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Current water quality status of a Monomictic LakeKashmir

Sualiha Tabassum[1]*, Alka Tiwari[1] and Mohammad Farooq Mir[2]

[1]Dept. of zoology Govt. MVM Bhopal, M.P, India.

[2]Hydrobiology Research Laboratory, S.P. College,

Constituent College of the Cluster University Srinagar, J and K, India.

ABSTRACT

Present investigation was undertaken to evaluate the water quality status of Manasbal Lake. The lake was investigated for a period of one year from March 2015 to February 2016 and a total of 11 physico-chemical parameters were analyzed by following standard methods of APHA,1998. Among the various parameters recorded the overall Air temperature ranged from 3.9°C-30.3°C; water temperature ranged from 2.2°C-26.6°C;Dissolved oxygen ranged from 6.9-8.9 mg/L; Total Alkalinity varied from 137-177 mg/L; Electric Conductivity varied from 292-433µs cm^{-1}; pH ranged from 7.1-8.5 ; Free carbon dioxide ranged from 9.1-20.2 mg/L; Transparency ranged from 0.81-2.1 m; Total Hardness ranged from 130-191 mg/L; Nitrate Nitrogen varied from 97.2-132µg/L and Total Phosphorous ranged from 82.2-210µg/L. The investigation revealed that untreated sewage and solid garbage from surrounding population, fertilizers containing Nitrates and Phosphates and slit load were the main causes for degradation of water quality of the studied lake. So immediate remedial measures should be taken for its protection from further depletion.

Key words: -Physico-chemical parameters, Anthropogenic pressure, Climatic factors, Manasbal Lake.

I INTRODUCTION

Kashmir valley is famous all over the world for its natural beauty as well as numerable freshwater resources in the form of lakes, wet lands, rivers, ponds,springs and streams.These freshwater bodies are not only important for ecological, socio-economic and cultural heritage of the state but also serve as primary source for the upliftment of local economy.Besides,80% population of valley is entirely dependent on these water bodies used for drinking, irrigation and domestic purposes while most of the water bodies have been maintained and decorated for tourist purposes and are the best health resorts of Kashmir valley.The valley lakes, are densely covered with macrophytic vegetation because during growing season bulk of nutrients are locked up within the macrophytic tissues. In these valley lakes the problem of pollution is mainly due to addition of major plant nutrients particularly Nitrogen and Phosphorus, derived from human wastes, detergents, fertilizers, agricultural activities etc at an accelerated rate. The nutrients have been chiefly responsible for an increase in organic production particularly in the form of dense

macrophytic growth and the overall deterioration of water quality. The deterioration of water quality and other associated problems as a result of racing eutrophication have reduced the recreational and aesthetic appeal of the lakes(Khan *et al.*,2013). The Present study was undertaken to study the physico-chemical parameters of Manasbal Lake,Kashmir and the main causes responsible for its water quality degradation.

II MATERIAL AND METHODS

STUDY AREA

Manasbal Lake, the urban valley lakehas its own unique identity due to its natural view which attracts the tourists. It is oblong shaped in outline and is the only lake in Kashmir that develops stable summer stratification and is classified as warm monomictic lake**(**Dewan, 2004).The Lake is situated at an altitude of 1583 m above sea level between geographical coordinates of $34^0$14' - $34^0$16'N latitude and $74^0$40' - $74^0$43' E longitude. The Lake covers an actual area of about 2.81 km^2 with depth of 13 m and catchment of about 33km^2.Manasbal Lake is considered as the deepest Lake in Kashmir Valley and the volume of water in Lake has been estimated as 12.8*$10^6$$m^3$. Three sampling sites were selected for the present studyviz; M1, M2 and M3 (Fig.1 and 2).

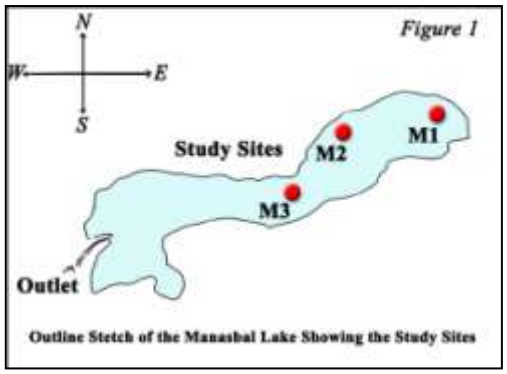

Figure 1
Outline Stetch of the Manasbal Lake Showing the Study Sites

Figure 2

Methodology

Water samples were collected from three sample sites with the help of 2.5 litre water sampler in polyethylene plastic sample bottles on monthly basis from March 2015 to February 2016 and were analyzed for various physico-chemical parameters according to the procedures given in(APHA, 1998).Some of the parameters like temperature, transparency, pH and free CO_2 were analysed on the spot.Dissolved oxygen samples were fixed on the spot in accordance with Winkler's method,whereas other parameters like total alkalinity,electric conductivity,nitrate nitrogen andtotal phosphorus were analysed at hydrobiology research laboratory S. P. College Srinagar.

Morphometric features of the Manasbal Lake

Latitude: - *34°.14'- 34°.16'N*

Longitude: - *74°.40'- 74°.43'E*

Lake type: - *Freshwater*

Catchment Area: - *33km²*

Surface area: - *2.81 km^2*

Length: - *5 km*

Width: - *1 km*

Maximum depth: - *13 m*

Minimum depth: - *4.5 m*

Distance from Srinagar: - *31 to 32 Km*

Water Volume: - *12.8*10^{6}m^3*

III RESULTS AND DISCUSSION

The results of various physico-chemical parameters of the water samples of Monomictic Manasbal Lake are summarized in **Table 1**.

The air and water temperatures of the different study sites during the study period ranged from 3.9°C to 30.3°C and 2.2°C to 26.6°C respectively. The maximum air temperature was recorded in July and minimum in January while as maximum water temperature was recorded in August and minimum in December.Both air and water temperature showed monthly variation in the present investigation. Similar results were obtained by Yousuf and Qadri(1981), Rao *et al*., 1982, Billore and Vyas(1982), Zuber et al., 2010, Parray*et al*., 2010, Dar*et al*., 2013 and Naik *et al*.,2015.

Dissolved oxygen is of paramount importance because it is critical to the survival of most forms of aquatic life besides being the most reliable criterion in assessing the trophic status and the magnitude of eutrophication (Edmondson, 1966).The dissolved oxygen (DO) values of the present study varied from 6.9 to 8.9 mg/L throughout the study period. The maximum concentration of dissolved oxygen was recorded in Februarywhich could be related to increased oxygen retention capacity of water and reduction in respiratory consumption of oxygen due to reduced metabolic rate and increased photosynthetic activity of the autotrophs. A marked decrease of DO concentration was observed in July that can be the result of increasing water temperature which results in decrease in oxygen retention capacity of water and increased rate of decomposition. These results are in broad agreement with Wanganeo (1980), Ganie*et al*.,(2012),Kumar *et al*.,(2004),Parveen*et al*.,(2013), Dar*et al*., 2013and Thoker*et al* .,2015.

The Total alkalinity in all the study sites during the study period ranged from 137 to 177 mg/L. Fluctuation of alkalinity can be attributed to the diurnal change in photosynthesis and seasonal change in biomass(Shah and Shah., 2013).Highly alkaline water is unpotable as with alkalinity beyond 200mg/l, the taste of water becomes unpleasant.

Electric conductivity is an indicator of dissolved ions present in any water sample.During the present study electric conductivity values varied from 292 to 433 µScm-1.The high values in June July may be probably due to high runoff from the catchment and abundance of minerals released during the decomposition of organic matter at rising temperature.While as,relatively lowest values were recorded in February thatcould be related to the uptake of ions by autotrophs.

During the present studypH values ranged from 7.1 to 8.5 showing alkaline nature of water.pH recorded being in alkaline range indicated that the lake was well buffered throughout the study period.pH range between 6.0 and 8.5 indicates productive nature of water body (Garg *et al*., 2010)

The carbon dioxide content of water depends upon the water temperature, depth,and rate of respiration, decomposition of organic matter, chemical nature of the bottom and geographical features of the terrain surrounding the water body (Sakhare and Joshi 2002).In the present study, concentrations of free carbon dioxide varied between 9.1 to 20.2 mg/L.High concentration ofCo_2wasfound in July may be due to decomposition of organic matter, utilizing dissolved oxygen and liberating Co_2 during various biological processes(Ahangar*et al*., 2012).

During present study transparency ranged from 0.81 to 2.1 m. Low Secchi values were recorded during this study.The flow of sewage and increased quantity of dissolved organic matter maybe the factor for low Secchi values (Wanganeo 1980).Lower values of transparency couldalso be due to increased suspended matter, siltation, blooms of planktonicalgae (Thilage*et al*., 2005; Akuskar andGaikawad 2006),humus brought in from the catchment area and rich macro-vegetation(Siraj*et al.,* 2006 and Naik*et al.,* 2015). However, higher values of transparency may be due to low biological activity (Pandit and Rather,2006) and sedimentation of suspended particles (Spurr,1975)**.**The transparency of 0.2 meters clearly depicts silt load in lake.

The values of total hardness ranged from 130 to 191 mg/L. Hardness is due to the presence of divalent metallic cations like calcium and magnesium. The source of calcium and magnesium can be attributed to the presence of lime stones and dolomites in the catchment areas (Zutshi*et al.,* 1980)and due to carbonates and bicarbonates of calcium and magnesium salts from detergents and soap (Dar *et al.,* 2013)**.**High values of hardness recorded throughout the study period in all the three selected sites might be due anthropogenic activities in and around this water body in addition to incoming sewage.

During the present study Nitrate nitrogen ranged from 97.2 to 132µg/L.An increase in the concentration of Nitrate Nitrogen was observed, that can be related to oxidation of ammonical nitrogen to Nitrate(Toetz, 1981) and (Quastle and Scholefield, 1951). Higher concentration of Nitrate favoured growth of phytoplankton (Miltan*et al.,* 2015)

The source of phosphate to the lake is sewage runoff and macrophytic decomposition.Phosphorus is an essential requirement for living organisms. However, at high concentrations it is considered as a pollutant, because it causes eutrophication which is supported by Thomas (1969) who pointed out that addition of phosphorus brings about eutrophication mechanism by increasing the bacterial content, increase in oxygen demand and increase in the growth of algae.In the present study total phosphorus ranged from 82.2 to 210µg/L at all the study sites. The high concentration of phosphorus was observed during July that can be attributed to decay and subsequent mineralization of dead organic matter and surface runoff (Cole, 1975), while low concentration was observed during the month of February, this may be due to the quick uptake and subsequent storage of phosphate by the plankton, locking up of phosphate in the dense macrophytic vegetation that abounds in the lake (khan *et al.*, 2014).

Table 1:-The minimum and maximum values of various physico- chemical parameters of Manasbal Lake during March 2015 to February 2016.

S.No.	Parameters	Units	Range of Variation		Mean	S.D
			Min	*Max*		
1.	**Air temperature**	**^{o}C**	3.9	30.3	17.4	9.45s
2.	**Water Temperature**	**^{o}C**	2.2	26.6	14.7	8.30
3.	**Dissolved O_2**	**Mg/L**	6.9	8.9	7.8	0.66
4.	**Total Alkalinity**	**Mg/L**	137	177	153.5	12.55
5.	**Electric Conductivity**	**(µS/cm)**	292	433	351.6	41.96
6.	**pH**	-	7.1	8.5	7.7	0.41
7.	**Free Co_2**	**Mg/L**	9.1	20.2	14.5	3.99
8.	**Transparency**	**M**	0.81	2.1	1.32	0.48
9.	**Total Hardness**	**Mg/L**	130	191	162	19.82
10.	**Nitrate Nitrogen**	**µg/L**	97.2	132	113.3	12.20
11.	**Total Phosphorous**	**Mg/L**	82.2	210	145.7	44.27

IV CONCLUSIONS

From the present study it can be concluded that the higher values of Nitrates, Phosphates, Alkalinity, Hardness, ElectricConductivity, Free carbon dioxide and lower values of dissolved oxygen and transparency clearly depicted higher trophic status of Manasbal lake. It can also be concluded that climatic factors, untreated sewage and solid garbage from surrounding population, fertilizers containing Nitrates and Phosphates and slit load were the main causes for degradation of water quality of the studied lake. Hence periodic monitoring of Manasbal Lake is necessary for assessing the quality of water for human and animal consumption as well as for aquatic life.

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