Impact of Effluents from Sheri-Kashmir Institute of Medical Sciences (SKIMS), Soura on Anchar Lake

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ABSTRACT

The present investigation was undertaken during October, 2000 and deals with the general water-chemistry of the Anchar Lake, Kashmir with emphasis on the impact of effluents coming from SKIMS complex on the lake ecosystem. Anchar, an urban shallow-basined lake, shows the usual cation progression: $Ca^{2+} > Mg^{2+} > Na^{+} > K^{+}$. The comparatively high nutrient level recorded at SKIMS site is an indication of nutrient enrichment and hence higher degree of pollution of the site in comparison with the other sites of the lake.

Keywords: Water chemistry, nutrients, eutrophication, macrophytes, Anchar Lake

INTRODUCTION

During recent years the lakes in general and the valley lakes in particular are becoming the victims of cultural eutrophication which in turn is due to the increase in anthropogenic pressures in their catchment areas (Zutshi *et al.*, 1980; Pandit, 1996, 99). Increased utilization of lake waters and its resources by locals, tourists-traffic and disposal of sewage and sewerage from the adjoining settlements, besides soil-erosion and encroachments for housing, road building and development of floating gardens for agricultural purposes are greatly responsible not only for deterioration of the lakes environment but also the shrinking of their size.

Though most of the limnological investigations of this region have centered round Dal Lake, yet all other waterbodies, though equally ecologically important, have received little attention. The only available literature dealing with the various ecological aspect of Anchar Lake, are those of Kaul *et al.* (1978, a, b), Kak (1981), Sarwar (1986, 87,88, 89) and Pandit (1996, 99); but mostly they pertain to the biological aspects and hardly any information is available on the impact of effluents from SKIMS complex on the nutrient level of the lake and, therefore, the present investigation is a step in that direction.

AREA OF STUDY

Anchar Lake, a shallow basined valley lake with fluviatile origin (altitude 1584 m a.s.l), is situated 14 km to the northwest of Srinagar city within the geographical coordinates of lat. 34° 20′ - 34° 26′ N and long. 74 ° 28′ - 74 ° 85′ E (Fig. 1). The suburban lake, with its catchment comprising Srinagar city and a number of bordering villages, as such is connected to the famous Dal Lake through a small inflow channel – Nalla Amir Khan. However, a network of channels, resulting in a delta-type formation, from the cold water river Sind enter the lake on its western shore. In addition to these feeding channels, the lake is also supplied by a number of springs present in the basin itself and along its periphery.

To the northeast of the lake is situated SKIMS. The effluents from SKIMS complex, run-off from agricultural fields and sewage disposals from the catchment area are drained into the lake which result in the nutrient enrichment especially, near the SKIMS site. The catchment comprises arable land under paddy cultivation and long stretches of elevated land on northwest side which is being used for raising multiple crops. The lake is heavily infested with macrophytic growth and the littorals, constituting the major portion of the lake, are especially dominated by tall growing emergents like *Phragmites australis*, *Typha angustata*, and *Spharganium erectum*. The heavily polluted sites are dominated by *Myriophyllum verticillatum*.

A number of floating gardens used for vegetable cultivation, being developed in the lake margins, result in myriad of channels which are heavily covered with thick mats of obnoxious weed complexes, *Lemna-Salvinia*. Rooted floating-leaf types like *Trapa natans, Nymphoides peltata, Potamogeton natans* and *Hydrocharis dubia*, either from isolated patches or grow in association with other macrophytes. Submergeds like *Myriophyllum spicatum, Ceratophyllum demersum, Potamogeton lucens*, and *Potamogeton crispus* are seen growing in the deeper zones of the lake. The lake is gradually becoming shallower and giving a look of a wetland. In fact, the

Shallabogh wetland is an extension of the littoral region of the Anchar Lake in its northwest.

MATERIAL AND METHODS

The water samples from different sites of the lake and the SKIMS site were analysed for various parameters adopting the standard methods of Mackereth (1963), Goltermann and Clymo (1969) and A.P.H.A. (1998). The water samples were collected in 1lit. polyethylene bottles. Parameters like conductivity, pH, temperature, dissolved oxygen, water depth and transparency were analysed at the sampling stations. pH, conductivity and dissolved oxygen were recorded by means of digital meters (US make) while depth and transparency of the lake were noted by means of a Secchi-disc.

Other parameters like alkalinity, chlorides, calcium and magnesium, nitrogen (NO_3-N and NH_3-N), phosphorus (orthophosphates and total phosphates) and silicates of the lake water were analysed in the laboratory within 24 hr from the time of sampling. Similarly, the estimation of sodium and potassium elements was done by means of a flame-emission photometer.

RESULTS

The physico-chemcial characteristics of lake water in general, as collected from a number of sampling stations and the SKIMS site are depicted in Table 1. There are marked differences in the physio-chemical features of water near SKIMS site as compared to other sites of the lake. The depth of the water (0.48 m) and its transparency was quite low (0.15 m) at SKIMS site as compared to the whole lake recording a depth range of 0.75 – 2.05 m and a transparency range of 0.38 – 1.0 m. Conversely, the SKIMS site registered a higher temperature of 17.2° C in comparison with the other sites, registering a range of 14.8 – 15.8 ° C. As expected, the amount of dissolved oxygen (1.38 mg l^{-1}) recorded at SKIMS site, was lower than that at other sites of the lake (1.4 – 3.9 mg l^{-1}) and hence the former site showed a tendency towards anoxic condition. Although the pH of the lake was towards alkaline side yet low pH (7.8) was noted at SKIMS site. Comparatively higher pH values (7.9 – 8.4)

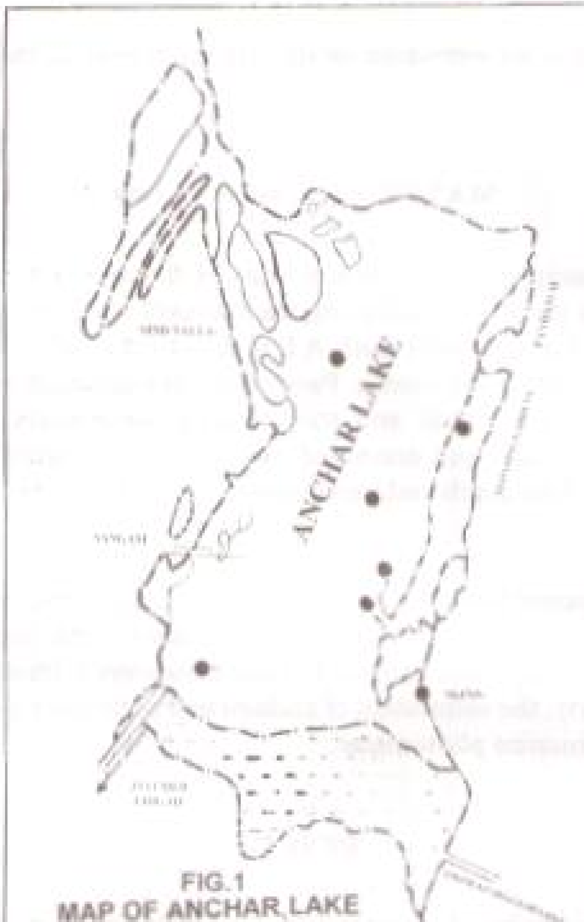

Fig.1. Map of Anchar Lake showing study sites

Fig.2. A drain carrying effluents from human habitation into the Anchar Lake.

were observed at all other sites. The conductivity values, an indication of total nutrient concentration, at SKIMS site was notably higher (710µS cm^{-1}) than the other sites showing a narrow range of 305 – 315 µS cm^{-1}). Of the divalent cationic components, calcium and magnesium are the most abundant in the lake. The usual cation progression is : $Ca^{++} > Mg^{++} > Na^{+} > K^{+}$. Higher values of the cations were observed at SKIMS site (Ca^{++} : 95.5 mgl^{-1} , Mg^{++} : 304 mgl^{-1}, Na^{+} : 13.1 mg l^{-1} ; K^{+} : 7.0 mg l^{-1}) when compared to other sites of the lake recording lower ranges of the elements (Ca^{++} : 19 – 36 mg l^{-1}, Mg^{++} : 6.2 – 13.7 mg l^{-1}, Na^{+} : 7.5 – 11.8 mgl^{-1} , K^{+} : 4.2 – 6.8 mgl^{-1}). Relatively higher values of alkalinity were recorded at SKIMS site (690 mg l^{-1}) as compared to the other sites of the lake recording a range of 440 – 640 mg l^{-1}. Similarly higher chloride content at SKIMS site (40 mg l^{-1}) is almost double than that recorded at other sites where it ranged between 14-20 mg l^{-1}. The silicate content, as analysed at SKIMS site (3.8 mg l^{-1}), was considerably very high as compared to the ones obtained for the whole lake depicting a range of 0.35 – 0.60 mg l^{-1}. Ammonical- nitrogen (695 µg l^{-1}) and nitrate nitrogen (980 µg l^{-1}) values recorded at SKIMS site were again much high as compared to the values obtained for the other sites of the lake showing a range of 395 – 560 µg l^{-1} and 185 – 435 µg l^{-1} for the two anions respectively. The concentration of orthophosphate phosphorus (OPP) at SKIMS site was quite high (458 µg l^{-1}) as compared to the other sites registering a very narrow range of 65 – 115 µg l^{-1}. A similar trend was noted for total phosphate phosporus (TPP) at SKIMS site (1410 µg l^{-1}) and at all other sites of the lake (110 – 440 µg l^{-1}).

DISCUSSION

The gross pollution at the SKIMS site as compared to the other sites spread over the whole lake, is attributed to the addition of non-demposable matter of both organic and inorganic origin along with the effluents coming from SKIMS complex into the lake. The low transparency and hence the turbidity of water is also due to siltation and blooms of planktonic algae, hence restricting the growth of submerged macrophytes (Kaul *et al.*, 1978; Pandit and Kaul, 1981; Kaul and Pandit 1982; Pandit, 1996, 99, 2001). Under such conditions, only pollution tolerant species of algae particularly belonging to Myxophyceae and obnoxious weed complexes like *Lemna - Salvinia* which thrive well under eutrophic waters flourish (Pandit and Kaloo, 1999). High temperature recorded at SKIMS site, is the result of low water depth and consequently the volume of water in contact with air as observed by Zutshi and Vass

(1971) and Pandit (1980) in other eutrophic waterbodies. Low values of dissolved oxygen at SKIMS site is an indication of anoxic condition which restrict the growth and development of plant and animal life except those that thrive well under such conditions.

The high chloride content at SKIMS site, an indicator of inorganic pollution, again owes its origin to the sewage wastes carrying detergents, sewerage from human settlements and chemical wastes (medicines) of the Institute drained into the lake. These findings are in agreement with those of Paramsivam and Srinivasan (1981). Comparatively higher values of sodium and potassium were recorded at SKIMS site. The high content of sodium in the freshwaters, owing its source to the domestic sewage, is also noted by Sharma *et al.* (1999). Similarly, higher values of Ca^{++} and Mg^{++} were recorded at SKIMS site as compared to other sites. Therefore, the hardness of water is very high at the study site, a fact also observed by Rai (1974) who attributed it to the inflow of sewage effluents. Higher amounts of nitrogen and phosphorus as observed at SKIMS site are again attributed to the leaching of fertilizing compounds and addition of faecal matter along with the effluents coming from the SKIMS complex and adjoining human habitation. Similarly, higher concentration of ammonia (NH_3 –N) recorded at SKIMS site is an indication of organic pollution and thus the waters are favourable for prolific growth of weeds like *Salvinia natans* a fact also recorded by Ellis and Wastfall (1946).

In conclusion, the effluents released from SKIMS complex are highly responsible for increasing the nutrient levels of the lake system and being detrimental to the growth and occurrence of some useful plants and animals like fish.

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