Microfauna of Priyadarshini Lake, Schirmacher Oasis, Antarctica

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ABSTRACT

Benthos of Priyadarshini Lake, Schirmacher Oasis, Antarctica was investigated during the austral summer (1984-85). Resting eggs of micro-invertebrates dominated the total fauna. These were significantly high in the lake bottom. Nematodes, turbellarians and tardigrades were abundant in the supra-littoral sediment covered with vegetation. Salinity and dissolved nutrients in the surface water column showed very low concentrations and the values fluctuated with the weather conditions.

INTRODUCTION

Fresh-water lakes on the Antarctic continent are closed aquatic ecosystems which provide an unique habitat for basic biological studies (Heywood, 1984). A comprehensive knowledge of the flora and fauna of such lakes is a prerequisite for further ecological studies. Most of the studies on the fresh water fauna of the Antarctic lakes have emphasized the physico-chemical aspects (Harris et a1., 1981; Hawes, 1983), primary productivity (Light et al., 1981) and microbial activities (Ellis-Evans, 1982). Very little is known about the benthic fauna of such water bodies (Opalinski, 1972; Heywood, 1984). Qualitative and quantitative aspects of the benthic fauna, from undescribed Priyadarshini Lake (Schirmacher Oasis, Antarctica), were investigated during the austral summer of 1984-85. These have been reported in the present communication.

MATERIAL AND METHODS

Study area: Priyadarshini lake is situated very close to the Second Indian base station, Maitri in the Schirmacher Oasis, Antarctica (70°45'S; 11°44'E). The lake is irregular in outline with an area of 0.297 sq. km. A mat of blue green algae and moss, characterizes the supralittoral margin of the lake. The melt water from the adjacent glaciers and snow-fields runs into the lake. The lake was visited twice during the fourth Indian scientific expedition's summer programme in Antarctica (1984-85). Four stations were established along the margin periphery of the lake (Stns. A, B, C, D) and four stations (1-4) were sampled inside the lake using a rubber raft.

Sampling: Water samples were collected by 5 litre Niskin sampler and the benthos samples using a Van Veen Grab (0.04 m^2 area). Primary productivity was measured by the *in situ* ^{14}C method (Steemann-Nielsen, 1952) and dissolved nutrients (nitrate-N, phosphate-P, silicate-Si), oxygen and salinity were analysed following the methods described by Grasshoff (1976). Temperature (air, water and sediment surface) was recorded by mercury thermometer (0.1°C accuracy).

Triplicate sub-samples of microfauna were taken from each station using a hand held plastic corer (4.5 cm inner diameter) to a sediment depth of 6 cm. Faunal samples were immediately preserved in 4% formaldehyde solution to which rose-bengal (0.2 g/1) was previously added. Samples were also collected separately for estimating organic carbon content and sediment characteristics. During February 1985, the lake was partly frozen and hence samples were collected by drilling a hole through the 12 cm thick ice sheet with a hand drill. A Van Veen Grab of 0.04 m^2 area was lowered through the hole to collect the bottom deposit.

Faunal samples were analysed following the procedure given by Parulekar, Nair, Harkantra and Ansari (1976). Biomass (dry wt.) was determined according to Dye and Furstenberg (1977) and dry mass of protozoa, rotifers and cysts (resting stages) was calculated following the method of Sarojini and Nagabhushanam (1967). Organic content of the sediment was estimated by the method of El Wakeel and Riley (1956).

RESULTS AND DISCUSSION

Physical and chemical parameters recorded at the Priyadarshini lake during January and February 1985 are given in Table I. Mean temperatures in the upper layer of sediments and in the overlying water were 4.7°C and 2.2°C respectively. The water was clear throughout the sampling period with a surface temperature of 2.3°C. Maximum temperature of 3.5°C was recorded at the station 3, perhaps because of the absorption of radiation energy by the biota (Goldman et al., 1972). The station 3 was fixed at the lake centre where a thick layer of benthic alga was recorded at the bottom. The pH at all the stations ranged from 7.6 to 8.6 (mean 8.1). The pH values are higher than those (5 to 6.8) reported earlier by Bardin and Leflat (1965) in an ice covered lake in the Schirmacher Oasis. This suggests an alkaline condition of the water. Since the lake is fed by the adjoining glacial melt water, the higher pH recorded in the present observation may indicate dissolution of the alkaline rock in the glacial waters. Dissolved oxygen content varied between 6.9 to 8.6 ($\bar{x}$= 8.0) mg/1. Salinity and dissolved nutrients showed very low concentrations. Mean values of 0.009% salinity, 0.3 µg at 1^{-1} nitrate, 0.11 µg at 1^{-1} phosphate and 15.97 µg at 1^{-1} silicate were recorded in the surface water. The source for the inorganic composition seems to be dependent on the glacier melt water (Sengupta and Qasim, 1983) and the summer period evaporation also plays an important role in regulating the nutrients (Walton, 1984). Three species of birds (South Polar Skua, Antarctic Petrel and Snow Petrel) roost in the catchment of the Priyadarshini lake. Remnants of dead birds (in deteriorated conditions) were also recorded. The bird population may contribute an appreciable amount of organic nitrogen and phosphorus to the lake water. Change in the salt concentration of the lake water could also be due to the abundance of birds as has been reported by Liano (1965) and Hawes (1983). Maximum water depth of 8.5 m was recorded at the station 3 (Lake Centre). The bottom deposit comprised of fine black sediment covered by a thick felt of filamentous blue green algae (*Oscillatoria, Synechocystis, Choococcus* and *Phormidium* species). This felt attached to the gravel was dense at the stations 2 and 3. Maximum algal production in an ice-covered lake at the Schirmacher Oasis has also been reported by Komarker and Ruzicka (1966). The algal flora not only acts as a food source for the benthic organisms but also provides a suitable insulation during the winter (Goldmann et al., 1972). Total faunal distribution (percentage) at all the stations have been presented in Fig. 1. Maximum density of 1490 numbers/m^2 was recorded at the Station C during January 1985. This station was located near the stream which

TABLE I

Environmental factors recorded at the Priyadarshini Lake (Values are mean of 8 replicates) on 21 January, 1985

Temperature (°C)		Coarse sand (%)	92.33
Air	-1.6	Silt clay (%)	07.66
Water	+2.38	Organic cabon (%)	01.07
Sediment	+4.70	NO_3 (µg at 1^{-1})	00.30
pH (overlying water)	8.1	PO_4 (µg at 1^{-1})	00.11
Dissolved oxygen (mg/1)	8.0	Si (µg at 1^{-1})	15.97
Salinity (%)	0.49		

brought the melt water and sediments to the lake. The sediment at this station was covered with moss carpet. Davis (1980) has reported that the maximum amount of DOM (Dissolved Organic Matter) production occurs in moss communities and it may also induce the increase of silt-clay fractions in the sediment. Minimum density of 450 numbers/m^2 was recorded at station A, located in the southern portion of the lake where the algal and moss vegetation was almost negligible. Analysis of the particle size showed very coarse sediment at all sampling stations with very low amount of silt-clay fractions. Maximum of 92.33% of coarse particle and minimum of 07.66% of silt-clay were recorded at the station A. These fine particles (silt and clay) are expected to hold high concentrations of nutrients thus increasing the adsorbing capacity of the sediments (Gerlach, 1978). As such the fluctuations in the faunal standing crop (density/biomass) between the stations may be due to the sediment characteristic and the availability of food (Ansari et al., 1986).

Seven groups of micro-invertebrates were recorded from the Priyadarshini lake. These included protozoa (ciliata, mastigophora and sarcodina 22.31%), nematoda (14.57%), acarida (0.54%) and

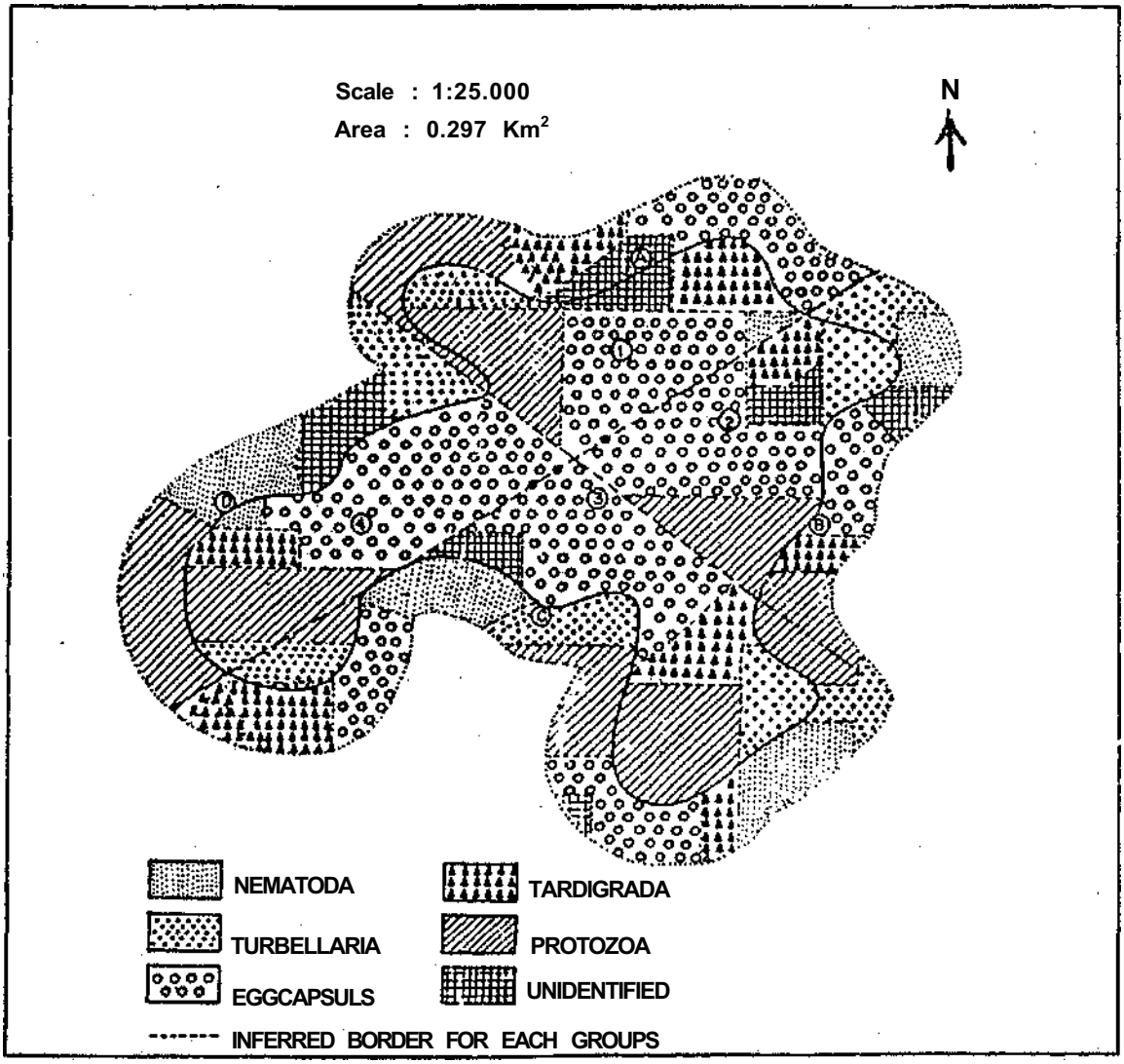

Fig.1. **Fauna of Priyadarshini Lake at Schirmacher Oasis, Antarctica.**

oligochaeta (0.60%). Resting stages (cysts) of micro-invertebrates (Rotifera, Turbellaria and Tardigrada) were recorded abundantly (38.61%) in all the samples with a maximum at the station 3 (530 eggs/m^2). A few rod shaped pigmented organisms (2.82%) were also collected and the maximum were in the supralittoral zone (station C). Some of these organisms could not be identified upto the species due to lack of expertise and proper literature and hence these have been placed under unidentified group (Table II).

TABLE II

Micro-faunal density (number/m^2)and biomass ($\mu g/m^2$)recorded at Priyadarshini lake, Schirmacher Oasis, Antarctica. (Values in parentheses are biomass $\mu g/m^2$)

Taxon	Around the lake		Inside the lake	
	Jan	Feb	Jan	Feb
Nematoda	272.5(122.6)	182.5(82.10)	12(05.60)	02.5(01.10)
Turbellaria	125.5(68.6)	97.5(43.80)	75.0(33.80)	30.0(13.50)
Ciliata	135.0(0.68)	107.5(54)	52.5(0.26)	22.5(0.11)
Tardigrada	140.0(63.30)	52.5(3.60)	80.0(36.00)	12.5(5.60)
Resting egg	140.0(0.70)	230.0(1.15)	367.5(1.84)	507.5(2.54)
Rotifera	10.0(0.05)	07.5(0.03)	05.0(0.02)	-
Protozoa	20.0(0.10)	115.0(0.55)	167.5(0.84)	100.0(0.50)
Acarida	12.0(05.00)	-	05.0(02.30)	-
Oligochaeta	12.0(05.00)	07.5(03.40)	-	-
Unidentified	42.0(18.50)	22.5(10.10)	15.0(06.80)	12.5(05.60)
Total	935.0(284.33)	822.5(165.27)	780.0(87.46)	687.5(28.95)

Fluctuations in the population density between January and February was mainly due to seasonal rhythm in phytoplankton production and instability of the environment due to the climatic fluctuations (Carriker, 1967; Heywood et. al., 1979). Diurnal studies on the physical features of the lake water showed wide fluctuations. The values for the air temperature varied between -3.0° to 2.0°C. Surface water temperatures were normally higher than the ambient temperature. The values ranged between 1.5° to 5.5°C. Very strong winds of more than 40 km/hr were recorded on 21 January 1985 (sampling day) with a continuous snowfall for six hours. Such high wind speed generated waves on the lake surface and created turbulence, resulting in the transport of coarse particulate matter into the lake basin (Sly, 1978). However, the values for dissolved oxygen varied between 6.90 to 8.60 mg 1^{-1}. It indicates that in the open part of the lake mixing occurs regularly which keeps the oxygen level almost constant.

The increase in the faunal standing crop in January 1985 indicates the high phytoplankton production during this month (Light et al., 1981). The increase in the resting egg density during February '85 suggests the protected development of some microorganisms (e.g., Turbellaria, Tardigrada and Rotifera) with long incubation periods. Although data for long term study are still being processed, the results of the present short term study clearly brings out the effect of climatological and sedimentological regimes on the morphology, abundance and diversity of the benthic fauna in the Antarctic limnetic ecosystems.

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