Univ. j. zool. Rajshahi Univ. Vol. 26, 2007. pp. 49-54
http://journals.sfu.ca/bd/index.php/UJZRU
ISSN 1023-6104

Seasonal variation of plankton population of Borobila beel in Rangpur district

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Abstract : Seasonal variation of the plankton populations with some water quality parameters of Borobila beel, Rangpur district was carried out during July 2003 to June 2004. Total plankton ranged from 98.3×104 to 35.0×105 cells/l with mean values of 19.67±9.77×105 cells/l. A total of 51 genera of planktons were recorded belonging to Chlorophyceae, Bacillariophyceae, Cyanophyceae, Euglenophyceae, Dinophyceae, Crustacea and Rotifera. Among the phytoplankton, Euglenophyceae was the most dominant group and contributing 33% of total phytoplankton in Borobila beel. The greatest abundance of phytoplankton was recorded in November with an average number 28.83×105 cells/l. The minimum abundance of phytoplankton was recorded in January (61.7×104 cells/l). Among the zooplanktons Crustacea was dominant, contributing 71% of the total zooplankton population. The abundance of zooplankton showed two peaks of which one in the month of August (81.7x 104 cells/l) and another in the month of May (16.7 x104 cells/l). Phytoplankton and zooplankton have a nominal positive relationship. Zooplankton was less increased with the increasing of phytoplankton.

Key words: Water quality parameters, plankton population, Borobila beel.

Introduction

The beel/maun/jheel/tal/pat represents the transitional phase between the terrestrial and aquatic systems with water table at or near the surface or the land is covered with shallow depth of water. Soil and water of beels are very productive and good natural habitats of large and small indigenous fishes of different food habits. Many other fish and prawn species move into the inundated areas of beels from adjacent rivers and canal for breeding, grazing and nursing purpose during monsoon months (Jha, 1989). The qualitative and quantitative abundance of plankton and its relation to environmental condition has become a prerequisite for fish production. In most cases, the proliferation of planktonic algae is beneficial for aquaculture, fish production and wild fisheries operations. However, in some situations algal blooms can have a negative effect, causing severe economic losses to aquaculture, fisheries operations and having major environmental and human health impacts. So, the monitoring programmes of plankton are very important because they may provide information on possible new introductions and may serve as early warning systems to detect the onset of potentially hazardous blooms and may suggest predicative factors for blooms. Species diversity indices when correlated with physical and chemical parameters, provide one of the best ways to detect and evaluate the impact of pollution on aquatic communities (Maraglef, 1968). Due to absence of planktonic study in the Borobila beel, the present study was undertaken to study monthly variation of plankton population with some water quality parameters and to find out the scope of aquaculture in this beel, Rangpur.

Materials and methods

Location

Information on the selected beel was obtained from baseline survey report by ARDMCS (2003) that Borobila beel is located at Pirganj Upazila under Rangpur district. It is a semi-closed beel connected with other beels and rivers through bamboo screens and sluice gate. The beel has two distinct parts: the relatively larger part at southern side is known as boro (big) beel and the smaller part in northern side is called choto (small) beel. The beel has two inlets and one main outlet, of which one inlet is connected with the Akhira River that has a sluice gate to control the water flow, and another is connected with a beel called Angrar beel. The main outlet is at the southern part of the beel which is connected to Kuchiamari River. The range of basin depth is 1.83 – 3.35 m.

Procedure of study

Plankton and water samples were collected monthly from July 2003 to June 2004 from six different sites of the beel. Samplings were made between 9.00 to 11.30 am. Ten liters of water were collected from each site by a plastic bucket and kept on wooden boat. Water temperature, pH and conductivity were measured directly from the collected water using a digital water proof pH, EC/TDS and temperature meters (HANNA instruments, model: HI 98129- HI 98130). Hundred ml sample of the collected water of each site were taken in a bottle and NO_3-N were measured directly from the reading of spectrophotometer HACH water analysis

Kit (HANNA instrument, model HI 93728) with one packet of HI 93728 reagent for 10 ml filtered water samples. The concentration of PO_4-P was measured directly from the reading of spectrophotometer HACH water analysis Kit (HANNA instrument, model HI 93713) with one packet of HI 93713 reagent for 10 ml filtered water samples.

For study of plankton, the collected 10 L water was filtered through plankton net of 10, 30 and 55 µ mesh and finally concentrated to 20 ml. The filtrates were then immediately preserved in 5% buffered formalin for further studies. Microscopic identification up to genera level was performed following the standard manual. Each sample was stirred well just before microscopic examination. One ml of stirred sample was transferred to Sedgewick-Rafter (S-R cell) cell with a wide mouth pipette. Identification and enumeration were done by a compound electrical microscope (NOVA 950 ES). All the planktons present in 20 squares of the cell chosen randomly were counted. The mean of three estimates was then calculated for each component occurring in the total count. Finally the quantitative counts of phytoplankton were done according to Rahman (1992) and expressed in cells/l. Qualitative studies were done after Peenak (1953), Ward and Whipple (1954), Needham and Needham (1962), Prescott (1964), Bellinger (1992) and APHA (1992).

Results

Environmental parameters

In the present study, temperature ranged from 18.5ºC in December to 33.72ºC in August, with a mean of 28.27±5.62ºC showing a typical seasonal pattern (Fig. 1). pH of water varied between 7.12 and 8.68 (mean 8±0.51) with the maximum in February and minimum in June. Total alkalinity of water ranged from 48.50 to 133.0 mg/l with an mean value of 86.03±30.25 mg/l. The maximum conductivity (239.0 µs/cm) was recorded in April and the minimum (124.0 µs/cm) in July with a mean value of 179.05±40.09 µs/cm.

Nutrients

During the study period, NO_3-N concentration fluctuated widely from 1.52 to 2.97 mg/l (mean value 2.31±0.52 mg/l). The highest value was recorded in September and lowest in February (Fig. 2). Fluctuation of PO_4-P concentration ranged from 0.08 to 0.88 mg/l (mean 0.29±0.23 mg/l) with the maximum in April and minimum in October (Fig. 3).

Phytoplankton

Temporal abundance of total phytoplankton varied from 6.17×10^3 to 28.83×10^5 cells/l with an average mean value of $15.04\pm8.49\times 10^5$ cells/l. Phytoplankton population showed peak abundance in November and lowest in January (Fig. 4). A total number of 40 phytoplankton genera belonged to five major groups-Euglenophyceae, Chlorophyceae, Bacillariophyceae, Cyanophyceae and Dinophyceae were identified (Table 1). Among them, Euglenophyceae was the most dominant group and the Dinophyceae is least. Percent composition of these groups is shown in Figure 5.

Euglenophyceae

Euglenophyceae was the most dominant group of phytoplankton in respect to abundance with mean value $50.1\pm31.7\times10^4$ cells/l. This group was the most abundant in November (13.33×10^5 cells/l) and least in December-January (13.3×10^4 cells/l). The frequently occurring taxa of Euglenophyceae were *Euglena*, *Tracelomonus*, and *Phacus*.

Chlorophyceae

Chlorophyceae ranked as the second highest among phytoplankton groups in respect to abundance and first in number of genera (18). The range of Chlorophyceae numbers was from 83×10^3 to 10.50×10^5 cells/l with an average mean $47.8\pm34.2\times10^4$ cells/l. The occurrence of Chlorophyceae was highest in October and lowest in April. *Chlorella, Staurastrum, Ulothrix, Pediastrum, Closterium, Cosmarium, Tetraedron* etc. were predominant genera.

Bacillariophyceae

A total of 8 genera of Bacillariophyceae were observed in Borobila beel. Among these, *Cyclotella, Navicula, Surirella, Pinnularia, Gyrosigma* were predominant. Bacillariophyceae was the most dominant in November (86.7×10^4 cells/l) and lowest in March (50×10^3 cells/l).

Cyanophyceae

The abundance of Cyanophyceae was found to be highest in September (43.3×10^4 cells/l) and lowest in December-January (50×10^3 cells/l) with 10 numbers of genera. Among them, *Anabaena, Microcystis, Gomphospheria, Oscillatoria, Chroococcus, Aphanocapsa, Aphanizomenon* were predominant.

Dinophyceae

Dinophyceae was the least dominant group of phytoplankton in respect of both abundance and number of species. Dinophyceae was the most abundant in November (25.0×10^4 cells/l). This group was rarely found in this beel from January to April. Only one genera *Ceratium* was found in this beel.

Zooplankton population

In the present study, the zooplankton populations of Borobila beel were composed of two major groups: Crustacean and Rotifer. Zooplanktons were represented by 11 genera among which 6 belonged to Crustacea and 5 to Rotifera. Total zooplankton populations ranged from 16.7×10^4 to 81.7×10^4 cells/l with a mean $46.3\pm21.5\times10^4$ cells/l. Monthly variations in mean abundance of Crustacea and Rotifera in Borobila beel are shown in Fig. 6. During the study period, Crustacea was the most dominant group composing 71% of the total zooplankton population and the rest were Rotifers. Total zooplankton populations showed two peaks. The maximum abundance of total zooplankton was recorded in the month of August (75.0×10^4 cells/l) and another in the month of May (81.7×10^4 cells/l).

Crustacea

Among crustaceans, *Bosmina, Cyclops, Daphnia, Diaphanosoma, Diaptomus, Moina* were predominant. Average abundance of Crustacea ranged from 33×10^3 to 50.0×10^4 cells/l with a mean value $32.8\pm15.5\times10^4$ cells/l. Crustaceans are most abundant in October and least in July.

Rotifera

Among rotifers, *Asplanchna, Brachionus, Filinia, Keratella, Polyarthra* are predominant. The abundance of rotifers was the highest in August. Average abundance of Rotifera ranged from 0 to 35.0×10^4 cell/l with a mean value $13.5\pm12.8\times10^4$ cells/l. This group was rarely found in this beel from January to March.

Discussion

It is almost well established that the planktons can be an index to compare the relative productivity and fishery potential of different water bodies. They play an important role in the food chain of fishes. The results of seasonal variation in plankton population suggest that the favourable period for primary production is from August to November, when nutrient accumulation from freshwater run-off due to monsoon rainfall is higher. Singh (1960) in his study on the phytoplankton of inland water of Uttar Pradesh in India recorded primary peak of phytoplankton in the months of September-October. Razzaque *et al.* (1995) and Ehshan *et al.* (2000) also observed similar phenomenon in October in Halti beel and Chanda beel, respectively. The lowest abundance of phytoplankton was obtained in the month of January. Similarly Razzaque *et al.* (1995) and Ehshan *et al.* (2000) observed lowest abundance of phytoplankton in April and March in Halti beel and Chanda beel, respectively. A total of 40 genera of phytoplankton was identified in studied beel that were more or less similar to findings reported by Ehshan *et al.* (2000) who observed 44 genera of phytoplankton in Chanda beel. Razzaque *et al.* (1995) identified 87 genera of phytoplankton in Halti beel, and Saha and Hossain (2002) found 46 genera in Saldu beel.

It is well-established that the productivity of plankton depends on the ecological balance between the various physico-chemical factors. Phytoplankton abundance and taxonomic diversity depend upon the supply of nutrients in natural waters. In the present study, the highest phytoplankton density and species diversity was found in September to November, when the temperature and $N\text{-}NO_3$ concentration were found to be highest. Similar relationship also present in case of lower abundance of phytoplankton in low temperature and $N\text{-}NO_3$ concentration. Phosphate exhibited inverse relation with the growth rate of planktonic organisms indicating its consumption by the plankters to certain extent. The lower value of phosphate corresponded with the higher plankton abundance in August-November supported this fact. Patra and Azadi (1987) found similar relationship between $P\text{-}PO_4$ and plankton population.

In the present study, the range of total zooplankton populations was from 16.7×10^3 to 81.7×10^4 cells/l, with mean value of $46.3\pm21.5\times10^4$ cells/l which was more or less close to the values reported by Patra and Azadi (1987) in Halda River, Razzaque *et al.* (1995) in Halti beel and Ahmed *et al* (2004) in Shakla beel. Crustacea was dominant group and Rotifera was the rarest among zooplankton. Similarly Patra and Azadi (1987) reported that crustacea was the most dominant group in Halda River and Saha and Hossain (2002) also reported similar results in Saldu beel. Zooplankton showed two peaks, one in the month of August to October and another in the month of May which was similar to the observation reported by Das and Srivastava (1956) in a pond. Patra and Azadi (1987) found two peaks of zooplankton one in August and another in February and Razzaque *et al.* (1995) reported that the zooplankton showed two peaks, one in May and another in October in Halti beel. Both phytoplankton and zooplankton showed direct relationship between themselves (Fig. 7). Similar relationships were also reported by Patra and Azadi (1987) in Halda River, Ali *et al.* (1985) in a pond, and Razzaque *et al.* (1995) in Halti *beel*. However, Das and Srivastava (1956) observed inverse correlation between phytoplankton and zooplankton.

Among the vast inland fishery resources, beels are more potential. But fish production from beel fishery is decreasing day by day due to various man made activities. So, beel fishery should be preserved for augmenting fish production and ecological balance of this habitat. Therefore, restoration and development of degraded habitats and rehabilitation of depleted stocks by ranching programme are urgently needed. From the present study, it is suggested that further study on seasonal changes of phytoplankton in relation to some water quality parameters should be under taken in different sites of Borobila beel.

Acknowledgments

The author is immensely grateful to Aquatic Research Development Management and Conservation Study (ARDMCS) funded by World Bank for its financial and technical supports in performance of this research work. The Authors are indebted to Professor Dr. Somen Dewan, Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh for his co-operation and advice during the study period.

Table 1. Generic status of plankton with their different groups recorded from Borobila beel during the study period

Phytoplankton		Zooplankton
Euglenophyceae	**Bacillariophyceae**	**Crustacea**
Euglena	*Amphora*	*Cyclops*
Phacus	*Cyclotella*	*Daphnia*
Tracelomonus	*Cymbella*	*Diaphanosoma*
Strombomonas	*Eunotia*	*Diaptomus*
	Navicula	*Moina*
Chlorophyceae	*Pinnularia*	Nauplius
Ankistrodesmus	*Stauroneis*	
Arthrodesmus	*Surrirella*	**Rotifera**
Chlorella		*Asplanchna*
Closteriopsis	**Cyanophyceae**	*Brachionus*
Closterium	*Anabaena*	*Filinia*
Coenochloris	*Aphanocapsa*	*Keratella*
Cosmarium	*Chroococcus*	*Polyarthra*
Euastrum	*Coelospherium*	
Microspora	*Gloeocapsa*	
Pediastrum	*Gomphospheria*	
Radiococcus	*Merismopedia*	
Scenedesmus	*Oscillatoria*	
Spirogyra	*Phormidium*	
Staurastrum	*Polycystis*	
Tetraedron		
Trebouxia	**Dinophyceae**	
Ulothrix	*Ceratium*	
Xanthidium		

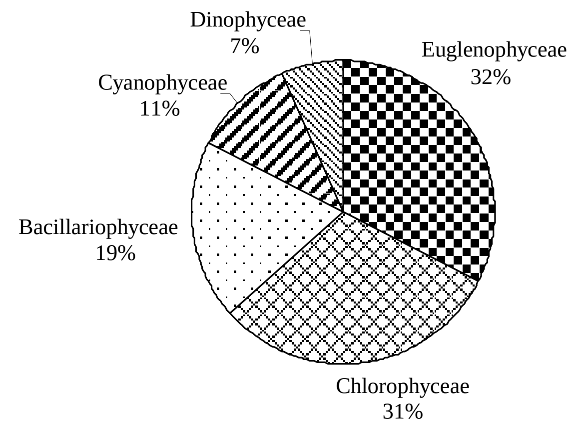

Fig. 5. Percent composition of various phytoplakton groups (average mean of one year)

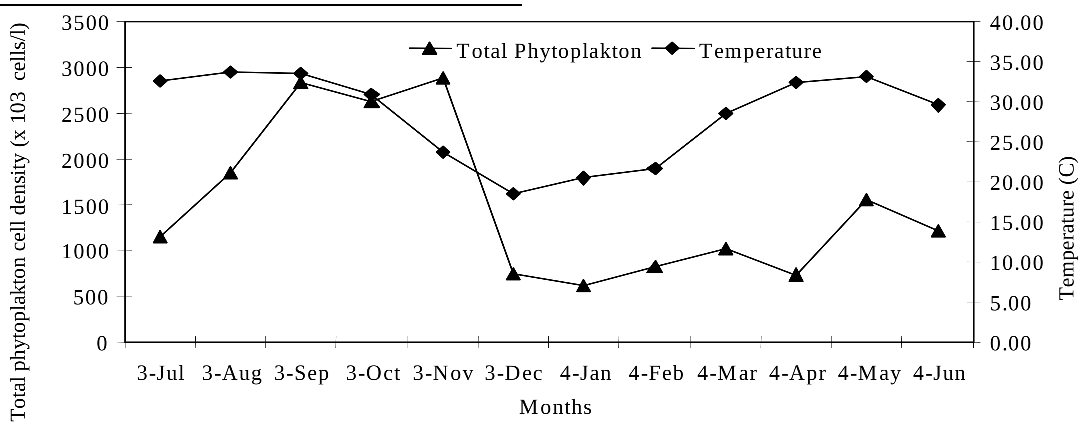

Fig. 1. Effects of temperatures on the seasonal abundance of plankton population in Borobila beel during the study period

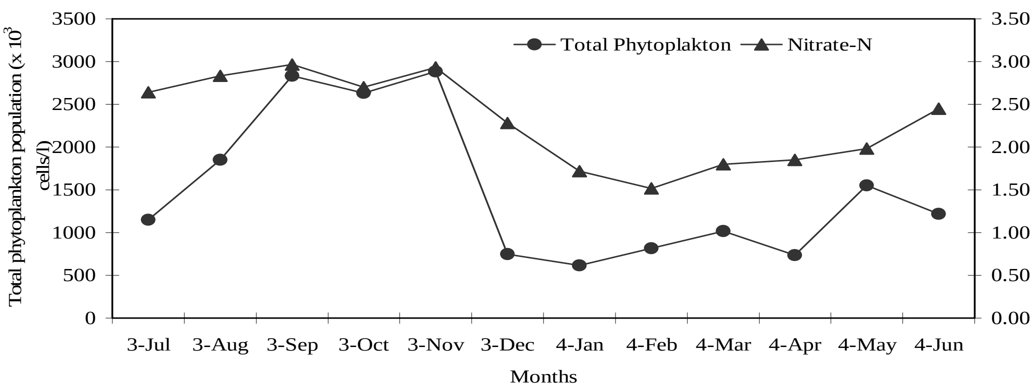

Fig. 2. Effects of Nitrate-N concentrations on the seasonal abundance of total phytoplankton population in Borobila beel during the study period

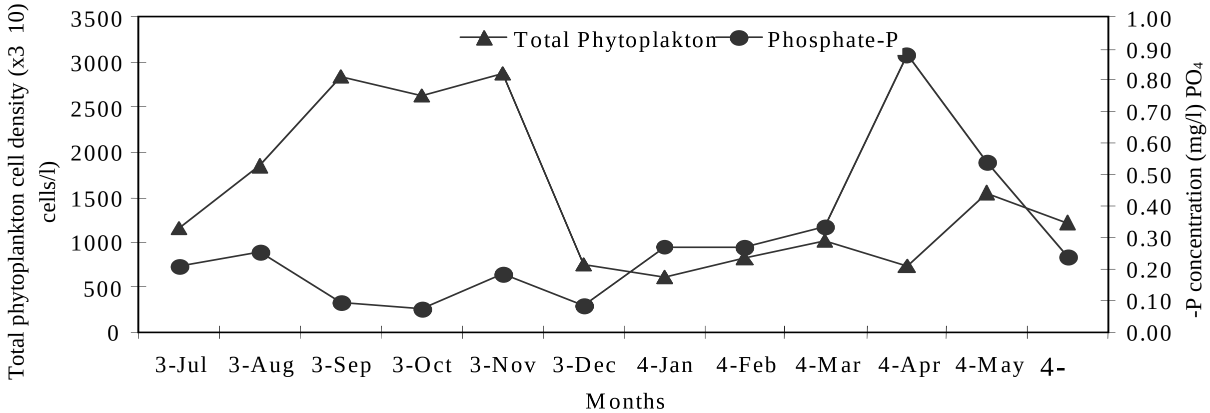

Fig. 3. Effects of Phosphate-P concentrations on the seasonal abundance of total phytoplankton population in Borobila beel during the study

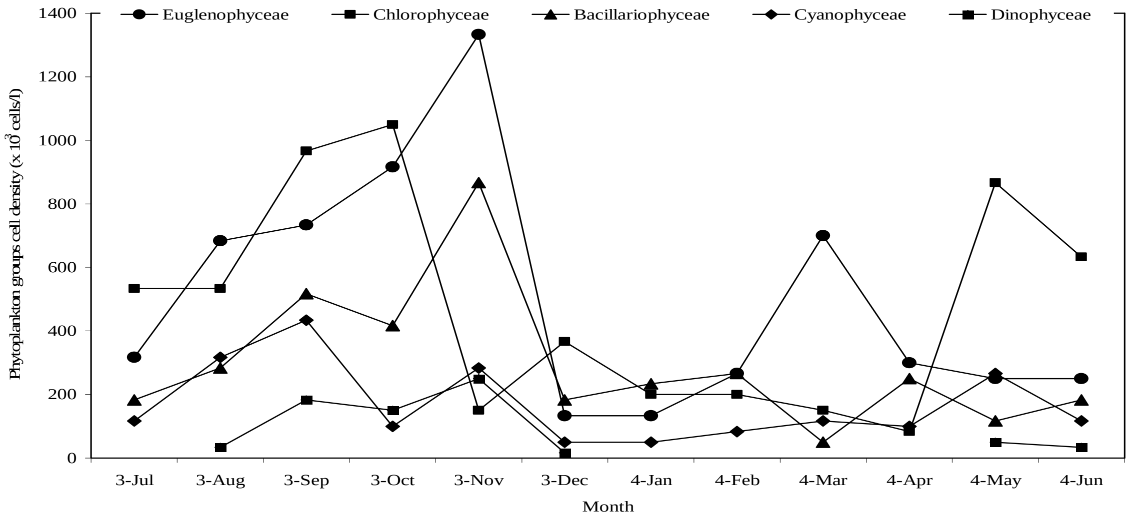

Fig. 4: Seasonal fluctuation of different planktonic groups in Borobila beel during the study period

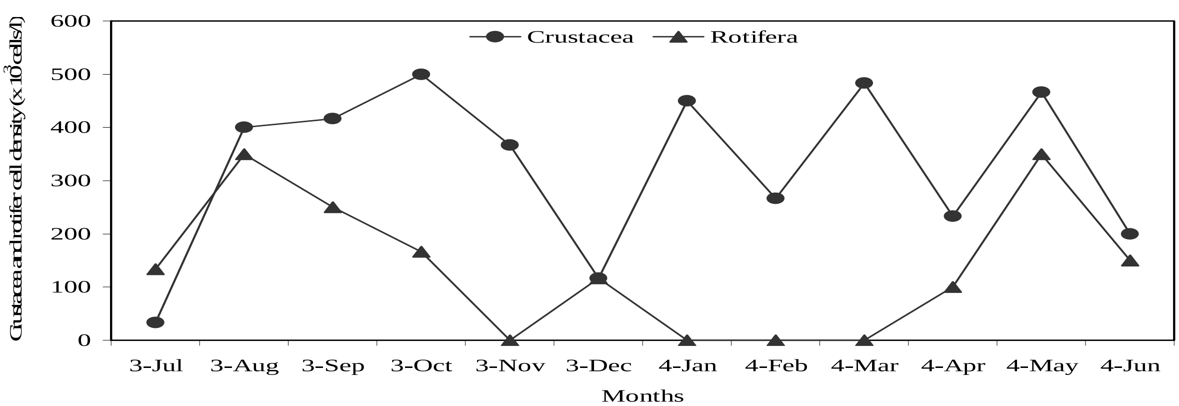

Fig. 6. Seasonal fluctuation of Crustacea and Rotifer in Borobila beel during the study period

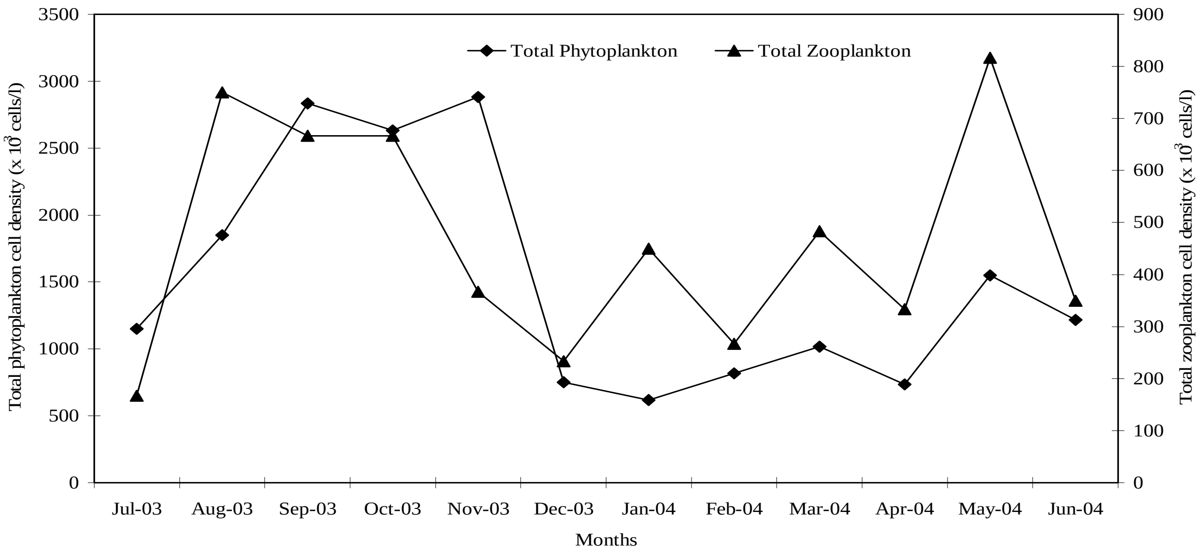

Fig. 7. Temporal relationship between total phytoplankton and total zooplankton population of Borobila beel during the study period

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Manuscript received on 06.08.07, accepted on 29.08.07