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Physio-chemical conditions and plankton population of two fishponds in Khulna

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Abstract: Sixteen physico-chemical variables, and the diversity and abundance of phyto- and zooplankton of two fishponds in Khulna University Campus have been studied during October 2003 and September 2004. A total of 25 phytoplankton genera, 7 belonging to Cyanophyceae, 7 to Chlorophyceae, 8 to Bacillariophyceae and 3 to Euglenophyceae, and 18 zooplankton genera, 4 belonging to Copepoda, 7 to Cladocera and 7 to Rotifera, were recorded. Both ponds were permanently alkaline in nature. The values of TDS, BOD and phosphate, and the current status of plankton population imply that the study ponds were eutrophic in nature.

Key words: Fishponds, physico-chemical conditions, plankton population, Khulna

Introduction

The pond water is considered as one of the major sources for fishery and domestic uses in Khulna region. This region abounds in many artificial ponds and temporary water bodies of large and small size, which make an interesting biotope for physico-chemical studies. Presently pond fishery is being practiced in the country in large scale for better augmentation of fish product. A number of researches have been done on fishponds. Fakruzzaman *et al*. (2001) studied the zooplankton of some fishponds in Barind Tract in relation to its physico-chemical variables. Naz (1992) studied the eutrophic and hypertrophic nature of fishponds of Rajshahi University Campus. Ameen *et al.* (1986) made some observations on the physico-chemical and biological conditions of some fishponds in Dhaka. Chowdhury *et al.* (1989) worked on the seasonal variation of zooplankton in a fishpond of Dhaka in relation to some physico-chemical factors. Bhuiyan *et al.* (1997) observed the physico-chemical conditions in relation to meteorological conditions of a fish pond in Rajshahi. Biswas (1993) studied the limnology of three fishponds in Rajshahi hatchery while Rahman *et al.* (1982) and Mumtazuddin *et al.* (1982) worked on some fishponds in Mymenshingh. The details of indigenous pond ecosystems have been studied by Bhuiyan & Nessa (1998), Begum & Alam (1987), Habib *et al*. (1984), Islam *et al*. (1998), Safi & Farooque (1983), Islam & Nahar (1967) and Rao (1977). But unfortunately, no such data are available on the physico-chemical and biological conditions of the fishponds in Khulna University Campus, which led us to design the present investigation.

Materials and methods

Fortnightly samplings were carried out in two fish culture ponds in Khulna from October 2003 to September 2004. The slope less ponds, each 20 m long, 15 m wide and 1.5 m deep on average are located beside the 2nd academic building of Khulna University Campus at a distance of 15 meter apart from each other. Both the ponds receive direct sunlight, the bottom soil of which contains clay and the ponds are highly charged. These ponds are dewatered every year in the month of March only for one week and cow dung, urea, TSP, lime, etc. are used as needed. Dipterex, Sumithion and Copper sulphate were used 4-6 times each month in all the ponds to control plankton. TSP, cow dung, urea and additional mixed food were used as needed in the ponds at the rate of 3-4% of total weight of stocked fishes.

Water samples were collected by using 250 ml glass stoppered bottle from a depth of 10-15 cm below the surface. Some of the physico-chemical studies were done on the spot, while others were done in laboratory. Temperature was measured by a centigrade thermometer. Transparency was measured by a Secchi disc while pH and TDS were measured by a digital pH meter (model-pH 211, HANNA) and a multi-range TDS meter (model no. HI-9635). Dissolved oxygen (DO) content of water was determined by DO meter (model- JENWAY-9015). Titrimetric methods (Welch, 1948) were used to determine free CO_2, CO_3 and HCO_3 alkalinities. Chloride content was measured by Argentometric method, biological oxygen demand (BOD_5) by Winkler modified method and all hardness were measured by following APHA (1989). Phosphate and silicate were measured following Gautam (1990). The plankton samples were collected by plankton net of No. 20 silk bolting cloth (mesh size 0.076 mm). After collecting, the plankton materials were transferred into the glass bottle and preserved permanently in Transeau's solution (Transeau, 1951) and identified by the help of relevant literature. The abundance of plankton was measured using Sedgewick Rafter counting chamber (Welch, 1948).

Results and Discussion

Physico-chemical conditions of the study ponds in Khulna are shown in Table 1. Water temperature (19-25.5 and 19-25.6˚C) and transparency (33-36 and 33-37 cm) of the ponds were similar. Alkaline nature of the study ponds was indicated by pH values that varied from 7.9 to 9.1 and 7.5 to 7.8 in pond 1 and pond 2, respectively. Dissolve oxygen content fluctuated between 2.7 and 4.8, and 2.8 and 5.0 $mg.l^{-1}$in two ponds while BOD_5 value varied from 5.5 to 6.9 and 4.3 to 5.8 $mg.l^{-1}$. During the period of study CO_2 was absent in pond 1 and CO_3 alkalinity was absent in pond 2. HCO_3 alkalinity ranged from 153 to 165 and 69 to 75 $mg.l^{-1}$ in pond 1 and pond 2, respectively. Chloride content varied from 498 to 543 and 500-532 $mg.l^{-1}$. Total hardness, calcium hardness and magnesium hardness were found to vary respectively from 900-1180, 866-1131 and 21-48 $mg.l^{-1}$ in pond 1, and 853-1220, 763-1202 and 17-89 $mg.l^{-1}$ in pond 2. Similar silicate values (0.0001- 0.0006 $mg.l^{-1}$) and phosphate contents (0.04-0.07 and 0.05-0.07 $mg.l^{-1}$) were recorded in both study ponds.

Table 1. Physico-chemical conditions and plankton abundance in two ponds in Khulna

Parameters	Pond 1		Pond 2	
	October 2003-March 2004	Mean±sd	October 2003-March 2004	Mean±sd
Air temperature (˚C)	20.2-32.2	27.2±0.9	20.2-32.2	27.2±0.9
Water temperature (˚C)	19-25.5	23.9±0.6	19-25.6	24±0.6
Transparency (cm)	33-36	34±1	33-37	34±2
TDS ($mg.l^{-1}$)	910-1190	1057±115	910-1190	1050±114
pH	7.9-9.1	8.4±0.5	7.5-7.8	7.6±0.1
Dissolved oxygen ($mg.l^{-1}$)	2.7-4.8	4.3±0.3	2.8-5.0	4.4±0.5
BOD_5 ($mg.l^{-1}$)	5.5-6.9	5.8±0.4	4.3-5.8	4.8±0.8
CO_2 ($mg.l^{-1}$)	-	-	12-18	16±3
CO_3 alkalinity ($mg.l^{-1}$)	31-36	34±2	-	-
HCO_3 alkalinity ($mg.l^{-1}$)	153-65	159±5	69-75	71±3
Chloride ($mg.l^{-1}$)	498-543	519±18	500-532	521±15
Total hardness ($mg.l^{-1}$)	900-1180	1076±126	853-1220	983±167
Ca. hardness ($mg.l^{-1}$)	866 - 1131	1042±124	763-1202	919±200
Mg. hardness ($mg.l^{-1}$)	21-48	34±11	17-89	63±32
Silicate ($mg.l^{-1}$)	0.0001-0.0006	0.0003±0.0002	0.0001-0.0006	0.0003±0.0002
Phosphate ($mg.l^{-1}$)	0.04 - 0.07	0.05±0.01	0.05-0.07	0.05±0.01
Phytoplankton ($units.l^{-1}$)	28156 - 48302	40156±9362	27542-44268	37526±8974
Zooplankton ($units.l^{-1}$)	9846 - 19282	14538±5574	9798 - 18954	14372±5896

- = Not detected

Plankton abundance (Table 1) was found to vary from 28156 to 48302 and 27542 to 44268 $units.l^{-1}$ and from 9846 to 19282 and 9798 to 18954 $units.l^{-1}$ for the phyto- and zooplankton in pond 1 and pond 2, respectively. Plankton diversity was obvious from recording a total of 25 phytoplankton genera (Table 2) and 18 zooplankton genera (Table 3) from these ponds.

Table 2. Diversity and abundance of phytoplankton of two ponds in Khulna

Phytoplankton	Pond 1		Pond 2	
	Total abundance ($units.l^{-1}$)	%	Total abundance ($units.l^{-1}$)	%
Cyanophyceae				
Anabaena sp.	16330	4.00	18372	4.63
Aphanocapsa sp.	18986	4.66	16710	4.21
Nostoc sp.	26768	6.56	24024	6.05
Oscillatoria sp.	44016	10.79	40830	10.28
Lyngbya sp.	17564	4.31	19678	4.96
Gloeocapsa sp.	15348	3.76	16328	4.11
Cylindrospermum sp.	10686	2.62	-	-
Chlorophyceae				
Stigeoclonium sp.	15308	3.75	15922	4.01
Chaetophora sp.	15124	3.71	15756	3.97
Cladophora sp.	15108	3.70	14730	3.71
Rhizoclonium sp.	16334	4.01	16520	4.16
Cosmarium sp.	13686	3.36	14539	3.66
Closterium sp.	11288	2.77	10962	2.76
Pediastrum sp.	16820	4.12	16890	4.25
Bacillariophyceae				
Synedra sp.	18570	4.55	15328	3.86
Melosira sp.	15710	3.85	14550	3.67
Navicula sp.	21018	5.15	17718	4.46
Pinnularia sp.	17132	4.20	18018	4.54
Gyrosigma sp.	11132	2.73	12156	3.06
Cymbella sp.	14698	3.60	14098	3.55
Nitzschia sp.	19610	4.81	18713	4.71
Fragilaria sp.	15018	3.68	16348	4.12
Euglenophyceae				
Euglena sp.	11854	2.91	12694	3.20
Phacus sp.	-	-	6810	1.72
Trachelomonas sp.	9802	2.40	9328	2.35
Total	407910	100%	397022	100%

- = Not detected

Of the physico-chemical conditions, pH values indicate that the study ponds were permanently alkaline in nature. Maximum values of TDS, BOD_5, chloride, hardness and phosphate contents were recorded in the months of April and May when water level was minimum in the summer, while the lowest values were recorded in the month of August when water level was maximum due to rainfall. Similar observations were made by Islam *et al.* (1998), Fakruzzaman & Zaman (1996), Naz (1999) and Rahman (1997) in their studies. Maximum transparency, DO and diversity of phytoplankton and zooplankton were recorded in the month of August when all dissolved solids, organic and inorganic materials were more diluted due to increase of water level. Chowdhury & Zaman (2000) and Gautam (1990) also expressed similar views.

Maximum abundance and diversity of Cyanophyceae, and all Euglenophyceae were recorded in the months of April and May when phosphate and BOD_5 values were highest, indicating that the study ponds were rich in nutrients in those months (Islam & Nahar, 1967). Chlorophycean genera were almost absent in the months of April and May. Zooplankton diversity and abundance were also poor in the months of April and May but cladoceran *Daphnia* sp., rotiferan *Brachionus* sp. and *Notholca* sp. showed highest abundance in these months. Maximum diversity and abundance of zooplankton were in the months of August and September. All genera of Copepoda except *Cyclops* sp. were recorded in the months of August, September and October. These findings are in good agreement with Islam *et al*. (2001) and Naz (1999). Maximum abundance and diversity of Bacillariophycean genera were recorded in the months of September and October when silicate value was the highest. This is supported by the results of Chowdhury & Zaman (2000).

Table 3. Diversity and abundance of zooplankton of two ponds in Khulna

Zooplankton	Pond 1		Pond 2	
	Total abundance (units.l^{-1})	%	Total abundance (units.l^{-1})	%
Copepoda				
Diaptomus sp.	10132	6.26	11374	7.13
Cyclops sp.	12986	8.02	13720	8.61
Macrocyclops sp.	7968	4.92	6028	3.78
Mesocyclops sp.	9516	5.87	8852	5.55
Cladocera				
Alona sp.	7456	4.60	6982	4.38
Bosmina sp.	8642	5.34	9526	5.98
Ceriodaphnia sp.	-	-	5240	3.29
Daphnia sp.	16230	10.02	15890	9.97
Diaphanosoma sp.	6412	3.95	4366	2.74
Moina sp.	14210	8.77	14992	9.40
Sida sp.	12342	7.62	11750	7.37
Rotifera				
Brachionus sp.	10468	6.46	10910	6.84
Filinia sp.	9888	6.11	9672	6.07
Harringia sp.	6218	3.84	5790	3.63
Notholca sp.	11120	6.87	10422	6.54
Philodina sp.	7770	4.80	8150	5.11
Rotaria sp.	5928	3.66	5764	3.61
Trichocerca sp.	4682	2.89	-	-
Total	161968	100%	159428	100%

- = Not detected

Phytoplankton population was found to have significant positive correlation each with transparency (r=0.962), DO (r=0.951), phosphate content (r=0.967) and zooplankton population (r= 0.944), and significant negative correlation with BOD_5 (r=–0.949), chloride (r=–0.992) and calcium hardness (r=–0.976). Zooplankton population, on the other hand, showed significant positive correlation with transparency (r= 0.983) and DO (r= 0.959), and significant negative correlation with BOD_5 (r= -0.935), chloride (r= -0.976) and calcium hardness (r= -0.948). High values of BOD_5 and the plankton population are clearly indicative of the eutrophic nature of the study ponds (Jayangaudar, 1964; Arora, 1966; Islam & Nahar, 1967; Gautam, 1990). After a few years these ponds probably would become hypertrophic. TDS values also suggest that the study ponds were loaded with high amount of organic and inorganic substances (Gautam, 1990). Further study, however, is needed for a sustainable pond fishery in these water bodies.

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