

MACROZOOBENTHOS IN THE BOD-DAL BASIN OF DAL LAKE, KASHMIR, J & K, INDIA

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ABSTRACT

Serving as ecological indicators of the lake ecosystem health, the macrozoobenthos fauna were studied, keeping in view the significant role played by these organisms in the assessment process. The article deals with the species composition and population density of macrozoobenthic community in the Bod-Dal basin of Dal lake, Kashmir as observed during January to September 2004. The macrozoobenthos was comprised of 9 species of benthic invertebrates belonging to 3 major phyla viz., annelida, arthropoda and mollusca. Annelids were more prevalent with the most dominant ones being *Limnodrills* sp. (oligochaeta) and *Chironomus* sp. (insecta).

INTRODUCTION

Macrozoobenthic fauna constitute a very important community in aquatic ecosystems and are of immense ecological value due to their unique response to environmental changes. Reports have indicated that the composition and diversity of macro-zoobenthic community is closely linked to aquatic habitat conditions, with many species serving as biological indicators of pollution (Arslan *et al.*, 2007; Lafont *et al.*, 1996; Richardson & Kiffney, 2000).

Dal Lake (N34° 5' -34° 6', E74° 8' -74° 9'; Elevation 1584m above MSL), an urban valley multi basin lake, with an open drainage system is under great ecological stress due to human inhabitation around and within

the lake. The 30,000 ha of approximate catchment area of the lake further results in huge mineral and silt loading into the lake ecosystem (Kango, 1983). As a result huge quantities of nitrogen and phosphorus are added to the lake both from inhabitations as well as from adjoining areas which has resulted into the luxurious growth of aquatic vegetation (Zutshi, 1968) like *Potamogeton* Spp., *Ceratophyllum demersum*, *Salvinia natans*, etc., and more recently the appearance of the problematic *Azola* sp. This in turn has affected all the life supported by the lake. The Lake which has been 7.44 Kms long and 3.5Kms broad covering an area of 22 Sq Kms at the turn of the century has not only shrunk little over half of the area but also turning its waters bad and posing health hazards to many

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people. The benthic community enables the determination of trophic status of water bodies and is therefore an important criterion in the ecological classification of lakes (Thut, 1965). According to Jumppanen (1976), the first signs of eutrophication and pollution in a lake are reflected in the benthic flora and fauna. Serving as ecological indicators of the lake ecosystem health, the macrozoobenthos fauna of Bod-Dal basin of Dal lake was undertaken for study, keeping in view the significant role played by these organisms in the lake assessment process.

MATERIALS AND METHODS

The study was conducted at the Bod Dal basin of Dal lake, a multi basin water body presently spread over an area of about 11 Sq Km. Four sampling sites were selected (Fig. 1) with Site - I (mean depth 6.9 feet; mainly dominated by the floating hydrophytes) situated about 50 meters towards NW of SKICC. The sediment at this site was assessed to be of loamy character with high percentage of silt and clay and low percentage of sand. Site-II, an open water site with a mean depth of 7.7 feet, was located in between the Zearat - E - Shareef and Char-Chinari (Rupa Lank) and was predominantly covered by submerged macrophytes like *Ceratophyllum Sp.*, *Hydrilla Sp.*, *Myriophyllum sp.*, etc. Site III, deepest among the study sites, was located near Char Chinari along northern side with average depth of 9.1 feet and presenting relatively high interference by tourists because of the islet park -*Rupa Lank* present over there. Site IV was situated near the settlements (having high human interference with mean depth of 6.1 feet and a dense growth of rooted floating hydrophytes like *Nelumbo sp.*, *Nymphaea sp.*, etc.) and the presence of floating gardens. For the collection of macrozoobenthos, the bottom sediments were collected with the help of Ekman Dredge having an area of 15.5×15.5 cm² and the samples were properly mixed with site water and passed through a series of different mesh size sieves. The individuals were sorted out manually using forceps, hand picking and brushes and preserved in 10% formaldehyde solution for detailed examination. With the help of standard taxonomical works of Penak (1978), Edmondson (1959), the identification of various species was done. The density of the benthic fauna was calculated/m² of bottom area by using the formula:

$$N = \frac{O}{A.S} \times 10,000$$

where

N = Number of individuals /m²

O = No. of organisms counted

A = area of Ekman's Dredge

S = no of samples taken at each site.

RESULTS

A total of 9 species of benthic invertebrates belonging to 3 major phyla viz. annelida, arthropoda and mollusca were recorded from the four sites of the Bod-Dal basin of Dal lake during the period January – September (Tables 1 & 2). Site - I reflected the presence of 3 species (*Limnodrillus sp.*, & *Tubifex sp.* belonging to oligochaeta and *Chironomus sp.* belonging to insecta). The total population density of the benthic organisms fluctuated from 104 ind/m² in the month of march to 208 ind/m² in the month of July with a mean population density of 145 ind/m² with *Limnodrillus sp.* (oligochaeta) being most abundant with respect to population density (49 ind/m²) (Table 3). Site-II showed the presence of 5 species (*Limnodrillus sp.*, *Branchiura sowerbyii*, *Tabunus sp.*, belonging to oligochaeta, *Lymnaea stagnalis* belonging to mollusca and *Chironomus sp.* belonging to insecta). The total population density at this site fluctuated from 26 ind/m² in the month of January to a maximum of 169 ind/m² in the month of May with a mean of 78 ind/m² with *Limnodrillus sp.* (oligochaeta) the most dominant in terms of density (57 ind/m²). The only mollusca (*Lymnaea stagnalis*) reported during the study was found from this site with population density fluctuating from (nil to 13 ind/m² with a mean of 13 ind/m²). From site-III, a total of six species (*Limnodrillus sp.*, *Branchiura sowerbyii*, & *Tubifex sp.* belonging to oligochaeta; *Chironomus sp.*, *Pentunura sp.*, & *Tabunus sp.* belonging to insecta) were recorded. The total population density of benthos fluctuated from 78 ind/m² in the month of March to 182 ind/m² in the month of July with a mean of 129 ind/m² with *Limnodrillus sp.* and *Tubifex sp.* being most dominant in terms of density (39 ind/m² and 34 ind/m² respectively). Also among the four study sites, this site exhibited the presence of *Tabunus sp.* with average density of 3 ind/m² ranging from no individuals to 13 ind/m². Site-IV showed the presence of seven species (*Limnodrillus sp.*, *Branchiura sowerbyii*, *Nais sp.*, *Aelosoma sp.*, & *Tubifex sp.* belonging to oligochaeta and two sp. viz *Chironomus sp.* and *Pentunura sp.* belonging to insecta). The total population density of benthic organisms varied from 117 ind/m² in the month of January to

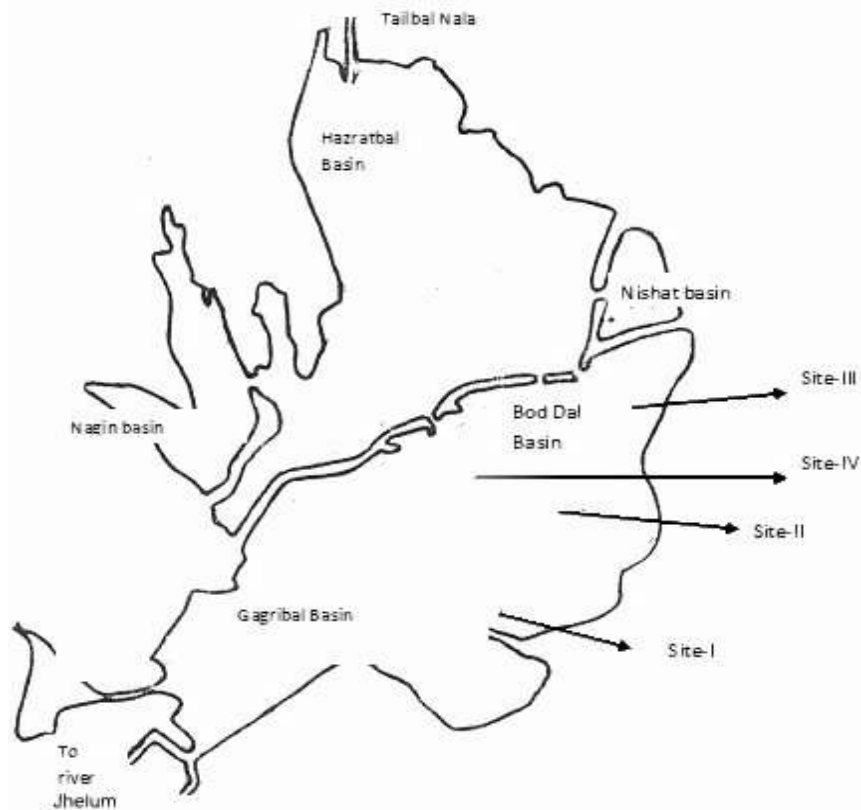


Fig. 1 Map showing four different sites.

315 ind/m² in the month of September with a mean of 211 ind/m² with *Limnodrillus* sp., and *Tubifex* sp. being most dominant in terms of density (57 ind/m²). *Nais* sp. and *Aelosoma* sp. were recorded only from this site during the study period with average density of 44 ind/m² and 21 ind/m² respectively.

DISCUSSION

During the present study, study sites I (one of the outlet drains of centaur hotel was found flowing into the lake basin near this site) and IV (witnessing the presence of settlements) showed comparatively higher pollution level on the basis of the biological organisms collected from the sediments comprising chiefly of three major classes – oligochaeta, followed by insecta and gastropoda. The results obtained are in conformity with results obtained by Mir (1995); Pandit *et al.* (1985) and Gupta (1979). *Tubifex* sp. and *Branchiura sowebyii* were restricted to shallower peripheral areas characterized by luxuriant growth of submerged macrophytes which is also reported by Qadri and Yousuf (2004). Moreover the abundance

of *Tubifex* sp., *Aelosoma* sp. and *Limnodrillus* sp. near habitation indicates sewage and organic matter pollution (Oliver, 1971; Brinkhurst and Cook, 1974; Milbrink, 1980). The quality and quantity of organic matter reaching the sediments might also be playing an important role in the distribution of these benthic organisms. The high density of the presently encountered species has also been reported to be the indicators of pollution by different workers like Brinkhurst and Cook (1974); Howmiller and Beeton (1971) and Singh (1989). The high population density of *Chironomus* sp. (arthopoda) is always associated with impact of the altered nature of substrate due to organic pollution and bacterial activity and hence indicating polluted condition. *Chironomids* have also been reported as pollution indicators (Bay *et al.*, 1966; Kaushik *et al.*, 1991) and have also been reported as being pollution tolerant (Milbrink, 1980). Among the mollusca, only one taxa – *Lymnaea stagnalis* was reported from the Site-II which seems that these prefer open water sites preferably with high sand content and luxuriant macrophytic growth (Qadri and Yousuf, 2004). On the basis of the macrozoobenthic organisms

Table 1. Macrozoobenthos density (ind/m²) at various sampling sites in Bod-Dal basin, Dal Lake.

Macrozoobenthos	Sites I	II	III	IV
ANNELIDA				
Oligochaeta				
<i>Limnodrillus</i> sp.	325	286	195	286
<i>Branchiuraa sowerbyii</i>	-	13	117	104
<i>Tubifex tubifex</i>	247	39	169	286
<i>Nais</i> sp.	-	-	-	221
<i>Aelosoma</i> sp.	-	-	-	52
ARTHROPODA				
Insecta				
<i>Chironomus</i> sp.	156	39	65	52
<i>Pentunura</i> sp.	-	-	78	78
Deptera				
<i>Tabunus</i> sp.	-	-	13	-
MOLLUSCA				
Gastropoda				
<i>Lymnaea stagnalis</i>	-	13	-	-
Total no. of ind/m ²	728	390	637	1079
Total no. of species	3	5	6	7

Table 2. Species composition of macrozoobenthic organisms at different sites of Bod-Dal basin.

S. No.	Species	Site -I	Sited -II	Site -III	Site -IV
1.	<i>Limnodrillus</i> sp.	+	+	+	+
2.	<i>Branchiura sowerbyii</i>	-	+	+	+
3.	<i>Tubifex</i> sp.	+	+	+	+
4.	<i>Nais</i> sp.	-	-	-	+
5.	<i>Aelosoma</i> sp.	-	-	-	+
6.	<i>Chironomus</i> sp.	+	+	+	+
7.	<i>Pentinura</i> sp.	-	-	+	+
8.	<i>Tabunus</i> sp.	-	-	+	-
9.	<i>Lymnaea stagnalis</i>	-	+	-	-

Table 3. Variation in population density (ind/m²) of macrozoobenthic organisms during different months of the study period, 2004.

Site	Jan	March	May	July	Sept
I	143	104	117	208	156
II	26	65	169	91	39
III	104	78	112	182	169
IV	117	143	195	278	315

collected from the basin comprising typically the eutrophic components, it may be expressed that the Bod-Dal basin of Dal lake is subjected to heavy organic matter loading chiefly in the form of sewage from the habitations and commercial enterprises like hotels in and around the lake and thus is reflecting the deteriorating lake condition.

REFERENCES

- Arslan, N., Ilhan, S., Sahin, Y., Filik, C., Yilmaz, V. and Onturk, T. 2007. Diversity of invertebrate fauna in littoral of shallow Musaozu Dam Lake in comparison with environmental parameters. *Journal of Applied Biological Sciences*. 1 : 67-75.

- Bazzanti, M. 1975. I - Chironomidi (Diptera) dei Sedimenti del lago di Martigano (Lazio). *Boll Pesca Piscie. Indrobio*. 30 : 139-142.
- Bay, E.C., Ingham, A.A. and Anderson, L.D. 1966. Physical factors influencing chironomids infestation of water spreading basins. *Ann. Entomol. Soc. Am.* 59 :714-717.
- Brinkhurst, R.O. and Cook, D.G. 1974. Benthic macroinvertebrates in relation to water and sediment chemistry. *Freshwater Biol.* 4 (3) : 183-191.
- Edmondson, W.T. 1959. *Freshwater Biology*. John Wiley, N.Y.
- Gupta, P.K. 1979. Macrobenthos of fresh water fish ponds. *Geobios*. 6 : 19-20.
- Howmiller, R.P. and Beeton, M.A. 1971. Biological evaluation of environmental quality, Green Bay, Lake Michigan. *J. Water Poll. Control Fed.* 43 : 123-133.
- Jumppanen, K. 1976. Effects of waste waters on a lake ecosystem. *Ann. Zool. Fennici*. 13 : 85-138.
- Kango, R.A. 1983. *Studies on the aquatic sediments of some Kashmir Himalayan lakes*. Ph.D. Thesis, University of Kashmir, Srinagar.
- Kaushik, S., Sharma, S. and Saksena, D.N. 1991. Ecological studies of certain polluted lentic waters of Gwailor region with reference to aquatic communities, pp. 185-200. In: *Current Trends in Limnology* (Nalin K. Shastree, ed.). Narender Publishing House, New Delhi.
- Lafont, M., Camus, J.C. and Rosso, A. 1996. Superficial and hyporheic oligochaete communities as indicators of pollution and water exchange in the River Moselle, France. *Hydrobiologia*. 334 : 147-155.
- Mir, F.A. 1995. *Ecological studies of zoobenthic communities of Dal Lake*. Ph.D Thesis, University of Kashmir, Srinagar.
- Milbrink, G. 1980. Oligochaete communities in population biology; the European situation with rapid reference to lakes in Scandinavia. In: *Aquatic Oligochaete Biology*, (R.D Brink Hurst and D.G. Cook, eds.) pp. 433-455. Plenum press, N.Y. and London.
- Oliver, D.R. 1971. Life History of Chironomidae. *Annual Review of Entomology*. 16 : 211-230.
- Pandit, A.K., Pandit, S.N. and Kaul, V. 1985. Ecological relations between invertebrates and submerged macrophytes in two Himalayan lakes. *Pollution Research*. 4 (2) : 53-58.
- Pennak, R.W. 1978. *Freshwater invertebrates of United States*. John Wiley and Sons, New York.
- Qadri, H. and Yousuf, A.R. 2004. Ecology of macrozoobenthos in Nigeen Lake. *J. Res. Dev.* 4 : 59-65.
- Richardson, J.S. & Kiffney, P.M. 2000. Responses of a macroinvertebrate community from a pristine, southern British Colombia, Canada, stream to metals in experimental mesocosms. *Environmental Toxicology and Chemistry*. 19 : 736-743.
- Singh, D.N. 1989. Studies on weed association of macrobenthic fauna of an ox-bow lake. *Proc. Nat. Acad. Sci. India*. 59 (B) : 271-278.
- Thut, R. 1965. A study of the profundal bottom fauna of lake Washington, Seattle. M.S. Thesis. 79p.
- Zutshi, D.P. 1968. *Ecology of Kashmir Lakes*. Ph.D Thesis, University of J & K, Srinagar, India.