Univ. j. zool. Rajshahi Univ. Vol. 27, 2008 pp. 55-58 **ISSN 1023-6104**
http://journals.sfu.ca/bd/index.php/UJZRU

Seasonal dynamics of plankton in relation to some environmental factors in a Beel ecosystem

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Abstract: Seasonal dynamics of plankton, water temperature, conductivity, pH, total alkalinity, phosphate-phosphorus and nitrate-nitrogen of Burulia beel were measured. These values were within the acceptable ranges. In the present study, water temperature, pH, Nitrate-nitrogen, Phosphate-phosphorus were found to range from 13.50 to 30.50°C, 6.21 to 7.33, 1.36 to 2.85 mg/l and 0.07 to 0.71 mg/l, respectively. The range of total plankton was from 12.67×10^5 to 80.83×10^5 cells/l with mean value $29.71\pm19.98\times10^5$ cells/l. A total of 47 genera of plankton was recorded belonging to Chlorophyceae, Bacillariophyceae, Cyanophyceae, Euglenophyceae, Dinophyceae, Crustacea and Rotifera. Among phytoplanktonic Chlorophyceae was the most dominant group contributing 46% of the total. Cyanophyceae was the least dominant group. From zooplankton, Crustacea was the most dominant group contributing 71% of the total zooplankton. The greatest abundance of phytoplankton was recorded in September to November with an average number 70.67×10^5 cells/l and the minimum in April with an average number 38.33×10^5 cells/l. The abundance of zooplankton showed two peaks, one in the months of August-October and another in the months of April-June. Phytoplankton and zooplankton have a direct relationship with each other.

Key words: Burulia beel, phytoplankton, zooplankton

Introduction

Beels are sauser-shaped depression of marshy characters usually formed by changed river system. It 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 are inhabited by distinct fauna and flora. They serve as natural habitats, breeding, feeding and spawning ground of large and small indigenous fishes of different food habits (Jha, 1989). People living in village around the beels harvest the fish almost round the year without any investment except catching devices. A large portion of rural families is engaged in part time fishing from the floodplains (Hughes *et al.,* 1994). But Beel fishery is being deteriorating day by day due to aforesaid un-coordinated multiple use of water. Beel fishery should be preserved for augmenting fish production and ecological balance of this habitat. On the other hand, success of aquaculture depends almost completely on the quality of different environmental factors. A thorough knowledge of abundance of plankton and its quality in time and space in relation to environmental condition has become a prerequisite for fish production. So, a one year study programme was carried out to know the composition and abundance of plankton population and monthly changes of some water quality parameters as well as plankton population of Burulia beel.

Materials and Methods

Location: Burulia Beel located at Gobindaganj Upazila under Gaibandha district. It is a semi-closed waterbody with three inlets and outlets. Of these three inlets, to are connected with two canals and one with floodplain. These inlets are screened during rainy season to prevent the escape of stocked fish. The basin depth of Burulia Beel ranged from 0.34 -2.74 m (ARDMCS, 2003).

Procedure of study: Phytoplankton and water samples were collected monthly from July, 2003 to June 2004 from six different sites of the Beel. Sampling was carried out between 9.00 and 11.30 am. Ten liter water was 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, Italy). Then 100 ml sample of previously collected water of each site were taken in a bottle and NO_3-N were measured directly from reading of spectrophotometer HACH water analysis Kit (HANNA instrument, model HI 93728, Italy) with one packet of HI 93728 reagent for 10 ml filtered water samples. The concentration of phosphate-phosphorus was measured directly from reading of spectrophotometer HACH water analysis Kit (HANNA instrument, model HI 93713, Italy) with one packet of HI 93713 reagent for 10 ml filtered water samples.

For plankton analysis, the collected 10 liter water was filtered through plankton net of 10, 30 µ mesh size and finally concentrated to 20 ml. The filtrates were then immediately preserved in 5% buffered formalin for subsequent studies. Microscopic identification upto genera 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 cell (S-R cell) with a wide mouth pipette. Identification and enumeration were done by a compound microscope (NOVA 950 ES). All the plankton present in randomly chosen 20 squares grids of S-R cell was counted. The mean of three counts was then calculated for each plankton 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 & Whipple (1954), Needham &Needham (1962), Prescott (1964), APHA (1992) and Bellinger (1992).

Results and Discussion

Environmental parameters: Water temperature was in the range of 13.50-30.50°C with a mean 24.45±5.47°C. The highest temperature was recorded in the month of June and lowest in December. Ehasan *et al*. (1996) found highest water temperature (31.7ºC) in the month of June and the lowest (25.2ºC) in January in Chanda Beel. Saha & Hossain (2002) found the highest water temperature in August (31ºC) and the lowest in January (19.25ºC) in Saldu Beel which was more or less similar to the present study. The water temperature fluctuated due to the seasonal variations of sunshine/rain. Conductivity varied from 33.67-61.83 µS/cm with mean value 49.51±9.58 µS/cm. The maximum value of conductivity was found in February whereas the minimum in August. This value was more or less similar to the results of Patra & Azadi (1987) who found conductivity from 51.58-147.65 uS/cm in Kaptai lake. pH is called the index of waterbody. In the present study, pH of water ranged from 6.21-7.33 with a mean of 6.79±0.35. The highest pH value 7.33 was recorded in July and the lowest 6.21 in April. The present finding agree with the findings of Patra & Azadi (1987) who recorded the range of pH values from 6.89-8.15 in Halda river and Khan *et al.* (1990) from 6.96-8.40 in Bachhra reservoir. Acharjee *et al.* (1997) also found pH from 6.2-7.1 in Dighali Beel which was similar to the present study. The fluctuation might be due to rise in temperature and decrease in water level for evaporation, rainfall, supply of slaked lined, soil properties etc. Total alkalinity of water was recorded from 20.83-58.80 (mg/l) with mean value 35.79±10.62 mg/l. The highest total alkalinity was recorded in the month of April and the lowest in September. Bhuiyan (1970) recorded the total alkalinity of medium productive water body ranging from 25-100 mg/l. Chowdhury & Mazumder (1981) reported more or less static alkalinity in Kaptai Lake (40 mg/l).

Nutrient content: Nitrate-nitrogen (NO_3–N) concentration ranged 1.36-2.85 mg/l with a mean 2.17±0.47 mg/l. The maximum NO_3–N was recorded in the month of October and minimum in the month of April. Islam and Saha (1975) recorded NO_3-N from 0.25-6.00 ppm in Ramna Lake and Mazumder *et al.* (1997) from 0.90-6.25 ppm in different water bodies in West Bengal (India). Jewel (2001) recorded NO_3-N values ranging from 0.80 ppm in July and 2.90 ppm in September at the mouth of Maheshkhali channel, Bay of Bengal, Cox's Bazar. In the present study, concentration of Phosphate-phosphorus (mg/l) was in 0.07-0.71 mg/l with a mean 0.32±0.18 mg/l. The maximum PO_4-P was recorded in the month of May and minimum in the month of September. The findings of present study were more or less in conformity with the findings of Islam & Saha (1975). The range of PO_4-P values recorded by them was 0.02-2.80 ppm, in Ramna Lake. Chowdhury & Mazumder (1981) reported PO_4-P 0.27-0.83 ppm in Kaptai Lake. Jewel (2001) found the wide range of PO_4-P 0.06-3.20 ppm at the mouth of the Maheshkhali channel, Cox's Bazar. The varied concentration of PO_4-P in the present investigation might be due to soil properties, decomposition of aquatic materials and utilization by algae, absence of inflow in summer, rainfall, etc.

Plankton Population: Plankton populations in the studied Beel was represented by 47 genera. Phytoplankton 35 genera of which 17 from Chlorophyceae (17) followed by 9 Cyanophyceae, 6 Bacillariophyceae, 2 Euglenophyceae and 1 Dinophyceae. The zooplankton population was composed of 12 genera belonging to two major groups: Crustacea and Rotifera- each was represented by 6 genera. Ehshan *et al.* (2000) observed 44 genera of phytoplankton in Chanda Beel. Saha & Hossain (2002) identified 46 genera of phytoplankton and 27 genera of zooplankton in Saldu Beel. Masud *et al.* (1996) reported 11 genera of zooplankton belonging to 9 families in derelict, extensive and semi-intensive fishpond. Similarly Dewan *et al.* (1991) identified 9 genera of zooplankton belonging to 1 Hydrozoan, 5 Crustacea and 3 Rotifera. Razzaque *et al*. (1995) found 87 genera of phytoplankton and 29 genera of zooplankton in Halti Beel. In the present study, ranges of total plankton recorded were 12.67×10^5-80.83×10^5 cells/l with mean abundance of $29.71\pm19.98\times10^5$ cells/l. Patra & Azadi (1987) recorded more or less equal number of total plankton in Halda river. Khan *et al*. (1990) also measured total abundance of plankton between 70 unit/l and 47.62 unit/l in Bachhra reservoir. The maximum abundance of total plankton was recorded in the month of October and minimum values were recorded in the month of January.

Phytoplankton population: The total abundance of phytoplankton ranged between 83.3×10^4-70.67×10^5 cells/l with a mean of $22.78\pm18.34\times10^5$ cells/l. Razzaque *et al.* (1995) published a figure of $11.70\pm4.60\times10^3$-$47.70\pm34.60\times10^3$ cells/l in Halti Beel. The combined data of one year showed peak of phytoplankton in October. Similarly Singh (1960) reported primary peak of phytoplankton in the month of September-October in Uttar Pradesh in India. Razzaque *et al.* (1995) observed similar dynamics in Halti Beel. In Chanda Beel, maximum abundance of phytoplankton was observed in October (Ehshan *et al.,* 2000). In the present investigation the lowest abundance of phytoplankton was obtained in the month of April. Similar result was obtained in Halti Beel and Chanda Beel (Razzaque *et al.*, 1995 and Ehshan *et al.,* 2000). The results of seasonal variation in environmental parameters and plankton population suggest that the favourable period for primary production in Burulia Beel is October to November when nutrients accumulated from freshwater run-off due to monsoon rainfall in these months (Fig. 1 and 2). On the other hand, phytoplankton abundance and taxonomic diversity depend upon the supply of nutrients in natural waters. In the present study, the highest cell density and diversity in phytoplankton genera was found in October, when NO_3-N concentration

(2.85 mg/l) was found high and PO_4-P concentration (0.13 ppm) was lowe (Fig. 3). So, it can be assumed that high temperature and NO_3-N concentration may be important factors for maximum cell density and taxonomic diversity of phytoplankton in Burulia Beel.

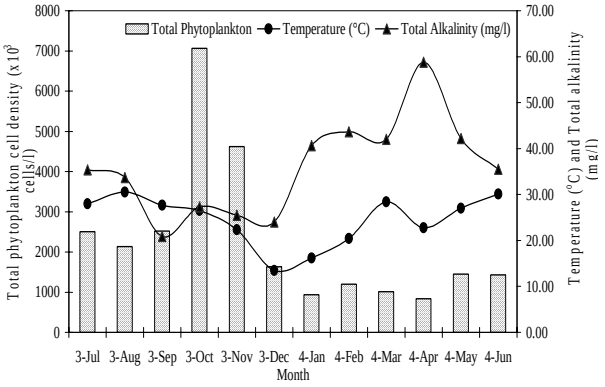

Fig. 1. Effects of temperatures (°C) and total alkalinity (mg/l) on the seasonal abundance of phytoplankton population in Burulia beel during the study period.

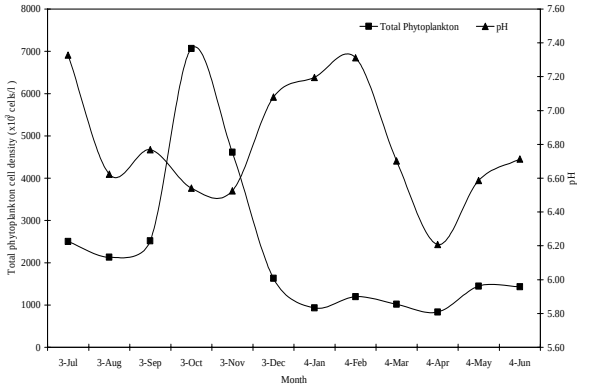

Fig. 2. Effects of pH on the seasonal abundance of phytoplankton population in Burulia beel during the study period

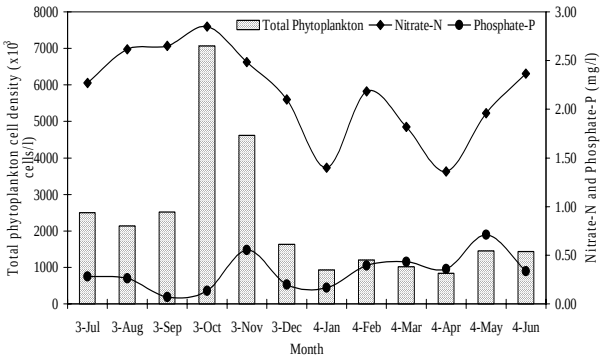

Fig.3. Effects of Nitrate-N and Phosphate-P concentrations (mg/l) on the seasonal abundance of total phytoplankton population in Burulia beel during the study period.

In Burulia Beel, Chlorophyceae was dominant phytoplankton and Cyanophyceae was least dominant. Khan *et al.* (1990) obtained similar results in Bachhra reservoir. In Kaptai lake, Ahmed *et al.* (1992) obtained 77.5% Chlorophyceae and 1.1% Dinophyceae. Yousuf &Parveen (1990) and Saha & Hossain (2002) observed almost similar phenomenon in Dal lake and Saldu Beel, respectively.

Zooplankton population: The population dynamics of zooplankton ranged 33.3×10^4-11.50×10^5 cells/l with a mean value of $96.3\pm28.6\times10^4$ cells/l. The value is more or less close to those reported by Patra & Azadi (1987) in Halda river, Razzaque *et al.* (1995) in Halti Beel and Ehshan *et al.* (2000) in Chanda Beel. In the present study, Crustacea was the most dominant group in Burulia Beel (73%). Similarly Khan *et al.* (1990) and Masud *et al.* (1996) observed Crustacea dominant zooplankton in fish ponds. On the other hand, Ahmed *et al.* (1992) and Razzaque *et al.* (1995) reported Rotifera dominant zooplankton in Kaptai Lake and Halti Beel, respectively. Total zooplankton populations showed two peaks, one in September and another in April made by Das and Srivastava (1956) in a pond. Similar bimodal peak of zooplankton was reported by Razzaque *et al.* (1995).

In the present investigation, both phytoplankton and zooplankton showed direct relationship as those obtained by Patra & Azadi (1987) in Halda river; Ali *et al.* (1985) in a pond and Razzaque *et al.* (1995) in Halti Beel (Fig. 4). However, Das & Srivastava (1956) observed inverse correlation between phytoplankton and zooplankton. During the study period zooplankton growth cycle was noticeably less than the phytoplankton abundance almost throughout the study period. Patra & Azadi (1987) observed similar phenomenon in Halda river.

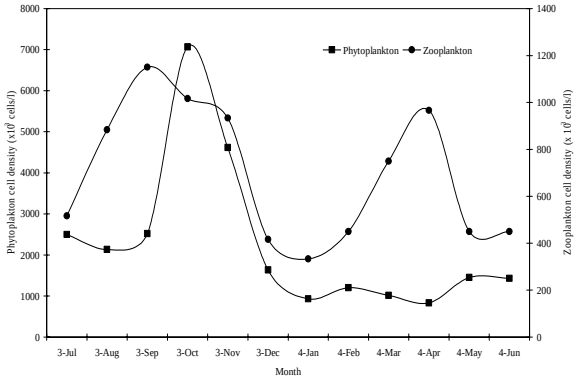

Fig.4: Temporal variation of phytoplankton and zooplankton in Burulia Beel during the study period.

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 and Professor Dr. Rezaul Hassan, Department of Aquaculture, Bangladesh Agricultural University, Mymensingh for his co-operation and advice during the study period.

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Manuscript received on 23.05.2008, accepted on16.08.2008