowering and thorny trees. There are several macrophytes inside and around the Lake for examples *Achyranthes aspera, Caesulia axillaries, Potamogeton nodusus, Spilanthus calva, Rotala rotundifolia, Hygrophila sclulli, Marseilea sps. And Saccharum spontaneum* etc. Among them Hygrophila schulli was seen dominant in around the Lake.

Lake water being polluted is not used for drinking purpose. Local inhabitants use water for various purposes like bathing, washing clothes, swimming and cleaning cooking utensils. Inlets pouring water into lake also carrying chemical fertilizers and insecticides which further pollute the water.

MATERIALS AND METHODS

Physico-chemical and biological characteristics of the Lake were studied seasonally i.e. during summer, rainy and winter season of the year 2009. For these studies four different sites were selected on the basis of substratum structure, algal occurrence and human activities. Physico-chemical analysis of water was done as per standard methods recommended by APHA (1995), Trivedy and Goel (1984), and Maiti SK (2001). For the identification of phytoplanktons the standard keys provided by Biswas (1980), APHA(1995) were followed . Statistical analysis (Correlation Coefficient and standard deviation) was done on the basis of substantial availability of finding for the reality and significance of the result.

RESULT AND DISCUSSION

Quality of an aquatic ecosystem is dependent on the physical and chemical qualities of water as also biological diversity of the system (Ghavzan *et al*., 2006;Tiwari and Chauhan, 2006; Tas and Gonulol, 2007). Cairns and Dickson (1971) stated that the analysis of biological materials along with chemical characteristics of water from a valid method of water quality assessment. Hence, the physic- chemical characteristics and phytoplankton composition during different seasons of a year observed in present study have been discussed below.

Jana (1973) and Chari (1980) stated that temperature is a critical factor for seasonal periodicity of phytoplankton. Devika *et al*., (2006) reported that water temperature had direct relationship with phytoplankton population. Present study revealed that Bacillariophyceae have a negative correlation and Cyanophyceae have positive correlation with temperature. Water temperature shows minimum in winter and maximum in summer similar seasonal variation were observed by Surve *et al*.,(2005), Garg *et al*., (2010).

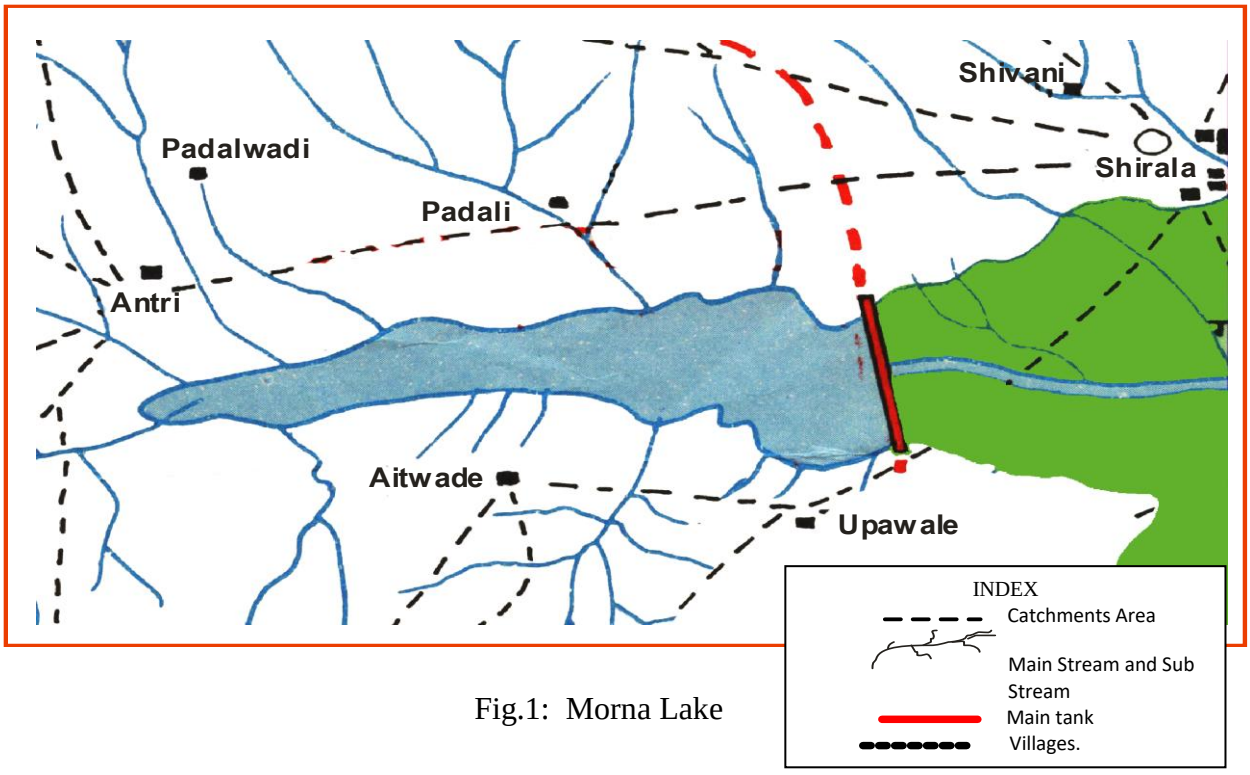

Fig.1: Morna Lake

S.No.	Parameters	Summer season	Rainy season	Winter season	Mean ± S.D
1.	Temperature (^{0}C)	26.74	25.13	13.94	21.93 ± 0.013
2.	Transparency (cm)	104.75	95.05	128.25	109.35 ± 4.08
3.	Total Solids (mg/l)	295.25	289.5	193.5	259.41 ± 5.53
4.	Conductivity (µs/cm)	297.75	293.75	194.75	262.08 ± 3.63
5.	pH	7.70	7.32	8.19	7.74 ± 0.069
6.	Alkalinity (mg/l)	188.5	150.05	178.25	172.26 ± 5.88
7.	Total Hardness (mg/l)	200	187.5	148.75	178.75 ± 7.98
8.	Dissolved Oxygen(mg/l)	5.35	4.77	9.86	6.66 ± 0.25
9.	B.O.D.(mg/l)	28.5	10.77	5.5	14.92 ± 2.06
10.	N-Nitrite (mg/l)	0.0157	0.020	0.032	0.023 ± 0.0014
11.	N- Ammonia (mg/l)	0.08	0.027	0.0005	0.035 ± 0.0044
12.	Orthophosphate (mg/l)	0.023	0.037	0.053	0.038 ± 0.0032

Table-1: Physico-chemical characteristics of water of Morna Lake

S.No.	Phytoplankton	Class	Summer season	Rainy season	Winter season
1	*Melosira granulata*	Bacillariophyceae	27	0	0
2	*Merismopedia elgans*	Cyanophyceae	45	405	440
3	*Oscillatoria brevis*	Cyanophyceae	36	356	380
4	*Phacus longicauda*	Euglenophyceae	0	35	44
5	*Navicula plecenta*	Bacillariophyceae	31	34	45
6	*Navicula subtilissima*	Bacillariophyceae	48	31	40
7	Nitezshia *palea*	Bacillariophyceae	56	42	31
8	*Pediastrum clathratum*	Bacillariophyceae	132	565	1256
9	*Euglena eherenbergii*	Euglenophyceae	125	700	1166
10	*Euglena spirogyara*	Euglenophyceae	26	39	0
11	*Merismopedia punectata*	Cyanophyceae	2556	1250	530
12	*Anabaena variabilis*	Cyanophyceae	48	28	45
13	*Microcystis wesenbergii*	Cyanophyceae	56	40	36
14	*Staurastrum gracile*	Bacillariophyceae	1450	1130	90
15	*Melosira italic*	Bacillariophyceae	4000	1260	3221
16	*Scenedesmus arcuatus*	Chlorophyceae	66	200	560
17	*Chroococcus minor*	Cyanophyceae	800	455	36
18	*Microcystis aeruginosa*	Cyanophyceae	4560	1258	5220

Table-2: Phytoplankton composition of Morna Lake (cells/ml)

It is well know that transparency of water is negatively proportional to primary productivity. During the present study highest value of transparency was (128.25cm) recorded during winter and the lowest value (95.05cm) during rainy season (Table 1). The value of correlation coefficient (r) of transparency was positive with Bacillariophyceae but negative with Cyanophyceae (Table 3). Similar observation was recorded by Bhatt *et al*., (1999), Devarju *et al*., (2005), Garg *et al*., (2010).

Conductivity is a good and rapid method to measure the total dissolved solids and is directly related to total solids (Mishra and Saksena 1993). Higher the value of dissolved solids, grater will be the amount of ions in water. In the present study highest value (297.75 µs/cm) was recorded in the month of May and lowest (194.75 µs/cm) in December. A similar pattern was recorded by Bhatt et al., (1999), Senthi Kumar and Sivakumar (2008), Garg *et al*., (2010).

During the present study average value of alkalinity varied 150.05 to 188.5 mg/l . Higher concentration of bicarbonate during summer season may be due to the decrease in water level by evaporation. In rainy season decrease the value of bicarbonates. Similar result was recorded by Bhatt *et al*., (1999), Garg *et al*., (2010). The correlation of alkalinity was negative with Bacillariophyceae and Cyanophyceae.

The total dissolved solids varied significantly along with phytoplankton. Value of total dissolved solids was positive significant with Cyanophyceae but negative with Bacillariophyceae. The pH of water varied from

S.No	Parameters	Correlation coefficient (r) with	
		Cyanophyceae	Bacillariophceae
1	Temperature (^{0}C)	0.337	-0.676
2	Transparency (cm)	-0.409	0.643
3	Total Solids (mg/l)	0.455	-0.638
4	Conductivity (µs/cm)	0.351	-0.686
5	pH	-0.325	0.323
6	Alkalinity (mg/l)	-0.145	-0.013
7	Total Hardness (mg/l)	0.344	0.221
8	Dissolved Oxygen(mg/l)	-0.345	0.876
9	B.O.D.(mg/l)	0.402	-0.672
10	N-Nitrite (mg/l)	-0.218	0.662
11	N- Ammonia (mg/l)	0.220	-0.676
12	Orthophospha te (mg/l)	0.201	0.722

Table 3. Correlation coefficient (r) values between physico-chemical parameters & phytoplankton of Morna Lake

7.7 to 8.1 during present study correlation coefficient was found negative with Cyanophyceae and positive with Bacillariophyceae.

However, earliar workers Jana (1973), Chari (1980), Bhatt *et al*., (1999), Bhulyan and Gupta (2007) observed that high pH value was related heavy bloom of phytoplanktons.

During present study hardness of water was maximum during summer (200 mg/l) and gradually decreased during rainy season (187.5 mg/l) and its lowest value during winter season (148.7 mg/l). Higher values in summer may be due to higher temperature which increases concentration of salts by excessive evaporation. The contents released from dead molluscan shell may also increase the concentration of total hardness, Khan and Chowdhury (1994), Bhatt *et al*., (1999).

Oxygen content is important for direct need of many organisms and affects the solubility and availability of many nutrients and therefore productivity of aquatic ecosystem (Wetzel 1983). Dissolved oxygen concentration more than 5.00 mg/l favors good growth of flora and fauna (Das 2000). During present study lowest average value (4.7 mg/l) was obtained during rainy season which reached highest during winter season (9.8 mg/l). The dissolved oxygen ranged from 3.41 to 6.21 mg/l in Seetadwar lake (Tewari and Mishra 2005), from 5.30 to 9.00 mg/l in Deoria tal (Rawat and Sharma 2005) and from 3.00 to 6.00 mg/l in Kandhar dam (Surve *et al*., 2005). The factors affecting the oxygen balance in water bodies are input due to atmosphere and photosynthesis and output from respiration decomposition and mineralization of organic matter as well as losses to atmosphere.

Yadav (1996) observed similar result that low Dissolved oxygen value in Taudaha Lake. Thus, the dissolved oxygen varies greatly from one water body to other. In summer season dissolved oxygen decreased due to increased temperature of water (Naz and Turkmen 2005) Harsi reservoir (Garg *et al*., 2006b) the dissolved oxygen in this reservoir also was quite enough to support biological life. Similar result also reported by Garg *et al*., (2010). The correlation of dissolved oxygen was found highly positive with Bacillariphyceae but it was found highly negative with Cyanophyceae.

Maximum value of Bio- chemical Oxygen Demand (BOD) was recorded in summer (28.5 mg/l) and lowest value (5.5 mg/l) in winter during the present investigation. High value of BOD in summer may be due to higher rate of organic decomposition. Gradual decline of BOD in winter may be due to decrease temperature which in turn retards microbial activity. Bhatt *et al*., (1999), Devaraju *et al*.,(2005), Garg *et al*.,(2010) have obtained similar result.

Nitrogen- nitrite is the middle step of nitrogen. Oxidation of ammonia first produces nitrite and then nitrate. The nitrate concentrations were lower during the entire investigation period. The nitrite content showed distinct seasonal cycle with relatively higher values in winter and lower in summer and monsoon. Lower concentration of nitrite in summer and monsoon may due to the utilization by Cyanophyceae. The negative

correlation of nitrite (-0.218) was found with Cyanophyceae which indicated higher consumption of nitrite by members of Cyanophyceae. A positive correlation was obtained for Bacillariophyceae (0.662).

Nitrogen- ammonia is present in the aquatic system mainly as the dissociated ions NH_4. The ammonia ion is rapidly taken up by phytoplanktons. Although, ammonia is a major excretory product of aquatic animals, this nitrogen source is quantitatively minor in comparison to that generated by microbial decomposition. Present study revealed that ammonia concentration ranged from 0.00 to 0.080 mg/l. higher value was recorded in summer which gradually declined in rainy season and could not be detected at all in winter. Higher value in summer may be due to the higher microbial activities and higher excretory product of aquatic animals Wetzel (1983) stated that ammonia is generated by heterotrophic microbes as a primary end product of decomposition of organic matter either directly from proteins or from the organic compounds. Correlation between ammonia and Cyanophyceae was found to be positive (0.220) but it showed negative correlation with Bacillariophyceae (-0.676).

The phosphorus in lake water occurs in form of Orthophosphates (P_{04}^{3}) .During the present investigation the highest concentration of phosphorus was found during monsoon and the lowest during summer. This was evidently due to the surface runoff from the surrounding crop fields fertilized with phosphate. Similar pattern recorded by Rawat and Sharma (2005), Thilaga *et al*., (2005), Garg *et al*., (2010). Lower concentration during summer may be due to higher consumption by macrophytes. Addition of phosphorus in different form causes explosive growth of algae like water hyacinth which lead to eutrophication of lake. During rainy season phosphate concentration increase may due to decayed phytoplanktons and concentration of zooplankton excreta.

Altogether 18 taxa of phytoplankton were recorded during the study period, out of which seven taxa belonging to Bacillariophyceae, seven to Cyanophyceae and three to Euglenophyceae and one to Chlorophyceae (Table 2). Maximum density of phytoplankton was recorded in summer and minimum in winter. Hassan *et al*.,(2010) reported contrast result that minimum density of phytoplankton during monsoon and maximum during summer in Euphrates river, Iraq. Similarly Laskar and Gupta (2009) reported minimum density of phytoplankton during monsoon and maximum during summer in Chatla Lake, Assam. High density of phytoplankton in summer was observed by Wojciechowska et *al*.,(2007), Nandan and Aher (2005), Pundhir and Rana (2002), Chellappa *et al*., (2008).

Among Cyanophyceae sp *Mycrocystis., Oscillatoria* sp., *Chrrococus* sp., *Anabaena* sp., were present throughout the year. *Microcyctis* sp., was dominant in all the season. Among Bacillariophyceae *Melosira* sp.,*Navicula* sp., were observed. Among Euglenophyceae *Euglena spirogyra, Euglena eherenbergii, Phecus longicauda* species were recorded. Among Chlorophyceae *Scenedesmus* sp.was recorded.

Result obtained suggest that Morna lake is moderately polluted and showed a trend of increasing eutrophication. Richness in nitrogen and orthophosphates were favorable for growth of phytoplanktons. Dominance of Cyanophyceae in summer and rainy seasons and Bacillariophyceae in winter showed distinct seasonal variation in the distribution of phytoplankton.

ACKNOWLEDGEMENT

Author is thankful to UGC (WesternRigional Office), Pune and Principal, head Dept. of Zoology, Krantisinh Nana Patil College, Walwe Dist. Sangli (M.S.) for providing laboratory facilities.

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DOI: https://dx.doi.org/10.5281/zenodo.7184936
Received: 10 April 2013;
Accepted; 25 May 2013;
Available online : 4 June 2013