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Nutrient Status of Ahansar Lake in Kashmir Himalaya

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ABSTRACT

A small rural valley lake, Ahansar, in Kashmir Himalaya was investigated for a period of one year during 2001-02 for its water quality. The lake is experiencing racing eutrophication as evidenced by low transparency, low dissolved oxygen, high conductivity and higher concentrations of major plant nutrients like nitrogen and phosphorus.

Keywords: Eutrophication, water quality, Ahansar lake, nutrient status, Kashmir Himalaya

INTRODUCTION

The valley of Kashmir is known for plenty of inland freshwater resources. Among these lakes play a significant role in the socio-economic and ecological wellbeing of the State. These freshwater resources not only provide water, food, fodder and medicinal plants for locals but also habitat for rich and varied forms of flora and fauna including the fish. In addition to these they are the main sources of recreation and tourist attraction. Unfortunately, during last few decades these invaluable natural water resources are loosing their pristine glory every passing day due to their indiscriminate exploitation by humans. The changing landscape through human activities for agricultural development, urbanization and waste disposal has greatly accelerated the rate of eutrophication of Kashmir Himalayan lakes in general and Ahansar in particular. The present study is, therefore, an attempt to assess the trophic status of a rural valley lake in terms of its nutrient levels.

STUDY AREA

The present study was carried out on a small rural valley lake Ahansar, in Kashmir Himalaya. The lake is situated in the floodplains of River Jhelum about 26 km north-west of Srinagar at an altitude of about 1600 m (a.s.l), within the geographical coordinates of 34° 18′ N latitude and 74° 39′ E longitude. The lake is spread over an area of 0.8 km^2 with a maximum depth of 5.5 m and has its own source of water in the form of springs spread over its basin. Besides, an ephemeral irrigation channel also supplements the water mass during paddy cultivation. The lake has a permanent outflow channel that joins River Jhelum on its western side. On the basis of its drainage patterns, the lake can be categorized as a "semi-drainage type".

MATERIAL AND METHODS

The water samples were collected from

four different sampling stations. The physico-chemical characteristics of water were monitored on monthly basis during 2001-02. The parameters like depth, transparency, temperature, pH and conductivity were determined on spot while the rest of the parameters were determined in the laboratory within 24 hours of sampling. The analysis was done as per standard methods of Mackereth (1963), Golterman and Clymo (1969) and A.P.H.A (1989).

RESULTS AND DISCUSSION

The lake is shallow with gentle sloppy margins and having a maximum depth of 5.5 m (Table 1). The lake waters are generally turbid with the maximum mean seasonal value of transparency (4.27 m) at site IV during winter and minimum of 0.73 m at site II during summer. The winter maxima in transparency may be attributed to the low biological activity and very little input of silt laiden run-off during the season. The seasonal variations in transparency have been attributed to seston (Cook and Kennnedy, 1970) and phytoplankton (Compose *et al.*, 1978). The study revealed a close relationship of water temperature with the air temperature as the increase or decrease in air temperature was followed positively by the water temperature. The oxygen concentration in aquatic ecosystems is of paramount importance as it is critical for the survival of most forms of the aquatic life and is the most reliable criterion in assessing the trophic status and magnitude of eutrophication (Edmondson, 1966). The dissolved oxygen concentration was generally low and ranged between a low of 4.27 mg/l during summer and a high of 9.53 mg/l during winter. The low concentration of dissolved oxygen in the lake may be attributed to the oxidative consumption during the decay and decomposition of profuse growth of aquatic vegetation. Further, the luxuriant growth of free-floating and rooted floating-leaf type species reduces light penetration and, therefore, hampers photosynthesis especially of submergeds (Zutshi and Vass, 1971; Pandit *et al.*, 1978).

The lake waters were well buffered as evidenced by alkaline pH throughout the year. The seasonal variation of winter low and summer high values may be related to photosynthetic activity of primary producers which remove CO_2 from water column and, therefore, shifting the equilibrium between carbonic acid and less soluble carbonates and increasing pH during summer. On the other hand, carbonic acid increases and pH decreases during winter on account of respiration exceeding photosynthesis. The conductivity, an indicator of total ionic potential and, therefore, the nutrient status of water body, is also one of the most reliable measures for assessing the nutrient enrichment of aquatic ecosystems. The lake under study depicted high values for conductivity, which point towards the increasing nutrient loading of the lake. The slight decrease in conductivity during summer may be related to the uptake of ions by autotrophs during their peak growth in summer (Pandit, 1999, 2002).

The lake revealed both temporal and spatial variability regarding calcium, magnesium and alkalinity. The calcium was the most dominant cation, being attributed to the predominance of lime rich rocks in the catchment area (Zutshi *et al.*, 1980). The calcium and magnesium depicted a ratio of almost 4:1 which is in conformity with some earlier reports on freshwater valley lakes (Zutshi and Khan, 1978; Kaul *et al.*, 1978; Pandit, 1999). Bicarbonates constituted the dominant anion and were solely responsible for alkalinity as carbonates never showed their presence. The lake can be classified as "hard water type" on the basis of alkalinity (Moyle, 1945).

Nitrogen and phosphorus are the two important macronutrients, which are closely related to the productivity in aquatic ecosystems (Edmondson, 1966). Among various forms of nitrogen, nitrate nitrogen is the most important nutrient for the growth and metabolism of algae. Sawyer (1945) and Vollenweider (1968) reported that the inorganic nitrogen less than 300 μg/l limits the aquatic plant growth. In the present investigation nitrate nitrogen (NO_3^--N) was present in higher concentrations than the ammonical nitrogen (NH_4^+-N), the former being the end product of nitrification and most utilizable form of nitrogen by plants.

Table 1. Seasonal mean values of physico-chemical parameters of Ahansar lake

PARAMETER	SITE	WINTER	SPRING	SUMMER	AUTUMN
	I	0.75	1.02	1.27	0.95
Depth (m)	II	0.75	1.02	1.27	0.95
	III	1.75	2.02	2.27	1.95
	IV	5.00	5.22	5.47	5.17
	I	0.75	0.92	1.00	0.95
Transparency (m)	II	0.75	0.75	0.73	0.85
	III	1.75	1.92	2.10	1.92
	IV	4.72	4.17	3.87	4.07
	I	5.67	18.00	27.33	17.33
Water Temperature (°C)	II	6.40	18.50	27.67	17.33
	III	5.50	18.00	27.17	17.13
	IV	5.53	17.93	27.10	17.17
	I	8.03	8.59	8.83	8.49
pH	II	8.03	8.65	8.86	8.57
	III	7.88	8.47	8.80	8.41
	IV	7 86	8 26	8 80	8 37

Table 1 Contd.

Table 1 Contd.

Conductivity (µS/cm)	I	378	369	296	331
	II	407	371	310	348
	III	372	374	294	321
	IV	370	365	286	312
Dissolved oxygen (mg/l)	I	9.37	7.47	5.00	6.27
	II	8.57	6.70	4.27	5.77
	III	9.53	6.33	5.40	7.17
	IV	9.27	6.50	5.60	7.70
Total alkalinity (mg/l)	I	139.33	128.67	111.67	133.50
	II	153.00	137.00	113.33	138.67
	III	142.00	122.33	97.67	126.00
	IV	137.00	117.00	94.00	118.00
Calcium + Magnesium (mg/l)	I	45.63	47.93	31.83	36.83
	II	47.60	50.57	35.97	36.47
	III	42.02	42.77	31.23	31.07
	IV	36.80	40.57	29.17	30.23
Chloride (mg/l)	I	10.70	16.30	15.70	10.30
	II	12.30	19.30	17.00	12.20
	III	9.70	11.70	13.30	11.10
	IV	9.70	10.70	11.70	9.70
Orthophosphate (µg/l) Phosphorus	I	10.00	27.00	26.33	20.33
	II	14.67	33.33	32.00	25.00
	III	10.67	24.33	22.00	18.00
	IV	10.00	21.00	21.67	16.67
Total phosphate phosphorus (µg/l)	I	136.67	188.00	176.62	150.33
	II	155.33	203.00	200.00	171.67
	III	129.67	164.33	143.67	132.33
	IV	131.00	141.33	134.00	121.33

Table 1 Contd.

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	I	148.00	153.67	157.00	147.67
Ammonical nitrogen (μg/l)	**II**	187.33	238.33	223.00	174.00
	III	146.33	152.33	129.67	133.67
	IV	134.33	137.33	115.00	126.33
	I	339.00	367.00	289.00	318.00
Nitrate nitrogen (μg/l)	**II**	356.67	406.67	354.00	345.67
	III	323.00	364.67	281.33	273.33
	IV	280.00	347.00	251.33	291.00
	I	1.70	0.36	2.30	1.83
Silicates (mg/l)	**II**	1.97	0.68	3.17	2.37
	III	1.53	0.21	2.30	1.20
	IV	1.57	0.26	1.37	0.97
	I	273.33	363.00	364.00	322.00
Iron (μg/l)	**II**	308.33	416.67	383.00	360.00
	III	257.33	335.00	323.33	312.33
	IV	259.00	318.67	246.33	272.00

The decreased concentrations of both the forms of nitrogen during summer may be attributed to the higher rate of absorption by the biota due to their peak growth (Raspopov *et al.*, 1986). The inorganic available phosphorus (orthophosphate) was present in much lower concentrations than the total phosphorus, which again point towards the increasing level of eutrophication of the waterbody as the element is considered the most critical factor causing excessive fertilization of a waterbody.

In conclusion, it can be inferred from the present study that the lake is showing signs of deterioration of its water quality as evinced by low depth, transparency and dissolved oxygen and higher conductivity, nitrogen and phosphorus concentrations, all pointing towards the nutrient enrichment and, therefore, the productivity of the system. The higher levels of nutrients in the lake are directly or indirectly an outcome of anthropogenic activities in its catchment area which further needs to be worked out. Further, the lake being shallow without proper flushing aggravates this situation as both allochthonous and autochthonous materials get accumulated in the system. All these forms contribute to the accelerated eutrophication of lake Ahansar.

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