Physico Chemical Characteristics of Brari Nambal Basin of Dal Lake, Kashmir

Anjum Malik and Ashok K. Pandit
Centre of Research for Development, University of Kashmir, Srinagar- 190 006, J & K, India.

ABSTRACT

The study was undertaken on the physico-chemical characteristics of one of the basins of Dal lake, the Brari Nambal, during 2002.The basin can be considered eutrophic as evinced by it's shallow depth (0.40-1.80m), low transparency (0.30-0.70m), low dissolved oxygen (0.4-2.5mg/L) and higher concentration of all the major plant nutrients.

Keywords: Water quality, Dal lake, Brari Nambal, eutrophic

INTRODUCTION

The Dal lake, one of the important urban water bodies of Kashmir, is showing clear signs of eutrophication due to heavy anthropogenic pressures in its catchment area. Brari Nambal, its most polluted basin, is the dumping ground for huge quantities of waste that is added to it from the adjoining areas, thereby shrinking its size, deteriorating its water quality, enhancing its trophic status and bringing near to dystrophic stage. Moreover, nothing has been done to stop the discharge of domestic effluents into the basin; instead more drains have been constructed to divert the raw sewage from the dense population directly into the basin. As the lagoon has a connection with Dal lake, its enriched water travels deep into the lake basin posing a serious threat to the health of the lake itself. Though numerous ecological studies have been conducted on the Dal lake in general, yet very little is known about its most polluted basin (Yousuf and Parveen, 1992). It is in this backdrop that the present work was carried out on the water quality of the Brari Nambal basin.

STUDY AREA

Brari Nambal, one of the polluted basins of Dal lake, has an area of about 0.7Km^2 and is saucer shaped with maximum depth of 1.77m (average depth ranging between 40-60cms).The basin is connected to the Gagribal basin of Dal lake through a channel called Chinar-Bagh Nallah passing through Nowpora. Besides this, a number of ephemeral water channels and drains enter the lake basin from the human settlements and discharge large quantities of wastewater. The peripheral catchment of Brari Nambal is composed of thickly populated area of Srinagar city and due to the closure of Nallah Mar, it has become an ecological sick lagoon without any flushing of water. The topography of the basin around Brari Nambal lagoon is such that all the drains bringing in huge quantities of sewage find their way into the lagoon making it a mere cesspool. Five sampling sites were selected for the collection of water samples. (Figs. 1-5)

Site I: located towards the southern edge of the lagoon having depth range of 0.70 -1.13m.
Site II: located towards the southwestern side having a depth range of 0.50-0.80m.
Site III: located in emergent vegetation at the western side and the water depth ranges between 0.57-0.83m.
Site IV: located in the center and water depth ranging between 1.10-1.77m.
Site V: located towards the eastern side and lies adjacent to a big drain bringing huge quantities of sewage into the basin. The site is moderately deep (0.97-1.57m)

METHODOLOGY

Water samples were collected on monthly basis from 900h to 1200h from five sampling sites in 1litre polyethylene bottles. Parameters like depth, water temperature, conductivity, pH, transparency and dissolved oxygen were determined on spot, while the chemical parameters were determined within 24hr of sampling, either titrimetrically or spectrophotometrically in the laboratory following the standard methods of Mackereth (1963), Golterman and Clymo (1969) and APHA (1989).

RESULTS AND DISCUSSION

Brari Nambal lagoon is a shallow water body with a maximum depth of 1.80m during spring at site IV. According to Rawson (1956), lake with a maximum depth of 10m or less is usually considered as eutrophic. The results depicted low mean values (0.50m) at Site II during summer and higher mean values (1.77m) at Site IV during spring (Table 1).

Fig. 1 Site I located in the house boat area near Gendhi College

Fig. 2 Site II near the vegeted zone towards the temple

Fig 3. III loated towards western side of the bas in

Fig. 4 Site IV in the open water area

Fig 5. Site V near the drainfull of garbage and other solid wastes. The area is subjected to dredging activity.

Water transparency is an important factor that controls the energy relationship at different trophic levels. It is essentially a function of reflection of light from the surface and is influenced by the absorption characteristics both of water and of its dissolved and particulate matter (Stepanek, 1959), especially in productive waters like that of Brari Nambal basin. Higher turbidity values during spring (0.60m at Site III) is attributed to the lesser biogenic activities and greater water mass due to rains, while as lower values (0.33m at Sites I and II) were corresponding with the months of higher algal growth periods of summer. Saran and Adoni (1982) also found the decreased values of transparency associated with phytoplankton maxima.

The surface water temperature showed a close relation with the atmospheric temperature and the incoming solar radiations. This may be attributed to its narrow depth and little water volume. In general, temperature of the basin fluctuated between a minimum of 5.0 °C at Sites I, II and IV during winter and a maximum of 28.0 °C at Sites II and III during summer.

The pH recorded during the present study (7.4 7.8) is indicative of the alkaline nature of water. The basin can be considered to hypereutrophic as per conductivity values ranging between 608.33 and 794.33uS/cm, which were thus above eutrophic levels of 200dS/cm (Olson, 1950).

Dissolved oxygen is one of the most reliable parameters in assessing the trophic status and the magnitude of eutrophication in an aquatic ecosystem (Edmondson, 1966). Its concentration was generally low and ranged between the lowest mean value of 0.70mg/L at Site IV during summer and highest mean value of 2.13mg/L at Site V during winter, which is in conformity with the concept of solubility of gases in relation with temperature (Pahwa and Mehrotra, 1966). The low level of dissolved oxygen is again indicative of polluted nature of water body.

According to Zafar (1964), chloride can be considered as one of the basic parameters of classifying lakes polluted by sewage into different categories. In the Brari Nambal basin, where large quantities of domestic sewage fall into the water; higher chloride content was recorded during summer against a lowest in winter. The high chloride content may be attributed to the presence of large amounts of organic matter of both allochthonous and autochthonous origin (Pandit, 1999). Further Thresh *et al.* (1994) attributed high chloride content of water to organic pollution of animal origin.

The alkalinity of water is mainly due to bicarbonates, carbonates being altogether absent. The values ranged between a minimum of 154.33mg/L during summer to a maximum of 331.33mg/L during winter. The lower values during summer may be attributed to the utilization of CO_2 by autotrophs and therefore, precipitation of calcium as $CaCO_3$ (Otsuki and Wetzel, 1972). The salts of the two most common divalent cations of the lake water, calcium and magnesium, usually account for most of the hardness. The calcium content varied between the lowest and highest values of 30.47mg/L at Site V during summer and 59.10mg/L at Site II during spring respectively.

The values of magnesium varied from minimum of 11.3mg/L at Site IV during summer to a maximum of 39.70mg/L during spring; as such the ion was comparatively four times lower than that of calcium. This is in conformity with the ratio recorded by Zutshi and Khan (1977) for other valley lakes. The low magnesium content is possibly due to its uptake by the plants in the formation of chlorophyll-magnesium-porphyrin metal complex and in the enzymatic transformations (Wetzel, 1975).

The higher iron content 938.67µg/L at Site I of the lake basin may be due to the increased effect of domestic wastes and washing activities in the catchment area, as most of the detergents used contain trace elements of iron (c.f. Koul *et al.*, 1989).

The higher concentration of the key plant nutrients, particularly nitrogen and phosphorous, are naturally to be expected in the polluted waters (Munawar, 1970; Vollenweider, 1968). Thus, the values of both NO_3-N and NH_4-N were high 1794.3µg/L and 1941.3ug/L at Sites I and IV respectively during summer compared to the lower values, 1413.0ug/L at Site IV and 1263.7µg/L at Site I during winter. In contrast to the findings of other authors (Kaul *et al*, 1978; Zutshi *et al.*, 1980; Pandit, 1999) where phosphorus levels were limiting in fresh water lakes in Kashmir compared to the nitrogen values. The phosphorus levels in this lake basin were not so limiting. The OPP and TPP values showed a trend similar to that of nitrogen, being maximum, 711.33µg/L and 3064.7µg/L during summer respectively and minimum 349.00µg/L and 1547.7µg/L during winter and autumn respectively. The higher levels of N and P during summer may be attributed to the application of nitrogen and phosphorus based fertilizers in the vegetable gardens located within and around the basin. The stimulation of algal blooms and a decrease in water clarity and quality during summer paralled the increased nutrient input to the lagoon, which is brought through domestic and agricultural wastes (Edmondson, 1959). The increased silicate concentration 20.67mg/L during spring at Site III seemed to be influenced by the input of silt laden runoff. Apart from this, weathering of alumino-silicates in the catchment area may be considered as the major source.

In conclusion, Brari Nambal basin may be considered highly eutrophic as evidenced by its shallow depth, low transparency, low oxygen level and higher amounts of plant nutrients.

Table 1. Seasonal mean values of physico-chemical parameters of Brari Nambal

Parameters	Sites	Winter	Spring	Summer	Autumn
Depth (m)	I	0.70	1.13	1.03	0.83
	II	0.50	0.80	0.73	0.57
	III	0.57	0.83	0.73	0.57
	IV	1.10	1.77	1.53	1.23
	V	0.97	1.53	1.37	1.07
Transparency (m)	I	0.47	0.57	0.33	0.53
	II	0.43	0.50	0.33	0.53
	III	0.47	0.60	0.43	0.50
	IV	0.47	0.57	0.43	0.53
	V	0.47	0.57	0.43	0.50
Water Temp (°C)	I	7.07	13.83	25.33	16.67
	II	7.33	14.00	25.50	16.83
	III	7.33	14.07	25.50	16.67
	IV	7.17	13.67	25.17	17.00
	V	6.83	13.73	25.33	17.00
pH	I	7.37	7.67	7.73	7.57
	II	7.43	7.80	7.67	7.47
	III	7.40	7.73	7.73	7.53
	IV	7.53	7.77	7.67	7.47
	V	7.50	7.73	7.73	7.50
Conductivity (µS/cm)	I	794.33	723.00	635.00	685.00
	II	783.00	681.33	628.33	654.67
	III	738.33	720.33	653.67	698.33
	IV	763.33	708.33	608.33	689.67
	V	755.33	704.67	646.67	661.67
Dissolved oxygen (mg/L)	I	2.07	1.70	0.97	1.37
	II	1.83	1.70	0.87	1.27
	III	1.97	1.73	0.97	1.27
	IV	1.90	1.70	0.70	1.47
	V	2.13	1.67	1.10	1.67
Total alkalinity (mg/L)	I	318.67	231.33	157.67	196.67
	II	247.67	219.33	164.00	195.67
	III	275.00	228.00	154.33	206.00
	IV	312.00	238.33	157.33	190.33
	V	331.33	229.67	162.33	202.33
Calcium (mg/L)	I	42.63	58.23	33.87	47.20
	II	43.93	59.10	34.17	47.37
	III	34.63	57.73	33.90	47.03
	IV	34.00	57.73	32.13	46.37
	V	36.83	58.60	30.47	45.57

Table 1 Contd.

Table 1 Contd.

Magnesium (mg/L)	I	28.23	38.77	13.53	23.97
	II	30.80	38.37	12.27	24.23
	III	28.63	38.43	13.57	24.27
	IV	28.00	38.30	11.13	24.10
	V	30.83	39.70	12.43	24.47
Chloride (mg/L)	I	73.00	101.00	238.67	130.67
	II	73.33	100.67	238.67	142.00
	III	73.67	97.67	242.67	134.33
	IV	75.33	100.33	239.00	141.00
	V	70.33	94.33	233.00	136.67
OPP (μg/L)	I	439.67	654.00	707.67	540.00
	II	349.00	687.33	709.00	527.67
	III	362.67	668.33	705.67	533.00
	IV	375.33	665.67	709.33	533.33
	V	406.00	674.00	711.33	530.00
TPP (μg/L)	I	2011.0	2404.7	2897.0	1578.7
	II	1978.7	2419.7	2887.3	1779.7
	III	2283.7	2520.3	3064.7	1654.7
	IV	2458.7	2266.3	2871.7	1734.7.
	V	2242.0	2612.3	2914.7	1547.7
Ammonical - N (μg/L)	I	1263.7	1539.3	1932.0	1446.3
	II	1272.3	1601.3	1939.0	1522.3
	III	1323.0	1640.7	1927.3	1477.7
	IV	1303.7	1627.0	1941.3	1477.7
	V	1268.0	1617.0	1936.0	1467.3
Nitrate - N (μg/L)	I	1416.0	1627.0	1794.3	1614.7
	II	1424.7	1624.3	1786.0	1624.0
	III	1421.7	1630.7	1831.3	1622.7
	IV	1413.0	1632.7	1792.3	1630.0
	V	1417.0	1659.3	1790.7	1623.7
Silicate (mg/L)	I	7.67	17.77	9.53	8.77
	II	7.40	16.67	10.73	8.93
	III	7.57	20.67	11.13	9.13
	IV	7.77	16.70	10.03	9.30
	V	7.70	16.57	10.67	9.70
Iron (μg/L)	I	938.67	766.00	627.00	739.33
	II	927.33	749.00	636.67	761.67
	III	930.00	754.33	629.00	775.00
	IV	893.00	736.67	636.00	763.33
	V	897.33	748.67	620.00	780.33

REFERENCES

A. P. H. A. 1989. *Standard Methods for the Examination of Water and Waste water*. 17" Ed. American Public Health Association, American Water Works Association, Water Pollution Control Federation, Washington D. C.

Edmondson, W. T. 1959. *Freshwater Biology*. John Wiley and Sons Inc., New York, London.

Edmondson, W.T. 1966. Changes in the oxygen deficit of lake Washington. *Verh. Internat. Verein. Limnol.*, **16:** 153-158.

Golterman, H. L. and Clymo, R. S. 1969. *Methods for Chemical Analysis of Freshwaters*. IBP. Handbook No. 8. Blackwell Scientific Publications, Oxford.

King, D. L. 1970. The role of carbon in eutrophication. *J. Water Poll. Cont. Fed.*, **42:** 2037 - 2051.

Koul, V.K., Zutshi, D.P. and Dubey, K.P. 1989. Hydrochemistry and pollution status of some Kashmir Himalayan lakes. *Pol. Arch. Hydrobiol.*, **36 (1)**: 21-28.

Mackereth, F. J. H. 1963. *Some Methods of Water Analysis for Limnologists*. Sci., Publ. Freshwater Biol. Assoc. (England) No. **21:** 71.

Munawar, M. 1970. Limnological studies on freshwater ponds of Hyderabad, India. II. The biocoenose. Distribution of unicellular and colonial phytoplankton in polluted and unpolluted environments. *Hydrobiologia*. **36:** 105-128.

Olson, S. 1950. Aquatic plants and hydrospheric factors. I. Aquatic plants in SW Jutland, Denmark. *Svensk Botanisk Tidskriff.* **44:** 1-34.

Otsuki, A. and Wetzel, R. G. 1972. Coprecipetation of phosphate with carbonates in a Marl lake. *Limnol. Oceanogr.*, **17 (5):** 763-767.

Pahwa, D.V. and Mehrotra, S.N. 1966. Observations on fluctuations in the abundance of plankton in relation to certain hydrological conditions of River Ganga. *Proc. Nat. Acad. Sci. India.* **36 (2):** 157-189.

Pandit, A.K. 1996. Lakes in Kashmir Himalaya. p. 1-40. In: *Ecology, Environment and Energy* (Khan A.H. and Pandit, A.K., eds.). The University of Kashmir, Srinagar, Kashmir, 190006, J&K, India.

Pandit, A. K. 1999. *Freshwater Ecosystems of the Himalaya*. Parthenon Publishing, New York, London.

Rawson, D.S. (1956). Algal indicators of trophic lake types. *Limnol Oceonogr.* **1 (1):** 18-25

Saran, W. M. and Adoni, A. D. 1982. Studies on seasonal variations in pH and dissolve oxygen contents in Sagar lake. *Acta. Botanica Indica.*, **10:** 324-326.

Saxena, K. L. Chakraborty, R.N., Khan, A.Q., Chattopadhya, S.N. and Chandra, H. 1966. Pollution studies of River Ganges near Kanpur. *Environ. Health,* **8 (4):** 270-285.

Sreenivasan, A. 1965. Limnology and productivity of tropical impoundmentAmravali Reservoir, Madras State, S. India. *Hydrobiologia,* **26:** 501-516.

Stepanek, M. 1959. Limnological study of the reservoir Sedlice near Zeliv. IX. Transmission and transparency of water. Sci. Pap. Inst. Chem. Technol., Prague. *Fac-Technol. Fuel Water,* **3:** 363-430.

Thresh, J.C., Suckling, E.V. and Beale, J.F. 1994. *The Examination of Water and Water Supplies.* 6th Edition (E.W. Taylor, ed.).

Vollenweider, R.A. 1968. *Scientific Fundamentals of the Eutrophication of Lakes and Flowing Waters, with Particular Reference to Nitrogen and Phosphorus as Factors in Eutrophication.* Tech. Rep. OECD, Paris. DAS/CSI/68.

Wetzel, R.G. 1975. *Limnology.* W.R. Saunders Co., Philadephia, U.S.A.

Yousuf, A. R. and Parveen, M. 1992. Ecology of polluted waters of Kashmir: Brari Nambal basin of Dal lake, p. 255-264. In: *Current Trends in Fish and Fishery Biology and Aquatic Ecology* (Yousuf, A.R., Raina, M.K. and Qadri, M.Y. eds.) Post Graduate Deptt. of Zoology. The University of Kashmir, Srinagar-190006. India.

Zafar, A. R. 1964. On the ecology of algae in certain fishponds of Hyderabad, India. Physico-chemical complexes. *Hydrobiologia,* **23:** 179-195

Zutshi, D.P. and Khan, M.A. 1977. Limnological investigations of two sub-tropical lakes. *Geobios.,* **4:** 45-48.

Zutshi, D.P., Subla, B.A., Khan, M.A. and Wanganeo, A. 1980. Comparative limnology of nine lakes of Jammu and Kashmir Himalayas. *Hydrobiologia,* **72 (1-2):** 101-112.