



RESEARCH ARTICLE

ECOLOGICAL STUDIES OF ALISAGAR LAKE WITH REFERENCE TO WATER QUALITY

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ABSTRACT

The present paper deals with the ecological studies of Alisagar lake of Nizamabad District, Telangana. The water samples were collected for a period of 2 years (June-2014 to May-2016) to assess the quality of water. The lake water was alkaline throughout the period of investigation. High concentration of dissolved oxygen, carbonates and low concentration of chlorides, bicarbonates, total hardness and organic matter were recorded throughout the period of investigation. Four groups of phytoplankton were recorded in the lake. Among the four groups Diatoms were dominant and showed rich diversity followed by Chlorophyceae. Low temperature, high dissolved oxygen and silica favored the growth of diatoms. The maximum growth of diatoms was recorded during winter and minimum during summer and rainy season. Temperature, bicarbonates, nitrates, phosphates and organic matter were exhibiting direct relationship with Chlorophyceae.

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INTRODUCTION

Water is an integral constituent of life, and is one of the most important natural resource. The present domain of life existing on the earth originated and has evolved from water. Lakes are the major life supporting systems but are facing ecological degradation these days, due to anthropogenic activities (Kedar and Patil, 2002). The undesirable activities and unscientific utilization of resources from the lakes have caused environmental problems, thus threatening the biodiversity sustained by them. It is again important to note that these species-rich aquatic ecosystems are capable of self maintaining; however the delicate equilibrium is sensitive to external stimuli such as human activities promoted by socio-economic goals (Krishnamoorthi and Selvakumar, 2010). Exercising a control on the prevailing anthropogenic activities is necessary to sustain these socio-economically and bio-aesthetically important aquatic ecosystems. Quality of water is important for drinking, irrigation, fish production, recreation and other purposes. The water quality deterioration in reservoirs usually results from acidification, heavy metal contamination, organic pollution, obnoxious fishing practices and excessive nutrient input that leads to eutrophication.

The effects of these imports into the reservoir not only affect the socio-economic functions of the reservoir negatively, but also lead to the loss of structural biodiversity of the reservoir (Manikya Reddy and Venkateswarlu, 1987).

MATERIALS AND METHODS

Alisagar reservoir is located in Nizamabad district in Telangana, India. Which it is 13 km from Nizamabad and 2 km off the Nizamabad-Basar road. The water samples were collected for a period of 2 years (June-2014 to May-2016) to assess the quality of water. For this purpose, three sampling stations have been selected. Station-I is situated right side of the lake. Station-II is located middle of the bund. Station-III is situated left side of the lake. Water samples were collected from all the stations at monthly intervals and analyzed for various physico-chemical parameters following the standard methods (APHA, 2005). One liter of surface water sample were collected from three different stations of the lake and were kept in the sedimentation column after adding 2-3 ml of 4% formaldehyde solution. The samples were kept undisturbed for about one month for complete settling of the organisms. The samples were concentrated to 100 ml.

Finally the concentrated material was used for frequency measurement and identification of species. For frequency measurement of different species of algae at each station, the drop method of Pearsall et al., (1948) was followed.

RESULTS AND DISCUSSION

Physico-chemical parameters: Ranges and average values of physico-chemical parameters incorporated in Table: 1 The physico-chemical parameters exhibit certain interrelationships. In the present investigation maximum surface water temperature recorded in summer and minimum in winter. The surface water temperature ranged from 22^oC – 26.5^oC. Temperature is one of the most important factors in the aquatic environment that plays a crucial role in physico-chemical and biological behaviour of an aquatic system (Dwivedi and Pandey, 2002 and Singh and Mathur, 2005). Aquatic organisms depend on certain temperature range for their optimal growth (APHA, 2005). In the present study pH value remains alkaline throughout the study period and it ranged from 8.2 to 8.8 at all the stations. The carbonate values were maximum during summer and minimum during monsoon. In the present study, low values of carbonates were observed at all the three stations, which may be due to lower input of nutrients in water through human activities (Sedamkar and Angadi, 2003).

The pH and carbonates are directly related and both are inversely proportional to bicarbonates. Water temperature exhibit inverse relationship with dissolved oxygen. The chlorides exhibit significant positive correlation with bicarbonates. Dissolved oxygen showed negative relationship with biological oxygen demand and organic matter. Total hardness has showed significant positive correlation with calcium. Calcium exhibit direct relation with magnesium. Nitrites exhibit negative correlation with pH and carbonates. Total solids exhibit direct relation with carbonates. Bicarbonates during the study period's minimum value were 212.06 mg/L and maximum was 288.36 mg/L. The values of chlorides range from 102.20 mg/L to 189.26 mg/L. The maximum value (189.26 mg/L) was recorded in the month of May (summer) and minimum value (102.2 mg/L) in the month of January. In the present study maximum value of chloride reaches in summer (Swarnalatha and Narsing rao, 1990). Dissolved oxygen is considered to be an important parameter in analysis of water. In Alisagar Lake, the amount of dissolved oxygen recorded ranges from 5.8 mg/L to 13.2 mg/L.

Organic matter is composed of organic compounds that have come from the remains of once-living organisms such as plants and animals and their waste products in the environment. Organic matter ranged from 0.2 mg/L to 1.9 mg/L. Biochemical oxygen demand (BOD) is an important parameter of water quality which measures the quantity of oxygen consumption by microorganisms during decomposition of organic matter. Hence, BOD approximates the amount of organic matter present in the solution, and the biochemical oxygen demand value can be used as measure of waste strength (Srinivas et al., 2016). The BOD in the present study ranged from 2 mg/L to 12 mg/L. Chemical oxygen demand is the amount of oxygen required for oxidation of organic constituents with strong oxidizing agent. In the present study, the chemical oxygen values fluctuate between 12 to 32 mg/L. Total hardness of the lake, during the study period maximum of 134 mg/L to minimum of 220 mg/L.

Magnesium is second important metal present in natural water with calcium. Its quantity is lower than that of calcium. Average Magnesium content of Alisagar lake was oscillated between 23.92 to 28.7mg/L. Total sulphate was maximum in monsoon season (38.32 mg/l) and minimum in winter season (32.32 mg/L). Sulphates are found appreciably in all natural waters, particularly those with high salt content. The major sources of phosphate in the lake are domestic sewage, agricultural effluents. Phosphorus plays a major role in biological metabolism. The value of phosphate fluctuates from 0.02 mg/L to 0.09 mg/L. Concentration of silica in the water ranged from 1.4 mg/L to a maximum of 3.82 mg/L. The decreased amount of silica may occur when there is an abundance of diatoms. Nitrate is the most highly oxidized form of nitrogen compound commonly present in natural waters. The values of nitrate ranges from 0.5 mg/L to 1.12 mg/L. the maximum value (1.12 mg/L) was observed in the month of August and minimum (0.5 mg/L) in the month of December.

Nitrite is an intermediate stage in oxidation of nitrogen, both the oxidation of ammonia to nitrate as well as in reduction of nitrate. TS is a very useful parameter indicating the chemical constituents of the water and can be considered as a generator of edaphic relations that constitute to productivity within the water body (Gose and Pingale, 2007). Maximum total solids in Alisagar lake in monsoon reflects the input of rain water which brings large amount of dissolved solids and suspended solids with it as well as agitation of lake water due to water current. Minimum values of TDS at Alisagar Lake were evident with the high water level of post monsoon due to the excessive dilution, stagnation and low rate of evaporation. In the present investigations, the total dissolved solids in three sampling stations fluctuated from 220-400 mg/L. In accordance to TS, maximum TSS was recorded in monsoon as a result of water runoff from the catchment area which brings various suspended matter. Increased level of suspended solids results in increased turbidity and lower photosynthesis, rise in water temperature and decrease in dissolved oxygen (Sharma et al., 2010).

Phytoplankton: In the present study, four groups of algae. Bacillariophyceae, Chlorophyceae, Cyanophyceae and Euglenophyceae were identified. In Alisagar lake Bacillariophyceae dominating during the entire study period. Chlorophyceae members occupied second position, Cyanophyceae and Euglenophyceae occupied third and fourth positions (Table: 2). The peaks of diatoms have been noticed in winter and monsoon seasons (Manikya Reddy and Chandra Shekar 2008). Higher level of DO, optimum temperature, alkaline pH and nutrient concentration has favored the growth and multiplication of diatoms (Mishra et al., 2007). Diatoms consists of *Synedra tabulata*, *Achnanthes microcephala*, *Coconeis placentula*, *Amphora ovalis*, *Cymbella affinis*, *C.turgida*, *C.delicatula*, *C.cymbiformis* and *Mastogloea smithii*. In the present study Chlorophyceae occupied second position in order of dominance in the lake at all the stations. Chlorophyceae showed maxima in summer months and minima in winter at all the stations. High Chlorophycean count registered during summer months may be due to low DO and bicarbonate level prevailing during these periods, which favors its quick growth. Chlorophyceae are represented by the species of *Chlorella pyrenoidosa*, *Pediastrum boryanum*, *Golonkinia radiata*, *Coelastrum cambricum*, *Oocystis elliptica*, *Tetraedron regulare*, *Scenedesmus acutiformis* and *S. armatus*.

Table 1. Ranges and Average Values of Physico-Chemical Parameters

All values are expressed in mg/L except pH and Temp ($^{\circ}$ C)

Parameters	STATION - I		STATION - II		STATION - III	
	Average	Range	Average	Range	Average	Range
Temperature	23.63	22.0 - 25.5	23.76	22.0 - 26	23.67	22.0-26.5
pH	8.47	8.0 - 8.8	8.50	8.0 - 8.8	8.51	8.2 - 8.8
CO ₃ ²⁻	34.95	12.42 - 56.24	38.33	18.24 - 58.64	42.0	18.02 - 58.24
HCO ₃ ⁻	246.62	212.06 - 288.26	245.27	214.26 - 288.58	248.0	228.46 - 288.36
Cl ⁻	134.89	102.20 - 158.26	137.59	122.44 - 168.54	149.75	114.86 - 189.26
DO	8.46	5.8 - 11.8	9.46	7.8 - 12.4	9.95	8.8 - 13.2
BOD	9.20	6.0 - 12.0	7.96	2 - 10.00	7.68	4 - 12.0
OM	0.88	0.2 - 1.8	1.08	0.6 - 1.9	0.98	0.4 - 1.4
COD	21.7	12 - 32	20.67	14 - 28	17.38	12 - 24
TH	156.73	134 - 192	184.20	140 - 220	178.96	134 - 206
Ca ²⁺	55.37	44.54 - 68.26	45.91	31.98 - 58.24	43.80	36.24 - 52.58
Mg ²⁺	26.22	20.63 - 35.95	23.92	18.54 - 32.26	27.30	12.86 - 32.69
SO ₄ ²⁻	38.32	32 - 55	35.77	25 - 45	32.32	10 - 44
PO ₄ ³⁻	0.06	0.02 - 0.09	0.08	0.04 - 0.09	0.07	0.04 - 0.09
SiO ₂	2.20	1.4 - 2.80	2.13	1.52 - 3.22	2.33	1.52 - 3.82
NO ₃ ⁻	0.68	0.50 - 0.90	0.71	0.5 - 0.95	0.82	0.64 - 1.12
NO ₂ ⁻	0.03	0.02 - 0.05	0.032	0.02 - 0.06	0.036	0.02 - 0.05
TS	464.3	420 - 510	494.46	410 - 550	534.30	470 - 590
TDS	264.4	240 - 290	310.36	220 - 380	343.20	290 - 400
TSS	194.26	150 - 230	194.70	170 - 250	190.56	130 - 250

Table 2 Percentage of Phytoplankton

ALGAE GROUPS	Station-I	Station-II	Station-III
BACILLARIOPHYCEAE	55.75	56.11	57.0
CHLOROPHYCEAE	29.28	28.11	26.42
CYANOPHYCEAE	10.12	10.54	12.09
EUGLENOPHYCEAE	4.85	5.24	4.49

Peak in Cyanophyceae has been observed during summer season. The increased temperature during this period seems to play a very important role in the periodicity of Cyanophyceae. In the present investigation this group is mainly represented by the species of *Merismopedia glauca*, *M. punctata*, *Gomphosphaeria aponina*, *Anabaena unisporea*, *Oscillatoria princeps*, *O. margarifera*, *Chroococcus turgidus* and *Chroococcus minutus*. Euglenophyceae, the least represented among phytoplankton was observed sporadically. The species of *Euglena*, *Phacus* and *Trachelomonas* have appeared in summer season, in considerable number.

Conclusion

In Alisagar lake all the physico-chemical parameters were well below the permissible limits of fresh water standards prescribed by various International Organizations. The lake water was alkaline throughout the period of investigation. High concentration of dissolved oxygen, carbonates and low concentration of chlorides, bicarbonates, total hardness and organic matter were recorded throughout the period of investigation. Four groups of phytoplankton were recorded. Among the four groups Diatoms were dominant and showed rich diversity followed by Chlorophyceae. Based on the physico-chemical and biological characteristics the Alisagar lake is categorized as oligotrophic. On the basis of physico-chemical and biological parameters it can be concluded that

the water is fresh and unpolluted and can be used for drinking, domestic and agricultural purposes.

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