

COMPARATIVE STUDIES ON LIMNOLOGY OF FRESHWATER BODIES LOCATED IN COASTAL AND HIGH ALTITUDE OF GOA AND MAHARASHTRA

Pai, I.K. and Vikrant Berde,
Department of Zoology,
Goa University, Taleigao Plateau,
Goa - 403 206

Abstract :

A comparative study on limnology of freshwater bodies located at Panhalgarh, Kolhapur District, Maharashtra and a freshwater body located in Goa, was made for physical, chemical and biological parameters with special reference to zooplankton diversity along with their seasonal variations. The results indicate that there are distinct differences in dynamics of these water bodies. It is reported that there are 31 species of rotifers and 17 species of cladocerans in the freshwater body in Kolhapur district, whereas, there are 29 species of rotifers and 21 cladocerans in the Goa waterbody. There is a significant variation occurring in limnological parameters in both the water bodies. This forms the first report on the planktonic forms in this area.

Introduction :

The freshwater bodies of the world are collectively undergoing high rates of degradation leading to eutrophication. In view of all this, considerable attention is now being paid towards the study of inland water. The inland water bodies are closed ecosystems in which zooplanktons hold a key position in the metabolism of water bodies, trophic levels, food chains and energy flow. As producers and consumers, plankton play an important role in the transformation of energy from one trophic level to the next higher trophic level, ultimately leading to fish production which is the final product of aquatic environment. Planktonic animals in freshwater are dominated by rotifers, cladocerans and copepods. The occurrence and abundance of zooplankton in freshwater ecosystem depends on its productivity, which in turn is influenced by physico-chemical parameters and level of nutrients. The species composition and distribution of freshwater zooplankton is very poorly studied in tropical inland waters (Fernando, 1980). In India, considerable work has been done on ecology and seasonal distribution of plankton than other

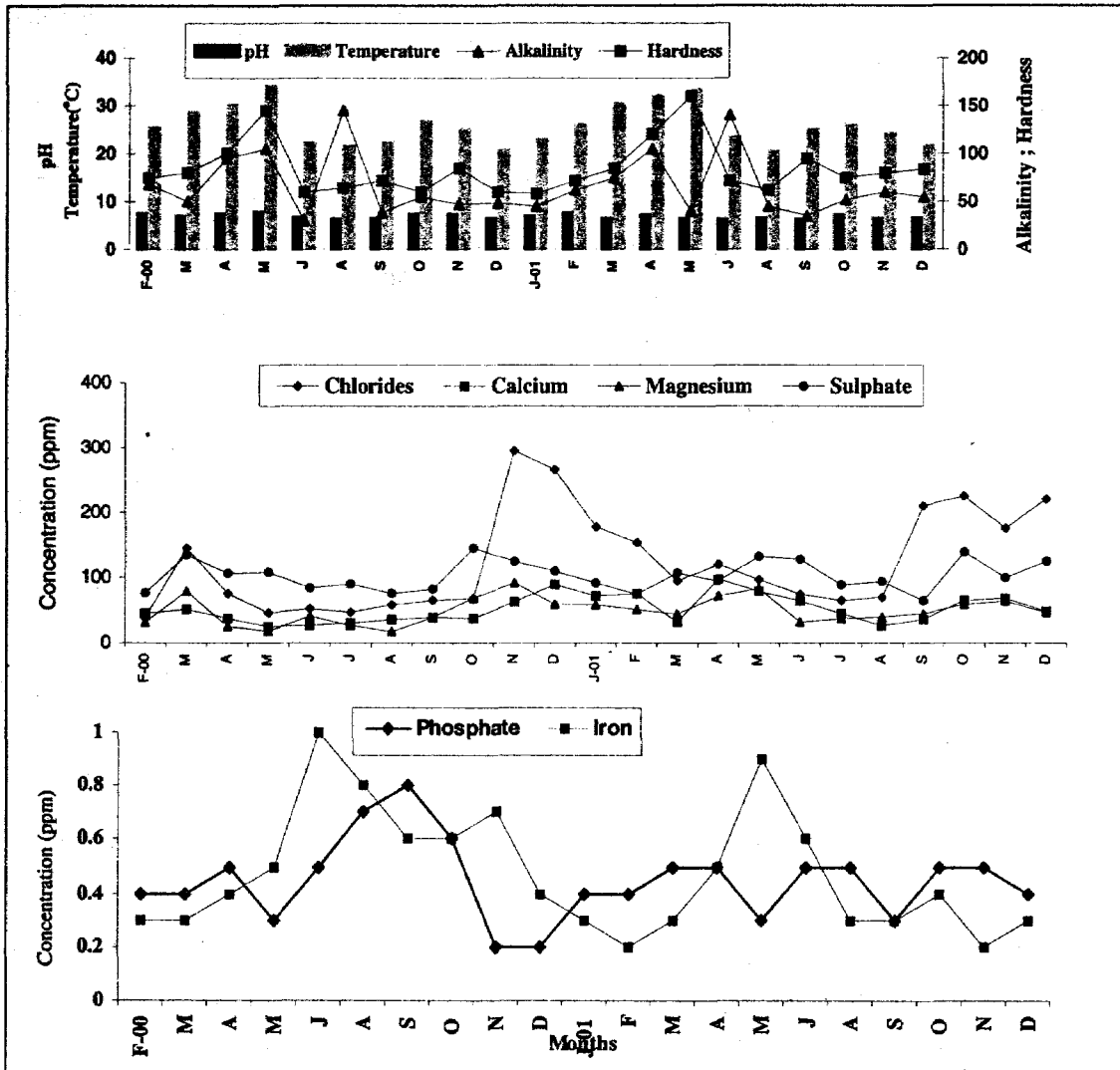
tropical and sub-tropical countries (Battish, 1992; Ranga Reddy, 2001)

Though a good deal of information is available on the distribution of plankton, no comparative study seems to have been carried out earlier, to understand correlation between zooplanktonic population and the abiotic factors. Apart from above, there are no comparative studies on physical, chemical and biological components of freshwater bodies distinctly visible agroclimatically different environmental conditions. Keeping in view the importance of zooplankton, the present work was carried out in few water bodies located at sea-level in the states of Goa and high altitudes in Kolhapur district of Maharashtra during February 2000 to January 2002.

Materials and methods :

Sadoba pond is situated at 968 msl in Panhalgarh hill fort (16° 50'N, 75° 10'E), 18 Km north-west of Kolhapur district, Maharashtra, known as historical place and famous as tourist spot. This temporary pond is used for the purpose of boating as well as for other domestic uses. It is deep perennial with shallow margin

Fig. 1.1 Physico-chemical parameters of Sadoba pond during 2000 – 2001.



with an average area of 0.6 hector. While Santacruz lake (15° 54'N, 73° 56'E) located 3 Km away from Panaji, is situated at almost sea level (128 msl), with an average area of 3.5 hector. The lake is totally covered with various types of hydrophytes. The lake is used for the purpose of washing clothes and cattle in some parts, while some areas are used for paddy plantation during monsoon. All together there is

lot of human interference with lake ecosystem. Water samples for physico-chemical parameters were analysed by using water testing kits manufactured by C.P.R. Foundation, Chennai, India and standard methods (APHA, 1989). Zooplankton samples were collected from littoral zone by filtering 50 litres of water through plankton hand net of bolting nylon cloth (mesh size 45 µm) from each water body, in

early morning hours (between 8.00 -11.00 a.m.), twice a month for a period of two years. The procedure for collection, storage and analysis of samples were followed as per standard methods (APHA, 1989). The zooplankton samples were preserved in 4% neutral formaldehyde. The samples were tagged for biomass, taxonomical and numerical studies. The individual species of zooplankton were sorted out and their whole mounts were stained with borax carmine or methylene blue, according to requirements. For numerical estimation, samples were observed under light microscope using "Sedgwick Rafter Cell" (APHA, 1989). The biomass of zooplankton was determined by displacement method (APHA, 1989). Zooplankton was identified up to species level, using standard literature (Michael and Sharma, 1988; Battish, 1992; Edmondson, 1992; Dhanpathi, 2000).

Results and discussion :

The physico-chemical parameters of the water of Sadoba pond and Santacruz lake are incorporated in Fig. 1. In general, as compared to Sadoba pond, Santacruz lake showed higher temperature, pH, alkalinity, hardness, chlorides, calcium and magnesium contents. But in other nutrients such as sulphates, Sadoba pond showed slightly higher values. Average iron and phosphate values of both the years showed almost similar values. As compared to the nature of both water bodies, Sadoba pond which is smaller in size and with temporary nature should have shown different results. It might be due to more human interference with Santacruz lake, in flow of domestic wastes and decomposition of hydrophytes during the course of study.

As depicted in Figs. 1.1 and 1.2, Santacruz lake showed slightly higher temperature than Sadoba pond, while the pH was acidic in both the water bodies. Concentrations of most of the elements was higher in Santacruz lake, except for phosphates and sulphates.

Goa being in the subtropical belt and Sadoba pond being on high altitude may be reason for such a temperature difference. Temperature controls development, growth, reproduction,

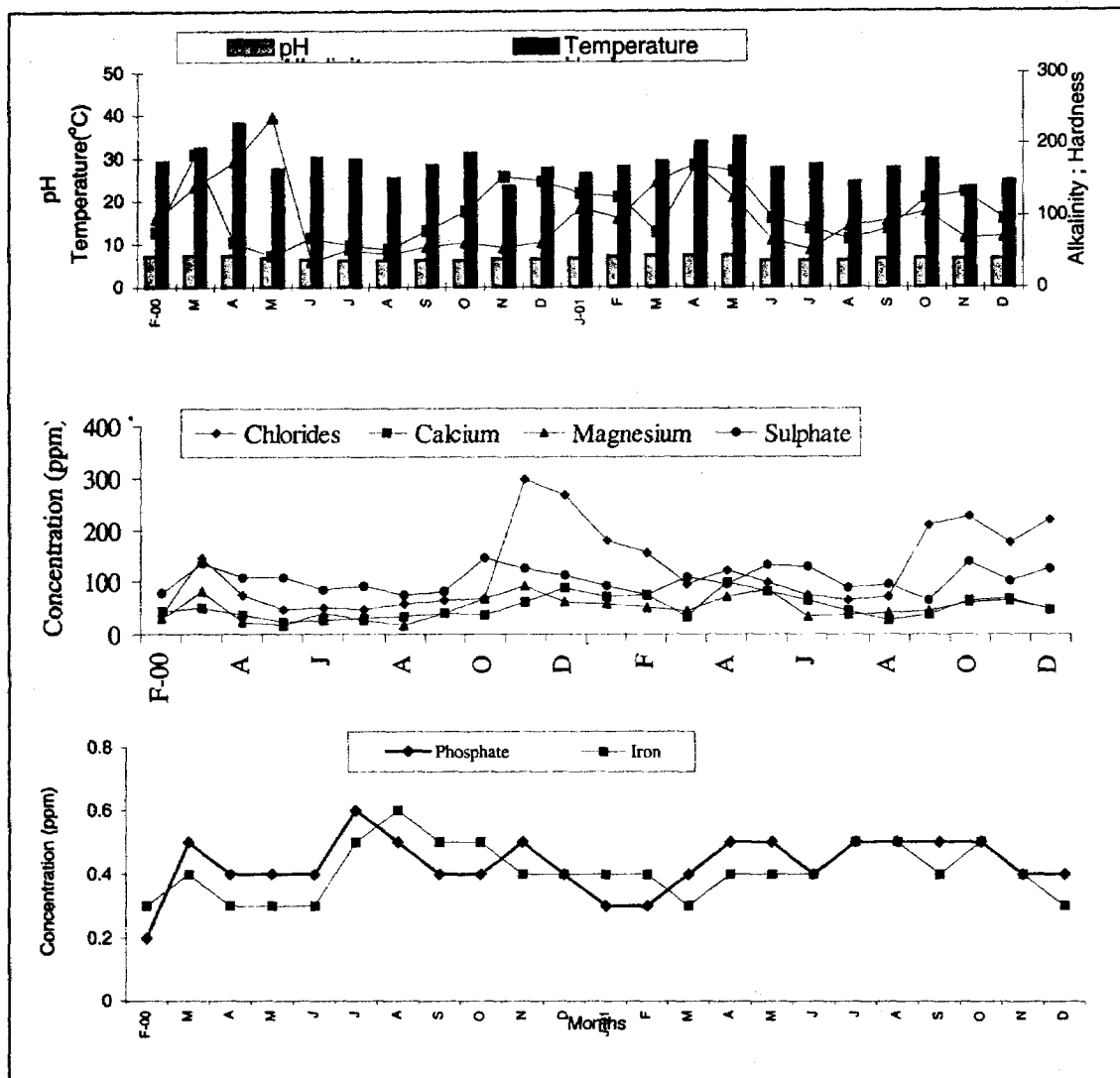
shape of body and distribution of the species (Caramujo and Boavida, 1999; Xie and Chen, 2001). The high altitude lakes, namely, Sadoba pond and Someshwar temple tank, differ from other low altitude lakes, only in temperature. Sadoba pond and Santacruz lake are acidic in nature. It is reported that alkaline pH is favourable for good plankton growth and indicates its unpolluted nature (Mahajan and Kanhere, 1995; Rasool *et.al.*, 2003). All the groups of zooplankton were encountered in Santacruz lake and Sadoba pond.

Biomass data of Sadoba pond showed two peaks in August and December of both years (Fig. 2). Rotifers and calanoids were found to be the most dominant zooplankton fauna during these months. The biomass concentration data of Santacruz lake during the year 2000 reveals a peak in November (Fig. 2). Whereas in 2001, two peaks of biomass were obtained in August and December. The zooplankton density was also maximum in December. Rotifers were dominant during both the months.

The zooplankton abundance of Sadoba pond is shown in Fig. 3.1 and indicates the presence of all species in the pond water. In August '00 and March '01, highest number of zooplankton *i.e.* 5366 and 5471 individuals/L, respectively, were encountered, whereas the least number were seen in April '00 at 2770 individuals/L and September '01 at 2230 individuals/L.

In the year 2000, rotifers were present all year round with peak densities in March, May, August and December. After February, the number of cladocerans fell considerably and a rise was seen only in August. Cyclopoids were absent during March and June '00 with the density almost constant in the remaining months. Calanoids were totally absent during the month of November. Its density increased from February till March, followed by a gradual fall and sudden rise in August. Copepoda larvae were absent in August '00. The density was seen to increase gradually from March till July and thereafter remained constant upto October. Harpacticoids were maximum in May and were not detected during most of the months except in

Fig. 1.2 Physico-chemical parameters of Santacruz lake during 2000 – 2001.



February, May - August and October. Harpacticoida and ostracoda densities were lower than the other zooplankton. Thus, the density of rotifers was highest and that of ostracods was lowest. The percent occurrence of zooplankton showed the following pattern: rotifera (44.53 %) > calanoida (17.54 %) > copepoda larvae (14.28 %) > cyclopoida (12.69 %) > others (below 10 %).

In 2001, density of rotifers was high from January till March and towards the end of the year. Cladocerans were high during rains. However, cladocerans were not detected during February - March, June and December '01. Cyclopoids were observed throughout the year except in November '01. While, Calanoids were totally absent during the months of January and July '01. Copepoda larvae were detected all year

round. A very slow rise in density was observed from January to July followed by a dip in density. In November, another peak in abundance of copepoda larvae was observed. Harpacticoids and ostracods were found occurring in scarce numbers.

The density of rotifers was highest as per the count in March while lowest density was that of harpacticoids. The percentage of zooplankton occurrence was in the following decreasing order: rotifera (45.84 %) > cyclopoida (13.82 %) > copepoda larvae (13.46 %) > calanoida (12.81 %) > cladocera (10.29 %) > others (below 10 %).

During the year 2000, *Keratella tropica* and *Brachionus caudatus* were the most populous species encountered. While *Brachionus calyciflorus* was most abundant during 2001. A total of 31 species were encountered in this freshwater body.

Sadoba pond had 17 species of cladocerans which included *A. pulchella*, *Kurzia longirostris*, *Biapertura karua*, *Ceriodaphnia pulchella*, *C. reticulata*, *Daphnia carinata*, *D. lumholtzi*, *D. pulex*, *Diaphanosoma sarsi*, *Echinisca triserialis*, *Macrothrix laticornis*, *Moina branchiata*, *Pleuroxus similis*, *Pseudosida bidentata*, *Scapholeberis kingi*, *Simocephalus exspinosus* and *S. vetulus*.

Zooplankton abundance of Santacruz lake is depicted in Fig. 3.2 and almost all species were present. During the two year's survey, highest number of zooplankton was 3068 and 3234 individuals/L during December of 2000 and 2001, respectively. Whereas, the lowest number being 1320 and 1129 individuals/L, seen during June '00 and April '01, respectively. Calanoids, harpacticoids and ostracods were found in low numbers and were absent in the water samples of some months, during both the years.

In 2000, Rotifer density was high in February, which gradually decreased upto June and started to increase again to give a peak in August. Maximum density was obtained in November. Cladoceran abundance was high during May -

June with peak density value in November. The density of calanoids was high during the rains while copepoda larvae showed the alternating monthly high - low pattern. Thus, the rotifers were most abundant while the lowest abundance was that of harpacticoids. The percentage of zooplankton occurrence was in the following decreasing order: rotifera (40.92 %) > copepoda larvae (17.52 %) = cladocera (17.51 %) > cyclopoida (16.10 %) > others (below 10 %).

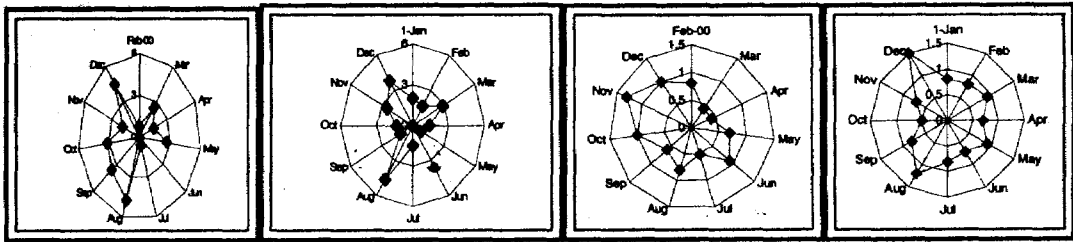
The density pattern of rotifers in 2001 was similar to that seen during 2000. Abundance of cladocerans was maximum during January, July and November, while in October, this group was not detected. Cyclopoids were most abundant during rains and totally absent in March. The density of copepoda larvae was high during June, September and December, with peak value being in September. Thus, the most abundant species were rotifers, while the least abundant were ostracods. The percentage of zooplankton abundance showed following pattern of occurrence: rotifera (49.62 %) > cyclopoida (16.23 %) > cladocera (15.56 %) > copepoda larvae (12.25 %) > others (below 10 %).

Out of the 29 species detected in this lake, *Brachionus calyciflorus* was most populous with highest individuals i.e. 570, during August '00. While, the most populous species during 2001 was *Keratella tropica* and its density peak was seen in December '01.

A total of 21 species were identified from the Santacruz lake, which included *Alona costata*, *Alonella excisa*, *Ceriodaphnia cornuta*, *C. pulchella*, *Daphnia pulex*, *Echinisca triserialis*, *Chydorus parvus*, *C. ventricosus*, *Kurzia longirostris*, *Diaphanosoma sarsi*, *D. excisum*, *Leptodorida kindti*, *Latonopsis australis*, *Macrothrix spinosa*, *M. laticornis*, *S. vetulus*, *Moina branchiata*, *Pleuroxus denticulatus*, *P. similis*, *Pseudosida bidentata* and *Sida crystallina*.

Keratella cochlearis was found only in Sadoba pond. This may be due to the acidic nature of the pond (Mallin, 1984). Rotifers such as *B.*

Fig. 2. Zooplankton biomass of the freshwater bodies: Santacruz lake (♦) and Sadoba pond (◆) during 2000 – 2001.



forficula (Rao and Durve, 1989) and *Filinia longiseta* (Schindler and Noven, 1971; Mishra and Saksena, 1998) are considered as indicators of eutrophy. These species are present in Sadoba pond and Santacruz lake, thus showing their eutrophic nature.

The zooplankton observed in Sadoba pond and Santacruz lake included total 70 types belonging to the different groups such as rotifera and cladocera. The zooplankton density in general was higher in Sadoba pond as compared to Santacruz lake. Rotifers were the dominant zooplanktons compared to other crustaceans in both the water bodies. But in Sadoba pond it is codominated with copepods, while in Santacruz lake, it is codominated with cladocerans. All these groups showed seasonal variations in their abundance and biomass.

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