

Trophic Status of Manasbal Lake on the Basis of Water Chemistry and Periphyton

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Abstract: An attempt has been made to assess the trophic status of Manasbal Lake on the basis of water chemistry & biotic characteristics (Periphytic Flora & Fauna). A total of 138 taxa of periphytic algae & 53 genera of periphytic micro-fauna were recorded on four macrophytes namely *Myriophyllum spicatum*, *Potamogeton lucens*, *Ceratophyllum demersum* and *Nymphoides peltatum*. While applying OECD standards to Manasbal lake, advanced trophic level of the water body was found. Further eutrophic forms were well represented in the periphyton community of Manasbal lake, thus it is assumed that the lake is also enjoying some degree of eutrophication as a few species of oligotrophic nature are still present in the lake though in small numbers.

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Introduction

The Valley of Kashmir, situated in the midst of the Himalayan range of mountains roughly between $33^{\circ} 01'$ & $35^{\circ} 00'$ N & $73^{\circ} 48'$ & $75^{\circ} 30'$ E, has been famous for its crystal clear tarns & lakes throughout the world. However, during the recent past many of these waters have started showing signs of instability. Although the increased fertility of lakes with aging is a natural phenomenon, but the pace at which the lakes of this part of Himalayas have shown this phenomenon clearly indicates that human interference in the catchment areas as well as within the basins of the aquatic system has greatly increased. In order to devise methods for the conservation of these natural resources of the region we need to monitor their trophic status. Although physico-chemical characteristics of water give an indication of its trophic status (Odum, 1963; Carlson, 1977; Jorgensen, 1980; Pandit and Yousuf, 2002; Malik, 2004), there are many problems associated with it that may affect its utility (Cairns and Schallie, 1980). It is believed that the biotic characteristics of a water body give a better idea about the trophic status of the water concerned (Patalas, 1972; Pandit, 1980, 1996, 1999). Therefore, the trophic condition of the lake under investigation is discussed on the basis of both water chemistry and biotic characteristic (periphytic flora and fauna).

Area Of Study

The study was carried from December 2007 to Nov. 2008 in Manasbal lake of Kashmir Himalaya. Manasbal lake is considered as the 'supreme' gem of all Kashmir lakes. It is located about 32 km NW of Srinagar, the summer capital of J&K State. It is situated at an altitude of 1585m (A.M.S.L) & is spread over an area of about 2.81 sq. Km, within the geographical coordinates of $34^{\circ} 15'$ N latitude & 74°

$40'$ E longitude. Origin of lake is fluvial. The lake has no major inflow channels & water supply is maintained through spring water inflow & precipitation.

Material And Methods

Sampling was done at the monthly intervals. The water samples were collected from the lake by dipping one litre polyethylene bottle just below the surface of water & analysis of various parameters was done in accordance with Mackreth (1963), Golterman and Clymo (1969), CSIR, Pretoria (1974) and A. P. H. A. (1998).

Monthly collections of naturally growing macrophytes *Myriophyllum spicatum*, *Potamogeton lucens*, *Ceratophyllum demersum* and *Nymphoides peltatum* were made from the Manasbal lake. Macrophytic leaves and stems together with the associated periphyton were sampled by gently cutting / pulling pieces of macrophytes at a depth of 0.5 – 1.5 m at each site with utmost care so that the periphyton was least disturbed. A pooled sample so obtained was carefully manoeuvred into a plastic bag which was closed with a rubber band. Then each plant sample was put in a wide mouthed plastic container with 500 ml of water and shaken vigorously for three minutes. Plants were also scrapped with a nylon brush to ensure the removal of tightly held periphyton. The freed periphyton material was passed through a wide meshed (1mm) sieve into plastic bottles. Two additional 500 ml rinses were sieved and combined with the previous washing. The sample was allowed to settle for 1 hr and the supernatant was siphoned off and discarded after finding out its volume. The resultant slurry was stirred and 5 ml of the slurry was diluted to 500 ml and mixed in a blender at top speed for 2 minutes to free the periphytic organisms from detritus. A sub-sample of

this blended material was preserved in 5% formalin for further investigation. Quantitative estimation of periphytic algae & periphytic micro invertebrates was done with the help of a Sedgewick Rafter Cell of 1 ml

capacity. The numbers of organisms were calculated per 10 mg dry weight of macrophytes for algae and 30 mg dry weight for micro invertebrates.

Results And Discussion

Table 1: Seasonal Mean & Standard Deviation for Various Parameters

| S.No | Parameter | Winter | | Spring | | Summer | | Autumn | |
|------|--------------------|--------|------|--------|-------|--------|-------|--------|------|
| 1 | Transparency | 0.68 | 0.1 | 0.99 | 0.01 | 0.97 | 0.005 | 0.77 | 0.04 |
| 2 | T.P.P | 136.67 | 7.5 | 170.67 | 13.31 | 201.33 | 10.59 | 123.67 | 15.3 |
| 3 | Ammonical Nitrogen | 105 | 13 | 144.67 | 3.6 | 207 | 7.93 | 194.33 | 5.03 |
| 4 | Nitrate-Nitrogen | 206.67 | 5.86 | 157 | 24.27 | 135.33 | 7.64 | 159 | 9.84 |

Table 2: Population Density of Periphytic Algal Groups

| S.No. | Taxonomic Group | Minimum | Maximum |
|-------|-------------------|-------------------|---------------|
| 1. | Bacillariophyceae | 62421 (July) | 741234 (Jan.) |
| 2. | Chlorophyceae | 3124 (Dec.) | 52318 (March) |
| 3. | Cyanophyceae | 5012 (Dec.) | 39812 (July) |
| 4. | Euglenophyceae | 0 (Oct. - March) | 2892 (June) |
| 5. | Dinophyceae | 0 (Nov. - August) | 90 (Oct.) |
| 6. | Chrysochyceae | 0 (Oct. -March) | 621 (August) |

Table 3: Population Density of Periphytic Micro-fauna

| S.No. | Taxonomic Group | Minimum | Maximum |
|-------|-----------------|------------|-------------|
| 1. | Protozoa | 135 (Jan.) | 7215 (Oct.) |
| 2. | Rotifera | 72 (Jan.) | 4440 (July) |
| 3. | Crustaceae | 0 (Feb.) | 1288 (July) |
| 4. | Nematode | 272 (Feb) | 1891 (July) |

I. On the basis of water chemistry

Seasonal mean & standard deviation for various parameters are depicted in Table 1.

Generally the total phosphorous content of water bodies has been used for categorization of aquatic habitats (Toerien and Walmsley, 1974). The authors further suggested that 25-30 mg/l of total P be regarded as the border of eutrophy. Thornton and Nduku (1982) proposed 2 sets of the values for delimiting the lower boundary of eutrophy, 30mg/l for temperate and 50-60mg/l for tropical lakes. A better picture of the trophic state is obtained if OECD (1982) guidelines are followed.

While applying OECD categorization of lake trophy to Manasbal lake, a mean summer maximum concentration of total phosphorous on the surface water (201.33µg/l) indicates that the lake is eutrophic as it falls within the eutrophic range (16.2 – 386µg/l) being set by OECD standards (after Vollenweider, 1968).

The mean maximum value of secchi disc transparency (0.99m) also falls within the eutrophic range (0.8 – 7.0m). Further the waters are characterized by high content of different nitrogen forms (NO₃-216.67 µg/l ; NH₄-207 µg/l) , thus indicating advanced trophic level of the water body.

II. Periphyton as indicators of trophic status

(a) Periphytic Flora

A total of 138 taxa of periphytic algae was recorded on four macrophytes namely *Myriophyllum*

spicatum, *Potamogeton lucens*, *Ceratophyllum demersum* and *Nymphoides peltatum* . Among these 66 belonged to Bacillariophyceae, 46 to Chlorophyceae, 22 to Cyanophyceae, 2 to Dinophyceae and 1 each to Euglenophyceae and Chrysophyceae. Thus, the species diversity of the algal taxa was in the order of Bacillariophyceae > Chlorophyceae > Cyanophyceae > Dinophyceae > Euglenophyceae /Chrysophyceae.

Population density of periphytic algal groups is shown in Table 2

The most common species amongst the various taxonomic groups recorded were

Bacillareophyceae *Cymbelle nentricosa*, *C. Cymbifomis*, *C. parva*, *Nitzschia supralitora*, *N. pusa* , *N. frustulum*, *Synedra ulna* , *Navicula musca* , *N. anglica* , *N. cuspidate*, *N. lancoelata*, *Gomphonima truncatum*, *Achanthidium* sp., *Cocconeis placentula*, *Epithemia* sp., *Eunotia* sp.,

Chlorophyceae *Ulothrix subconstricta*, *Zygnema* sp., *Spirogyra* sp., *Pediastrum boryanum*, *P. tetras*, *Scenedesmus* sp., *Cosmarium* sp., *Ankistrodesmus* sp.

Cyanophyceae *Merismopodia* sp., *Microcystis aeruginosa* , *Anabaena* sp., *Nostoc* sp.,

Euglenophyceae *Euglena* sp.

Dinophyceae *Glenodium* sp.

Chrysophyceae *Dinobryon* sp.

Numerical superiority of diatoms both in terms of number of taxa and population density is indicative of the eutrophic nature of water body (Rawson, 1956; Lund, 1962; kawoosa, 1997). The dominant Chlorophycean taxa in Manasbal lake like *Ankistrodesmus* spp, *Pediastrum* spp., *Cosmarium* spp., *Tetradon* spp. and *Scenedesmus* spp. have been reported to be abundant in eutrophic waters (Hutchison, 1967). Cyanophyceae was mainly represented by

Merismopodia punctata, *Microcystis aeruginosa* and *Anabaena* sp. According to Rawson (1956) eutrophic lakes are characterized by *Anabaena* and *Microcystis*. Presence of Dinophycean sp. especially, *Peridinium* spp. indicates advanced trophic level of the water body. Euglenophyceae was represented by *Euglena* sp. being more characteristic of eutrophic waters. According to Forsyth and Mccoll (1975), presence of Euglenoids suggests an abundance of nitrogen rich organic matter in the lake sediments.

The presence of well known eutrophic algal forms is suggestive of the racing eutrophy of the water body.

(b) **Periphytic Fauna**

A total of 53 genera of periphytic micro-fauna was recorded on *Myriophyllum spicatum*, *Ceratophyllum demersum*, *Potamogeton lucens* and *Nymphoides peltatum* in Manasbal lake during the entire period of study. Of the various taxonomic groups the greatest number of taxa was recorded for Rotifera (25), followed by Protozoa (15), Crustaceae (11) and Nematodes (2)

Population density of periphytic micro-fauna is shown in Table 3.

The dominant forms among the periphytic micro invertebrate however were

Protozoa *Amoeba* sp., *Centrophyxis* sp., *Arcella vulgaris*, *Diffugia* sp., *Comparella umbellaria*, *Podophrya* sp., *Trichophrya* sp.

Rotifers *Filinia* sp. *Keratella* sp. *Brachionus* sp. *Lecane* sp., *Monostyla* sp., *Notholca* sp., *Lepadelle* sp.

Crustaceae *Alona* sp., *Alonella* sp. *Bosmina* sp., *Chydorus* sp.

Among rotifers the species of *Keratella*, *Brachionus*, *Monostyla* and *Notholca* are considered as pollution tolerant organisms and are typical eutrophic forms (Hutchinson, 1957; Hakkari, 1977 and Sladeck, 1983). The presence of crustacean species like *Alona*, *Alonella*, *Chydorus* again indicate eutrophic condition as also opined by Pandit (1999).

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