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# Ecology of Macrozoobenthic Community in the Wular Lake, Kashmir

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## ABSTRACT

An attempt has been made to study the occurrence and abundance of macrozoobenthos in the Wular Lake, a temperate fresh water habitat. The lake is typical hard water type, having high values of bicarbonates of calcium and magnesium, total inorganic nitrogen and total phosphorus. The study revealed presence of eight macrobenthic invertebrates in the lake, the most dominant being *Corbicula fluminea* (Pelecypoda), *Glossiphonia weberi* (Oligochaeta).

***Keywords :*** Zoobenthos, Wular Lake, Pollution.

## INTRODUCTION

The Wular Lake, situated in District Baramulla in North Kashmir (34° 15' – 34° 28' N latitude, 74° 30' – 74° 45' E longitude) is the biggest and most picturesque freshwater lake of Kashmir. The lake is mainly fed by the River Jehlum, which joins it on its south eastern side at "Banyar" near Sadrakut. The other tributaries of the lake include Madhumati, Erin, Ferozpore, and Haritar streams. At the close of 19th Century the area of the lake was about 225 $km^2$ but during the last one hundred years or so its size has got reduced to less than one third mainly due to human interference within its basin as well as in its catchment. Sedimentation, reclamation of large areas for agriculture and silviculture and entry of large quantities of domestic sewage and agricultural runoff containing the plant nutrients have been the main factors responsible for accelerated aging of the lake.

According to Jumppanen (1976) the first signs of eutrophication and pollution in a lake are reflected in the benthic flora and fauna. The benthic community enables the determination of the trophic status of water bodies and is, therefore an important criterion in the ecological classification of lakes (Thut, 1965; Seather and McLean, 1972; Bazzanti, 1975). In spite of its importance, both ecological and socio-economic, the Wular Lake has received the least attention of limnologists and only a few reports (Kango, 1983; Sarwar et al, 1992; Moza, 1992) are available on the limnology of this water body. It was therefore decided to have an in-depth study of the macrozoobenthos of the lake in relation to the water and sediment characteristics. The present article is based on a part of the data collected during this study which is still going on and is expected to reach completion by the

end of 2005.

## MATERIAL AND METHODS

Data from three sites (Fig. 1) is presented in the present paper. The Site 1 was located near Ningli from where the River Jhelum re-emerges from the lake as its sole outlet. In this zone the maximum depth is 2.6 m. This area is infested with a free floating macrophyte, *Trapa natans*. Site 2 was located near Hatlangoo (maximum depth of 2.8m). This site receives heavy load of household sewage and exhibits a rich macrophytic growth of both submerged and emergent macrophytes. Site 3 was near Watlab in the deepest zone of the lake ( maximum depth 5.8m). This site is infested by a rich diversity of macrophytes mainly *Salvinia natans, Ceratophyllum sp., Nelumbo nucifera, Trapa natans,* etc. Water samples for the analysis of physico-chemical parameters were collected from June 2004 to December 2004 in 1.5 l polyethylene bottles. The analysis was done according to the standard methods (CSIR, 1974 and APHA, 1998). Benthos was collected by Ekman's dredge (15.5cm X 15.5cm). The macrozoobenthic organisms were preserved in 70% alcohol for qualitative and quantitative enumeration in the laboratory (Edmondson, 1959; Pennak, 1978).

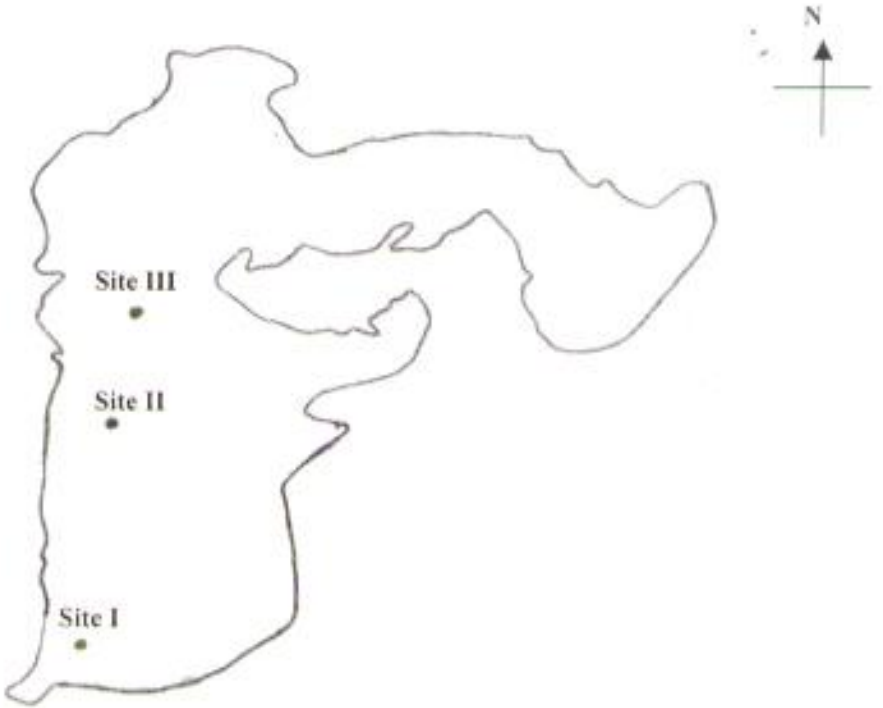


Fig 1. Map of Wular Lake showing study sites

## RESULTS AND DISCUSSION

The data on the various physico-chemical parameters are summarized in Table 1. As is evident from the data most of the limnological parameters recorded a similar trend at all the three sites. The water was hard (mean Total hardness 225.33mg/l) and alkaline (mean pH = 7.82) with moderate ionic content (mean conductivity = 256μS). The alkalinity was mainly of the bicarbonate type and fluctuated from 108 mg/l to 340 mg/l, with a mean value of 160 mg/l. Free $CO_2$ fluctuated between 7.7 and 30.9 mg/l with an average concentration of 11.89mg/l, while the dissolved oxygen content ranged between 2.8-13.2 mg/l (mean 6.73mg/l).

The most dominant cation in the lakes of Kashmir Himalaya is calcium (Zutshi *et al, 1980),* which recorded a range of 26.90 - 69.80 mg/l (mean 64.74 mg/l) in the present water body. Magnesium fluctuated in the range of 9.24 - 41.72 mg/l. Sodium and potassium were in very low concentration, showing mean concentration of 4.31 mg/l and 2.83mg/l respectively. The cation progression for the lake was of the order of Ca > Mg >> Na > K. According to Zutshi et al (1980) such a progression is typical of fresh waters of Kashmir. Nitrate - nitrogen is normally the most common form in lakes and streams (Cole, 1975). In the Wular the nitrate - nitrogen fluctuated between 60.77 μg/l and 975.27 μg/l (mean 515.76), while ammonia - N and nitrite -nitrogen had a range of 30.0 μg/l - 212.08 μg/l (mean 74.61 μg/l) and 16.98 - 74.65 μg/l (mean 46.83 μg/l) respectively.

The total phosphorus showed a range of 28.83 - 448.62 μg/l (mean 150.7 μg/l). Keeping in mind the quantum of sewage received by the lake from its catchment directly as well as through its tributaries one would expect the nutrient level, particularly nitrogen and phosphorus, very high. But when we compare the values with those reported for the Dal, Anchar and Khushalsar lakes of the valley (Pandit & Yousuf, 2002), the nutrient concentration, especially that of nitrogen, is relatively lower. It seems that the lower concentration of nutrients in this water body is due to i) presence of rich macrophytic growth, particularly of rooted submerged and emergents, which lock up the nutrients and ii) continuous flow of water in to the lake through various tributaries and out of it through River Jhelum. On the whole the lake shows eutrophication but among the various valley lakes of Kashmir (Pandit & Yousuf, 2002) its trophic status is relatively lower than that of Anchar, Dal and Khushhalsar lakes but is higher than that of the Manasbal lake.

The invertebrate macrozoobenthos of the lake was composed of eight taxa of which three belonged to Annelida, three to Arthropoda and two to Mollusca (Table 2). Both the molluscan taxa, *Corbicula fluminea* and *Lymnaea columella,* were present at all the study sites but showed very low population in Watlab area (site 3). It seems that these molluscs prefer shallow water (Zm < 4m), preferably with silty sand texture as is found in Ningli area (Site 1).

*Gammarus pulex* was the only macro - crustacean recorded during the present study and it was distributed in Hatlangoo and Watlab areas (site 2 and 3), with higher population at the latter

**Table 1: Physical and chemical properties of Wular lake at three study sites:**

| Parameter | | Site-I | Site-II | Site-III | Mean |
|---|---|---|---|---|---|
| Temperature (atm.) °C | R | 3.5-34.7 | 3.5-34.7 | 4.5 - 35.9 | 21.16 |
| | A | 20.5 | 20.5 | 22.5 | |
| Temperature (Water) °C | R | 9.0 - 26.0 | 9.0 - 26.0 | 9.0 - 28.0 | 19.9 |
| | A | 19.5 | 19.5 | 20.75 | |
| Depth (m) | R | 2.3 - 2.6 | 2.6 - 2.8 | 5.3 - 5.8 | 3.5 |
| | A | 2.4 | 2.7 | 5.5 | |
| Transparency (m) | R | 2.1 - 2.3 | 2.2 - 2.4 | 5.1 -5. | 3.23 |
| | A | 2.2 | 2.3 | 5.2 | |
| pH | R | 7.57 - 8.49 | 7.90 - 8.30 | 7.18 - 8.34 | 7.82 |
| | A | 7.80 | 8.04 | 7.62 | |
| Conductivity ($\mu S\ cm^2$) | R | 250 - 276 | 242 - 270 | 212 - 280 | 256.58 |
| | A | 260.25 | 257.25 | 252.25 | |
| Alkalinity (mg/l) | R | 148 - 184 | 132 - 340 | 108 -144 | 159.83 |
| | A | 161 | 195 | 123.5 | |
| Free $CO_2$ (mg/l) | R | 7.7-30.9 | 7.7 - 15.4 | 7.7 - 11.62 | 11.89 |
| | A | 16.40 | 10.60 | 8.68 | |
| DO (mg/l) | R | 5.7- 13.2 | 3.6 - 9.6 | 2.8-10.0 | 6.73 |
| | A | 8.12 | 6.15 | 5.92 | |
| Calcium (mg/l) | R | 26.96-59.71 | 33.64 - 69.80 | 29.43 - 49.24 | 64.74 |
| | A | 47.09 | 51.72 | 95.42 | |
| Magnesium (mg/l) | R | 9.42-31.77 | 10.57-41.72 | 9.9 - 25.75 | 23.24 |
| | A | 22.54 | 26.41 | 20.78 | |
| Total hardness (mg/l) | R | 146 - 270 | 188 - 342 | 166 - 206 | 225.33 |
| | A | 210 | 285 | 181 | |
| Chloride (mg/l) | R | 12.99-34.98 | 17.99 - 31.98 | 16.99-18.99 | 21.48 |
| | A | 22.98 | 23.23 | 18.24 | |
| Sulfate (mg/l) | R | 12.92-44.01 | 40.4 - 36.15 | 15.15-41.81 | 31.58 |
| | A | 36.14 | 30.80 | 27.82 | |
| Total Phosphate (µg/l) | R | 66.30 - 150.66 | 28.83-101.18 | 49.01-448.62 | 150.07 |
| | A | 114.10 | 70.22 | 265.90 | |
| Ammonia - N (µg/l) | R | 52.36-212.08 | 30.8-123.64 | 36.08 - 78.32 | 74.61 |
| | A | 100.65 | 72.49 | 50.71 | |
| Nitrate - N (µg/l) | R | 60.77-975.27 | 237.30 - 604.84 | 462.04 - 870.77 | 515.76 |
| | A | 400.81 | 384.89 | 761.59 | |
| Nitrite - N (µg/l) | R | 23.30-67.54 | 16.98 - 59.25 | 18.17 -74.65 | 46.83 |
| | A | 53.81 | 39.59 | 47.10 | |
| Sodium (mg/l) | R | 1 - 7 | 1 - 6.5 | 1 - 6.5 | 4.31 |
| | A | 4.62 | 3.80 | 4.50 | |
| Potassium (mg/l) | R | 2 - 4 | 2 - 3 | 2 - 3 | 2.83 |
| | A | 3 | 2.75 | 2.75 | |

Where : R = Rnage; A = Average

**Table 2: Variation in the population density (ind/m²) of aquatic invertebrate fauna**

| Animal kingdom | | Sites | June | August | October | December | Mean |
|---|---|---|---|---|---|---|---|
| I. Annelida | | | | | | | |
| A. Oligochaeta | *Branchiura sowerbyii* | I | A | 180 | A | A | 45 |
| | | II | 180 | 28 | 194 | 166 | 142 |
| | | III | 14 | A | 14 | 14 | 10.5 |
| | | | | **Total** | | | **197.5** |
| B. Hirudinea | *Erpobdella octoculata* | I | 42 | 14 | 28 | 14 | 24.5 |
| | | II | 14 | A | A | 14 | 7 |
| | | III | 111 | 139 | 180 | 277 | 176.75 |
| | *Glossiphonia weberi* | I | A | A | A | A | A |
| | | II | A | A | A | A | A |
| | | III | A | A | A | 208 | 52 |
| | | | | **Total** | | | **260.25** |
| II. Arthopoda | | | | | | | |
| A. Insecta (Diptera) | *Chironomid* larvae | I | 14 | 14 | 14 | A | 10.5 |
| | | II | 42 | A | A | 14 | 14 |
| | | III | 14 | A | 14 | A | 7 |
| Odonata | Dragon fly nymph | I | A | A | A | A | A |
| | | II | A | A | A | A | A |
| | | III | 14 | A | 14 | 55 | 20.75 |
| | | | | **Total** | | | **52.25** |
| B. Crustacea | *Gammarus pulex* | I | A | A | A | A | A |
| | | II | 42 | 14 | 14 | A | 17.5 |
| | | III | 42 | 42 | 55 | 55 | 48.5 |
| | | | | **Total** | | | **66.0** |
| III. Mollusca | *Lymnaea collumella* | I | 111 | 97 | 97 | 111 | 104 |
| A. Gastropoda | | II | 69 | 83 | 83 | 97 | 83 |
| | | III | 42 | A | 28 | 28 | 24.5 |
| | | | | **Total** | | | **211.5** |
| B. Pelecypoda | *Carbicula fluminea* | I | 139 | 166 | 180 | 208 | 173.25 |
| | | II | 69 | 69 | 111 | 139 | 97 |
| | | III | 28 | 28 | 14 | 28 | 24.5 |
| | | | | **Total** | | | **294.75** |

Where: A = Absent

site. Among insects chironomids are known to be pollution tolerant (Milbrink, 1980). Chironomid larvae were recorded at all the three sites, although in very low numbers. Similarly dragon fly nymphs were encountered rarely only at Site 3.

Oligochaetes have been designated as indicators of pollution (Howmiller and Beeton, 1971). The group was represented by *Branchiura sowerbyii*, which recorded the maximum density in Hatlangoo area (Site 2), where the lake receives large quantities of sewage from the catchment. Hirudinea was represented by *Erpobdella octoculata* and *Glossiphonia webri;* both had maximum density in Watlab area (Site 3). Some of *Glossiphonia weberi* were seen parasitizing on *Lymnea collumella* (Mollusca).

On the basis of the data collected on the physico – chemical parameters and the macrozoobenthos it may be concluded that the zoobenthos of the Wular lake is composed of typical eutrophic elements.

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