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INFLUENCE OF PHYSICO-CHEMICAL FACTORS ON THE ZOOPLANKTON POPULATION OF BOSTAMI POND OF CHITTAGONG

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Abstract: The study was conducted on the influence of physico-chemical factors on the zooplankton of Bostami pond in Chittagong city for a period of one year from February 2013 to January 2014. During this study the water depth varied from 1.54 to 2.53 m, water temperature 24.5 to 32.6°C, conductivity 0.234 to 0.297 mS, turbidity 26.55 to 33.41 ntu, light intensity 27 to 39.5 lux, total dissolved solids 161 to 191 ppm, pH 7.02 to 7.79, dissolved oxygen 3.4 to 5.73 ppm, free carbon dioxide 2.82 to 5.85 ppm, and calcium 25.08 to 43.03 ppm. It was found that the temperature was less during February 2013 and gradually increased up to June 2013. Then with a break in July it gradually decreased until the next January 2014. More or less reverse data observed for the monthly variation of conductivity, total dissolved solids and calcium. Free carbon dioxide is inversely related with water depth and pH. In total 19 species of zooplankton were identified, where 16 rotifera were the dominant followed by two copepods and one cladoceran. Among these, *Brachionus diversicornis*, *B. angularis*, *B. quadridentatus*, *B. falcatus*, *B. calyciflorus*, *B. forficula*, *B. caudatus*, *Platyias patulus*, *Keratella cochlearis*, *Lecane luna*, *Trichocerca cylindrica*, *Polyarthra vulgaris*, *Asplanchna priodonta*, *A. brightwelli*, *Filinia longiseta*, *F. terminalis*, *Mesocyclops leuckarti*, *Cyclops varicans rubellus* and *Moina brachiata* were the most common species in the pond throughout the year. Abundance of phytoplankton and zooplankton indicated that the nutrient quality of the pond water was good. The total phytoplankton varied from 842 to 2223 individuals/l and total zooplankton 187 to 494 individuals/l; with rotifera 105 to 266 individuals/l, copepoda 43 to 135 individuals/l and cladocera from 39 to 115 individuals/l throughout the year. Plankton abundance and physico-chemical characteristics of the Bostami pond indicate that the pond is eutrophic in nature.

Key words: Plankton population, zooplankton, physico-chemical factors, Bostami pond.

INTRODUCTION

Bangladesh has an unique geographical location in the humid tropical and subtropical regions with high rainfall during monsoon. It has many different types of water bodies such as ponds, lakes, rivers, etc. (Ali 1985). The quality of water determines the distribution and abundance of aquatic flora and fauna (Rana 2003), where the zooplankton forms the principal source of food for fish within the water body (Prasad and Singh 2003). Zooplankton also plays very

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important role in the food chain as they are in the second trophic level as contributors to the higher trophic level (Bhuiyan and Islam 1988). They regulate the phytoplankton population by eating and again they are being eaten by insects or by small fishes (Welch 1952). Moreover, with the advent of knowledge zooplankton are used as indicator by the pollution experts to assess the level of pollution of water body caused by human activities (Bhouyain and Asmat 1992).

Considerable works have been done on the water bodies of Bangladesh by different authors. (Begum 1958, Das 1974, Das and Bhuiyan 1974, Islam *et al.* 1974, Islam and Saha 1975, Islam and Haroon 1975, Islam and Mendes 1976, Hussain *et al.* 1978, Islam *et al.* 1978, Majumdar 1980, Chowdhury and Bhouyain 1981, Bhouyain and Sen 1983, Ameen *et al.* 1986, Latif *et al.* 1986, Chowdhury *et al.* 1989, Begum *et al.* 1989, Khondkar *et al.* 1990, Bhouyain and Sen 1991, Khondkar and Rahim 1991, Chowdhury *et al.*1992, Khondkar and Parveen 1992, Hossain *et al.* 1993, Khan and Chowdhury 1994, Kabir *et al.* 1996, Kabir *et al.* 1997, Bhuiyan and Nessa 1998a, Bhuiyan and Nessa 1998b, Ahmed *et al.* 1999, Islam *et al.* 2002, Rahaman 2004, Bhouyain *et al.* 2005, Azher *et al.* 2006, Chowdhury and Mamun 2006, Bhuiyan *et al.* 2008, Rahman *et al.* 2007, Naz and Najia 2008, Chowdhury *et al.* 2008, Hossain *et al.* 2008, Nahar *et al.* 2008, Ahmed *et al.* 2010, Siddique *et al.* 2011, Mozumder *et al.* 2011 and Hossain and Haque 2012).

Chittagong is the second largest metropolitan city of Bangladesh. It is bounded by a large number of different types of pond. Bostami pond is one of the famous ponds in Chittagong and situated at the northern side of Chittagong city. The famous mazar of Hazrat Bayezid Bostami (R) is situated at the western side of the pond. The pond is so much famous in home and abroad for its mazar and the turtles which are very much uncommon. Recently, Bangladesh government has declared it as a Ecologically Sensitive Area (ESA) and has given emphasis on its protection.

The purpose of the present work was to assess the physico-chemical and biological aspects of an important water body and to observe the influence of physico-chemical factors on the plankton composition. So, an attempt was taken to measure the physico-chemical parameters viz., water depth, water temperature, conductivity, turbidity, total dissolved solids, pH, dissolved oxygen, free carbon dioxide and tried to relate them with biological parameters viz., phytoplankton and zooplankton (rotifera, copepoda and cladocera).

The main objectives of the present study was as follows:

(i) Identify the zooplanktonic organisms of the Bayezid Bostami pond.

(ii) Measure the physico-chemical properties of the pond water.

(iii) Observe the influence of physico-chemical parameters on the abundance of the phytoplankton and zooplankton population.

MATERIAL AND METHODS

Two sampling points were selected for the collection of water and plankton sample at the two site of the pond. Samples were collected in each month for one year from February, 2013 to January, 2014. During the study period the samplings were done in between 7:30 and 11:30 a.m.

Water depth was measured by dipping a weighted nylon cord. A centigrade thermometer was used to record water temperature (ELFO Co., Japan). The conductivity was measured by conductivity meter (Model: YK-22CT, Taiwan). The turbidity was measured by turbidity meter (Model: TU-2016, Taiwan). The light intensity was measured by lux meter (Model: LX-101, China). The total dissolved solids was measured by total dissolved solids meter (Model: TU-2016, Taiwan).

Chemical parameters such as pH, DO, free CO_2 and calcium have been studied during this investigation. The hydrogen ion concentration (pH) was measured by pH meter (Model: 208, Digital Instrument,Taiwan).The Azide modification method was used during this study for the determination of dissolved oxygen. The analysis of free carbon dioxide was conducted by Titrimetric method following APHA, 1975. EDTA titrimetric method was used to measure the free carbon dioxide concentration.

Plankton samples were collected from each station by using plankton net. The net was thrown to the desired distance and allowed to reach the desired depth of the sampling station from a raft. Then the thrown rope with net was pulled quickly towards the raft for the collection of the plankton samples. The net was pulled five times from several places of each station. The collected samples were preserved by adding 10 ml of commercial formalin to 100 ml of sample. The volume of final concentrate was made into 110 ml. Sedgwick-Rafter Cell (Model: S50, Sedgu-Graticules Limited,UK) was used to count the total number of plankton. Each sample was counted for five times and each time 10 cells were observed out of 1000 cells. Thus from the total number of planktons obtained in 1 ml, the total number of plankton in 110 ml was calculated. The formula: $\pi r^2 L$ (where 'r' is the radius of the mouth of the plankton net, and 'L' is the length of the rope) was used to calculate the volume of water passed in each tow and which was multiplied by 5 tow for obtaining total volume of water containing the number of planktons in 5 tows. Thus plankton numbers present in one liter of water was calculated. The population of zooplankton (rotifera, copepoda, cladocera) and phytoplankton were counted under the compound binocular microscope (Model: XSZ-107B, China).

RESULTS AND DISCUSSION

The monthly fluctuations of water depth have been presented in Table 1. The highest water depth 2.52 m was recorded in the month of July, 2013. The water depth started to decrease from August and reached to its lowest depth 1.54 m in June. The highest water depth in August was recorded by Saha *et al.* (1971), Swarup and Singh (1979), Bhouyain and Sen (1991) and Khondkar and Parveen (1992). Rahman *et al.* (2007) recorded highest water depth in September.

The lowest water depth 1.54 m was recorded in June, 2013 (Table 1). Bhouyain and Sen (1991) and Ameen *et al.* (1986) recorded the minimum water depth in March. Latif *et al.* (1986), Khondkar and Parveen (1992), and Bhouyain *et al.* (2005) recorded the lowest water depth in April. Rahman *et al.* (2007) also recorded the lowest water depth in April. In this study it has been also recorded that the water depth started to decrease from February, 2013 and reached to its lowest depth in June, 2013 and then started to increase until August, 2013.

The data of water temperature are presented in Table 1. The highest water temperature was recorded in the month of June, 2013 (Table 1). Similar result of highest water temperature in June was also reported by many researchers from different water bodies (Mathew 1975, Swarup and Singh 1979, Ramakrishnaiah and Sakar 1982, Latif *et al.* 1986, Bhouyain and Sen 1991, and Khondkar and Parveen 1992). Islam and Saha (1975) recorded the highest water temperature in April. Saha *et al.* (1971), Ameen *et al.* (1986), Chowdhury *et al.* (1989), Begum *et al.* (1989) and Chowdhury *et al.* (1992) observed the highest water temperature in May. Islam and Mendes (1976) reported highest water temperature in August. Bhouyain *et al.* (2005) recorded the highest water temperature in May. Siddique *et al.* (2011) reported the highest water temperature in September.

The lowest water temperature 24.5°C was recorded from Bayezid Bostami pond in the month of January (Table 1) which was also recorded by Saha *et al.* (1971), Islam and Mendes (1976), Swarup and Singh (1979), Ramakrishnaiah and Sakar (1982), Chowdhury *et al.* (1989) and Chowdhury *et al.* (1992) from other water bodies. Latif *et al.* (1986), Bhouyain and Sen (1991), and Khondkar and Parveen (1992) also recorded the lowest water temperature in February. Ameen *et al.* (1986) and Begum *et al.* (1989) recorded the lowest water temperature in December. Bhouyain *et al.* (2005) recorded the lowest water temperature in January. Siddique *et al.* (2011) recorded the lowest water temperature in February.

The conductivity of the Bayezid Bostami pond water was found to be fluctuating throughout the study period which ranged from 0.234 to 0.297 mS (Table 1). The highest conductivity was recorded in the month of January, 2014 (Table 1). From February, 2013 to June, 2013 it was decreased showing the values of 0.273, 0.266, 0.253, 0.243 and 0.235 mS, respectively. Vyes and Kumar (1968) observed the highest conductivity in September. Ramakhrishmaiah and Sarkar (1982) observed the highest conductivity in May. Campos *et al.* (1992) recorded the maximum conductivity in January.

The lowest conductivity was recorded in the month of July, 2014 (Table 1). Then from August, 2013 to December, 2013 it was increased showing the values of 0.264, 0.282, 0.291, 0.293 and 0.295 mS, respectively. Vyes and Kumar (1968) also observed the minimum conductivity in May. Ramakhrishmaiah and Sarkar (1982) observed the lowest conductivity in November. Nessa (1996) recorded the lowest conductivity in May.

The turbidity showed monthly variation and the data are presented in Table 1. The highest turbidity 33.41 ntu was recorded in the month of June, 2013 and lowest turbidity 26.55 ntu in September, 2013 was seen in Bayezid Bostami pond (Table 1). The turbidity of pond water was found to be fluctuating from 31.11 ntu recorded in February, 2013. It was increased showing the values 31.32 and 33.24 ntu in March and April 2013, respectively. Then it was decreased showing the turbidity 28.74 ntu. Then it was again increased and showed its highest turbidity 33.41 ntu in June, 2013. Then again it was decreased showing the values 30.35, 26.95 and 26.55 ntu in July, August and September, respectively. Then it was again increased showing the values 27.27, 27.63, 28.11 and 28.18 ntu in October, November, December and January, respectively.

The variations of light intensity are showing in Table 1. The highest light intensity 39.5 lux was recorded in the month of February, 2013 (Table 1). March, 2013 to November, 2013 it was gradually decreased showing the values of 37, 36, 35, 34.5, 34, 33.5, 32.5, 30.5 and 31 lux, respectively. The lowest light intensity 27 lux was recorded in the month of December, 2013 (Table 1).

The total dissolved solids of the pond water were observed through out the study period which ranged from 161 to 191 ppm (Table 1). The highest total dissolved solids 191 ppm was recorded in the month of January, 2014 shown in Table 1. February, 2013 to July, 2013 it was gradually decreased showing the values of 181, 181, 178, 163, 162 and 161 ppm, respectively. Then it was increased in the month of August, 2013 having the total dissolved solids 168 ppm. The lowest total dissolved solids 161 ppm was recorded in the month of July, 2013 (Table 1).

The data of hydrogen ion concentration (pH) are presented in Table 1. The pH value of the pond showed to be alkaline in nature during the study period with small variation (Table 1). The alkaline nature of water also reported by Islam and Mendes (1976), Swarup and singh (1979), Ameen *et al.* (1986), Latif *et al.* (1986), Begum *et al.* (1989), Khondkar and Parveen (1992), Chowdhury *et al.* (1992), Bhouyain *et al.* (2005), Rahman *et al.* (2007), Latifa *et al.* (2008), Ahmed *et al.* (2010), and Siddique *et al.* (2011). The highest pH value 7.79 was recorded in May, 2013 (Table 1) in the present study. Similar results were observed by Ameen *et al.* (1986) and Latif *et al.* (1986). Chowdhury *et al.* (1989), Bhouyain and Sen (1991), Khondkar and Parveen (1992), Chowdhury *et al.* (1992) recorded the highest pH value in April. Rahman *et al.* (2007) recorded in August, Latifa *et al.* (2008) recorded in March, Ahmed *et al.* (2010) recorded in June, and Siddique *et al.* (2011) recorded in February. The high pH due to high temperature, low free CO_2, high photo-synthesis and low rainfall in summer months.

The lowest value 7.02 was recorded in January, 2014 (Table 1). Similar observation was also recorded by Islam and Mendes (1976), and Ahmed *et al.* (2010). Shil (1980) recorded it in October at Kamal dighi and in September at Lal dighi, Begum *et al.* (1989) recorded in October and Chowdhury *et al.* (1992) recorded this in September. Bhouyain *et al.* (2005), Rahman *et al.* (2007), Latifa *et al.* (2008) and Siddique *et al.* (2011) recorded in January, December, September and October respectively. Mamun *et al.* (2010) reported the highest value of pH in October.

The monthly abundance of dissolved oxygen are showing in Table 1. The highest dissolved oxygen 5.73 ppm was recorded in the month of January, 2014 (Table 1). The maximum dissolved oxygen was recorded in November by Islam and Mendes (1976), Khondkar and Parveen (1992). The concentration of dissolved oxygen was maximum in winter month. It is also noticed by Welch (1952), Swarup and Singh (1979), Ameen *et al.* (1986), Begum *et al.* (1989) and Bhouyain *et al.* (2005). Ahmed *et al.* (1999) recorded the highest dissolved oxygen during monsoon season. Hossain *et al.* (1998) reported the highest dissolved oxygen in May. Kabir and Naser (2008) reported the highest dissolved oxygen in May. Rahman *et al.* (2007), Latifa *et al.* (2008), Ahmed *et al.* (2010) and Siddique *et al.* (2011) recorded the highest dissolved oxygen in June, March, November and September respectively. The high concentration of dissolved oxygen content during winter month possibly due to the low rainfall and low volume of water.

The lowest dissolved oxygen 3.4 ppm was recorded in the month of August, 2013 (Table 1). The similar observation was also recorded by Islam and Mendes (1976), and Ameen *et al.* (1986). Hossain *et al.* (1998) reported the lowest dissolved oxygen in December. Bhouyain *et al.* (2005) reported the lowest dissolved oxygen in August. The lowest dissolved oxygen was recorded in November by Rahman *et al.* (2007). Kabir and Naser (2008) reported the lowest dissolved oxygen in July. Latifa *et al.* (2008) reported the lowest dissolved oxygen in May. Mamun *et al.* (2010) reported the lowest dissolved oxygen in June. Siddique *et al.* (2011) reported the lowest dissolved oxygen in October.

In this work the highest free carbon dioxide 5.85 ppm was noticed in the month of January, 2014 (Table 1). Chowdhury (1997) recorded the highest free carbon dioxide in May. Iqbal (1998) reported the highest free carbon dioxide in April. Bhouyain *et al.* (2005) recorded the highest free carbon dioxide in January. Rahman *et al.* (2007) recorded the highest free carbon dioxide in November. Kabir and Naser (2008) recorded the highest free carbon dioxide in November. Latifa *et al.* (2008) recorded the highest free carbon dioxide in June. Ahmed *et al.* (2010) the highest free carbon dioxide was recorded in June. Siddique *et al.* (2011) recorded the highest free carbon dioxide in February.

The lowest free carbon dioxide 2.82 ppm was recorded in the month of September, 2013 (Table 1). Majumder (1980) recorded the lowest free carbon dioxide in the month of March. The minimum concentration of free carbon dioxide in March observed by Sen (1982). Chowdhury (1997) recorded the lowest free carbon dioxide in March. Iqbal (1998) reported the lowest free carbon dioxide in January. The lowest free carbon dioxide also recorded by Bhouyain *et al.* (2005) in November, Rahman *et al.* (2007) in June, Latifa *et al.* (2008) in February, Ahmed *et al.* (2010) in July and Siddique *et al.* (2011) in September.

Calcium: The calcium concentration of the Bayezid Bostami pond showed a clear seasonal and monthly trends of fluctuations (Table 1). The highest calcium concentration 43.03 ppm was recorded in January, 2014 (Table 1). Swarup and Singh (1979) recorded the highest calcium concentration in January. Saha *et al.* (1971) noted higher calcium concentration in summer. Campos *et al.* (1992) recorded the maximum calcium concentration in February. Chowdhury (1997) recorded the highest calcium concentration in April. Iqbal (1998) reported the highest calcium concentration in February. Bhouyain *et al.* (2005), Ahmed *et al.* (2010) and Rahman *et al.* (2007) reported the highest calcium concentration in August. Latifa *et al.* (2008) recorded the highest calcium concentration in August. Kabir and Naser (2008) recorded the highest calcium concentration in September.

The lowest calcium concentration 25.08 ppm was recorded in October, 2013 (Table 1). Similar result was also recorded by Swarup and Singh (1979). Saha *et al.* (1971) noted the lowest calcium concentration in winter. Campos *et al.* (1992) recorded the minimum calcium in July. Chowdhury (1997) recorded the lowest calcium concentration in October. Iqbal (1998) reported the lowest calcium concentration in September. Bhouyain *et al.* (2005) and Latifa *et al.* (2008) recorded the lowest calcium concentration in November. Rahman *et al.* (2007), Kabir and Naser (2008), and Ahmed *et al.* (2010) recorded the lowest calcium concentration in April, September and June, respectively. The lowest calcium concentration after rainy season was probably due to dilution by rain water. The Bayezid Bostami pond can be classified as rich depending upon calcium content.

The fluctuations of phytoplankton population were observed in Table 1. The highest number of phytoplankton 2223 individuals/l was observed in September, 2013 (Table 1) in this study. Hossain *et al.* (1998) observed two high peaks, one in May and second in October. The phytoplankton densities increased in spring as light increased observed by Rahman *et al.* (2007). A large number of phytoplankton genera and seasonal succession of phytoplankton population were observed by Rahman *et al.* (2007). The highest number of phytoplankton population was observed due to clean weather, highest light penetration, comparatively higher free carbon dioxide and high rate of photosynthesis. The lowest number of phytoplankton 842 individuals/l was recorded in March, 2013 (Table 1). Rahman *et al.* (2007) the population densities were relatively lowest in October and the lowest peak appeared in January. The lowest number was observed in March due to low light penetration, comparatively lowered free carbon dioxide and low rate of photosynthesis.

During the study period a distinct fluctuation of zooplankton population in different months was observed (Table 1). In the present study, rotifera, copepoda and cladocera are represented in Table 1. The zooplankton 494 individuals/l showed its maximum abundance in September, 2013 (Table 1). Begum *et al.* (1989) recorded the peak abundance in March. Bhouyain *et al.* (2005) recorded maximum abundance in September. The highest number of zooplankton in autumn was observed by Saha *et al.* (1971), Ramakrishnaiah and Sakar (1982). Begum *et al.* (1989) recorded the peak abundance in March. The highest number of zooplankton in autumn was possibly due to comparatively low light penetration, comparatively low amount of free carbon dioxide.

The lowest number of zooplankton 187 individuals/l was recorded in March, 2013 (Table 1).

Rotifera: The data of rotifera are presented in Table 1. The highest number of rotifera 266 individuals/l was recorded in September, 2013 (Table 1). Saha *et al.* (1971) recorded the highest number of rotifera in November. Bhouyain *et al.* (2005) recorded the highest number of rotifera in November. Chowdhury and Raknuzzaman (2005) recorded the highest number of rotifera in May. Rahman and Hussain (2008) reported peak season of rotifera in January. Siddique *et al.* (2011) recorded the highest number of rotifera in February. The highest number of rotifera was found due to the suitable environment, favourable conditions of physico-chemical parameters and the availability of food and nutrients in the pond. The lowest number of rotifera 105 individuals/l was recorded in March, 2013 (Table1). Bhouyain *et al.* (2005) recorded the lowest number of rotifera in March. Chowdhury and Raknuzzaman (2005) recorded the lowest number of rotifera in September. Siddique *et al.* (2011) recorded the lowest number of rotifera in October. 16 species of rotifera was identified during the study period.

The genera *Brachionus*, *Asplanchna*, *Lecane*, *Filinia*, *Platyias*, *Keratella*, *Polyarthra*, *Trichocerca* were found throughout the study period. Saha *et al.* (1971), Begum *et al.* (1989) also recorded similar type of observation. Bhouyain and Asmat (1992) recorded 25 species, Chowdhury and Raknuzzaman (2005) identified 12 genera, Mozumder *et al.* (2010) identified 31 taxa and Mozumder *et al.* (2011) identified 22 genera of rotifera.

The number of copepoda was varied from 43 to 135 individuals/l where the highest was recorded in September, 2013 (Table 1). Das and Srivastava (1956) divided their entire investigation year into various dominant periods such as September, October and November constituted the copepodan period. The highest number of copepoda in autumn was recorded by Saha *et al.* (1971), Ramakrishnaiah and Sakar (1982) and Begum *et al.* (1989). Bhouyain *et al.* (2005) recorded the highest number of copepoda in October. Rahman and Hussain (2008) recorded peak season of copepods in September. Siddique *et al.* (2011) recorded the highest number of copepoda in February. The lowest number of copepoda 43 individuals/l was recorded in March, 2013 (Table1). Bhouyain *et al.* (2005) recorded the lowest number of copepoda in March. Chowdhury and Raknuzzaman (2005) recorded the lowest number of copepoda in February. Siddique *et al.* (2011) recorded the lowest number of copepoda in September. Irregularity of the copepods at different months might be due to the fact that different species involved had their maximum and minimum occurring at different times. 2 species of copepods were identified during study period. Bhouyain and Asmat (1992) recorded 10 species, Chowdhury and Raknuzzaman (2005) identified 4 genera, Mozumder *et al.* (2010) identified 5 taxa.

The cladocera was shown in Table 1. The highest number of cladocera 115 individuals/l was recorded in October, 2013 (Table 1). Das and Srivastava (1956) divided their entire investigation year into various dominant periods such as December and January constituted the cladocerans period. Begum *et al.* (1989) noticed it in March. Bhouyain *et al.* (2005) recorded the highest number of cladocera in the month of July. Rahman and Hussain (2008) reported peak season of cladocera in January. Siddique *et al.* (2011) recorded the highest number of cladocera in February. The highest number was shown due to the favourable conditions of the environment.

The lowest number of cladocera 39 individuals/l were recorded in March, 2013 (Table 1). Bhouyain *et al.* (2005) recorded the lowest number of cladocera in March and December. Siddique *et al.* (2011) recorded the lowest number of cladocera in October. The lowest number of cladocera were found due to the unfavourable conditions of the environment in the pond. 2 species of cladocerans were identified during the study period. Bhouyain and Asmat (1992) recorded 14 species, Chowdhury and Raknuzzaman (2005) identified 6 genera, Mozumder *et al.* (2010) identified 5 taxa.

From the statistical analyses it has been observed that water depth showed positive correlation with conductivity (r = 0.460671), total dissolved solids (r = 0.209221), phytoplankton (r = 0.705899), zooplankton (r = 0.706033), rotifera (r = 0.693527), copepoda (r = 0.672022) and cladocera (r = 0.685201) while inversely related with water temperature (r = –0.27148), turbidity (r = –0.67769), light intensity (r = –0.45883), pH (r = –0.58268), DO (r = –0.12364), CO_2 (r = –0.29967) and Ca (r = –0.36948).

Water temperature showed positive correlation with turbidity (r = 0.214818), light intensity (r = 0.222867), pH (r = 0.432564), copepoda (r = 0.095395) and cladocera (r = 0.005732) while inversely related with conductivity (r = –0.52376), total dissolved solids (r = –0.66934), DO (r = –0.74676), CO_2 (r = –0.60122), Ca (r = –0.60846), phytoplankton (r = –0.01773), zooplankton (r = –0.01714) and rotifera (r = –0.08567).

Conductivity showed positive correlation with total dissolved solids (r = 0.877554), DO (r = 0.495264), CO_2 (r = 0.240759), Ca (r = 0.166984), phytoplankton (r = 0.621081), zooplankton (r = 0.620661), rotifera (r = 0.70139), copepoda (r = 0.525426) and cladocera (r = 0.469583) while inversely related with turbidity (r = –0.63596), light intensity (r = –0.55084) and pH (r = –0.70245).

Turbidity showed positive correlation with light intensity (r = 0.620516), pH (r = 0.20055), DO (r = 0.095448), CO_2 (r = 0.424087) and Ca (r = 0.398395) while inversely related with total dissolved solids (r = –0.24527), phytoplankton (r = –0.81717), zooplankton (r = –0.81699), rotifera (r = –0.80631), copepoda (r = –0.75586) and cladocera (r = –0.81091).

Light intensity showed positive correlation with pH (r = 0.286063), DO (r = 0.111119), CO_2 (r = 0.363533) and Ca (r = 0.2767) while inversely related with total dissolved solids (r = –0.31618), phytoplankton (r = –0.67905), zooplankton (r = –0.67882), rotifera (r = -0.62242), copepoda (r = –0.6545) and cladocera (r = –0.75166).

Total Dissolved Solids showed positive correlation with DO (r = 0.728013), CO_2 (r = 0.637039), Ca (r = 0.559291), phytoplankton (r = 0.20775), zooplankton (r = 0.207231), rotifera (r = 0.313859), copepoda (r = 0.114532) and cladocera (r = 0.046576) while inversely related with pH (r = –0.74093).

pH showed negative correlation with DO (r = –0.43779), CO_2 (r = –0.3914), Ca (r = –0.22047), phytoplankton (r = –0.37107), zooplankton (r = –0.37083), rotifera (r = –0.46506), copepoda (r = –0.30898), and cladocera (r = –0.17969).

DO showed positive correlation with CO_2 (r = 0.878696) and Ca (r = 0.855547) while inversely related with phytoplankton (r = –0.19119), zooplankton (r = –0.19176), rotifera (r = –0.0467), copepoda (r = –0.31303) and cladocera (r = –0.35465).

Table 1. Monthly variation of physical, chemical and biological parameters of Bayezid Bostami pond during February, 2013 to January, 2014

Months Parameters	Unit	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.
Water depth	m	2.03	1.97	1.83	1.62	1.54	2.53	2.52	2.37	2.35	2.32	2.29	2.15
Temperature	°C	27.8	28.4	30.3	29.5	32.6	27.7	31.5	30.7	29.7	27.8	26.8	24.5
Conductivity	mS	0.273	0.266	0.253	0.243	0.235	0.234	0.264	0.282	0.291	0.293	0.295	0.297
Turbidity	ntu	31.11	31.32	33.24	28.75	33.41	30.35	26.95	26.55	27.27	27.63	28.11	28.18
Light intensity	lux	39.5	37	36	35	34.5	34	33.5	32.5	30.5	31	27	32
TDS	ppm	180	181	178	163	162	161	168	174	179	184	187	191
pH	_	7.14	7.11	7.24	7.79	7.38	7.27	7.2	7.15	7.16	7.1	7.06	7.02
DO	ppm	5.67	4.48	4.06	3.83	3.68	3.5	3.4	3.62	3.76	4.02	4.94	5.73
Free CO_2	ppm	5.57	5.32	4.91	3.31	3.53	3.18	3.01	2.82	2.92	3.66	4.35	5.85
Calcium	ppm	41.73	40.06	39.06	34.21	31.18	29.65	28.75	27.06	25.08	31.67	40.02	43.03
Phytoplankton	ind./l	1350	842	1013	1148	1193	1458	1746	2223	2196	1917	1782	1532
Zooplankton	Ind./l	300	187	225	255	265	324	388	494	488	426	396	340
Rotifera	ind./l	180	105	119	127	141	160	207	266	248	228	211	196
Copepoda	ind./l	67	43	59	61	65	83	92	135	125	103	98	73
Cladocera	ind./l	53	39	47	67	59	81	89	93	115	95	87	71

CO_2 showed positive correlation with Ca (r = 0.94561) while inversely related with phytoplankton (r = –0.54098), zooplankton (r = –0.54149), rotifera (r = –0.40802), copepoda (r = –0.62372) and cladocera (r = –0.68006).

Ca showed negative correlation with phytoplankton (r = –0.59312), zooplankton (r = –0.59355), rotifera (r = –0.47622), copepoda (r = –0.66831) and cladocera (r = –0.69705). Phytoplankton showed positive correlation with zooplankton (r = 0.999999), rotifera (r = 0.983265), copepoda (r = 0.979812) and cladocera (r = 0.933722). Zooplankton showed positive correlation with rotifera (r = 0.983187), copepoda (r = 0.979925) and cladocera (r = 0.933767). Rotifera showed positive correlation with copepoda (r = 0.9438) and cladocera (r = 0.864744). Copepoda showed positive correlation with cladocera (r = 0.91172).

Miah *et al.* (1981) found that zooplankton showed positive correlation with CO_3^- and HCO_3^- alkalinity. Rahman & Hussain (2008) found that zooplankton showed significant positive correlation with pH, DO and CO_2. Siddique *et al.* (2011) found that zooplankton showed positive correlation with pH, DO, CO_2 and alkalinity where negative correlation found with water temperature and transparency.

The importance and influence of the physico-chemical factors on the phytoplankton and zooplankton are understood to assess the seasonal fluctuation of phytoplankton and zooplankton; all these factors; should be considered separately or collectively. No single factor is responsible for production or fluctuation. Hence for studying the growth, distribution and fluctuation of phytoplankton and zooplankton population all the physical, chemical and biological factors should be taken into consideration.

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