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Research Article

ABUNDANCE OF PLANKTON AND WATER QUALITY AT SELECTED THREE WATER BODIES OF BIRULIA UNION, SAVAR, BANGLADESH

Nasif Sadat, Fatema Tuz Zohora, Mohsina Farhana Afrose, Shayer Mahmood Ibney Alam, Md. Mahedi Hasan and Tonima Mustafa*

Department of Zoology, Jagannath University, Dhaka, Bangladesh

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ABSTRACT

The present research was conducted to assess the abundance of plankton fauna and some physico-chemical parameter of water in selected three different water bodies (beel river and pond) of Birulia union, Savar, Dhaka during the period of March 2016 to January 2017. Samples were taken at two months interval from each selected spot. During the study period,a total of 32 genera of planktons belonging to 9 classes including Mastigophora (5 genera), Sarcodina (2 genera), Monogononta (3 genera), Ciliata (2 genera), Secernentea (1 genera), Eurotatoria (6 genera), Crustacea (10 genera) and Insecta (3 genera) were identified. Among them, Zoospore of *Volvox* was dominant whereas *Chrysamoeba*, *Mysis*, *Lacane*, *Trichocerca*, *Pseudoharringa*, *Collotheca*, *Cypris*, *Culex* larva were lowest. The growth and productivity of planktons and other aquatic organisms mainly depends on different physico-chemical parameters. Different physico-chemical properties of water i.e. temperature, p^H, DO and transparency were determined as ranged from 19°C to 30°C, 6.6 to 9.6, 4.5 mg/l to 10.7 mg/l and 13.5 cm to 66.5 cm respectively in beel, 20°C to 31°C, 6.5 to 9.6, 4.7 mg/l to 10.8 mg/l and 12.6 cm to 26 cm respectively in river, 20°C to 32°C, 6.5 to 9.8, 4.6 mg/l to 9.7 mg/l and 7cm to 37.5 cm respectively in pond. The number of species was lowest in Turag River compare to others as the water of the Turag River was more polluted.

Keywords: *Plankton, abundance, water quality, physico-chemical parameters*

Introduction

Bangladesh is endowed with plenty of surface and ground water resources. The surface water resources comprise water available from flowing rivers and static water bodies as ponds, beel and haor (Banglapedia 2012). Water is fundamental not only for the existence of human beings, but also for the different communities of aquatic organisms (Razo *et al*., 2004). Plankton denominates the community of aquatic organisms, consist of different groups, which have a limited ability to swim and inhabit the pelagic part of a water body (Declince 1992). They are microscopic,

***Correspondence:** *Tonima Mustafa, Email:tonimamustafa@yahoo.com*

construct the biotic load of a water body and used as essential food for fish and other aquatic organisms (Battish 1992). The productivity of the aquatic body mainly relies on the quantity of plankton in particular (Davies *et al.,* 2009). They have fundamental importance to the economy of aquatic environment, as they take part in the nutrient release into the water that enhances the productivity of water bodies (Shariful 2009).

They consist of photosynthetic organisms or phytoplankton and zooplankton or heterotrophic organisms. Phytoplankton is a primary producer; most of the aquatic fauna directly or indirectly depend on phytoplankton for their food during early stage of their life cycle (Haque *et al*., 2020). Phytoplankton indicates the biological index of an aquatic body, constituting a fundamental link in the aquatic food chain (Hossain *et al*., 2017). Zooplankton is a heterotrophic organism and plays a pivotal role in the nitrogen cycle. They are capable to increases nutrient regeneration in the microbial food web (Nagata 2000). The abundance of plankton indicates the nutrient status, especially the heath condition of the aquatic system (Rahman and Hossain 2009; Bahaar and Bhat 2011). Therefore, changes in their abundance can give important indications of environmental change or disturbance, because they are dependent on interactions between physical and chemical factor of environment (Cetin and Sen 2004).

Several environmental factors including temperature, dissolved oxygen, pH, salinity, toxic contaminants may control the abundance and composition of planktons. So, it was inevitable to assess the water quality in the present study areas. Evaluation of water quality is very important to detect the health condition of the water bodies. Keeping these points in thinking, the present study was designed to access the abundance of plankton community with their variation and determining the water quality parameters in different months to assess the water quality status of the selected water bodies of Birulia union, Savar, Dhaka.

Materials and Methods

Study Area

Birulia union (23°51'28.9"N 90°18'33.0"E) is located at Savar upazila of Dhaka district (Fig. 1). It is situated on the bank of the Turag River and about 25km from the center of Dhaka city on the Dhaka-Manikgonj highway. In present study, three spots of Birulia union were selected as spot 1 (23˚51.241’N, 90˚20.050’E) is a beel, also known as khayarghat to the local people. This water body is originated from the Turag River. But this is disconnected from the river during dry season and connected with the river in rainy season. In dry season it is almost dried up.

Spot 2 (23˚51.099’N, 90˚20.320’E) is the Turag River which flows across the Dhaka city. Water sample were collected from the river just under the Birulia Bridge which is situated in the Birulia union. Spot 3 (23˚51.582’N, 90˚17.501’E) is the Zinzira pond which is also situated in Birulia union. The pond is situated at the corner side of the hospital. This pond is medium in size and depth. There is no big tree but grassland around the pond.

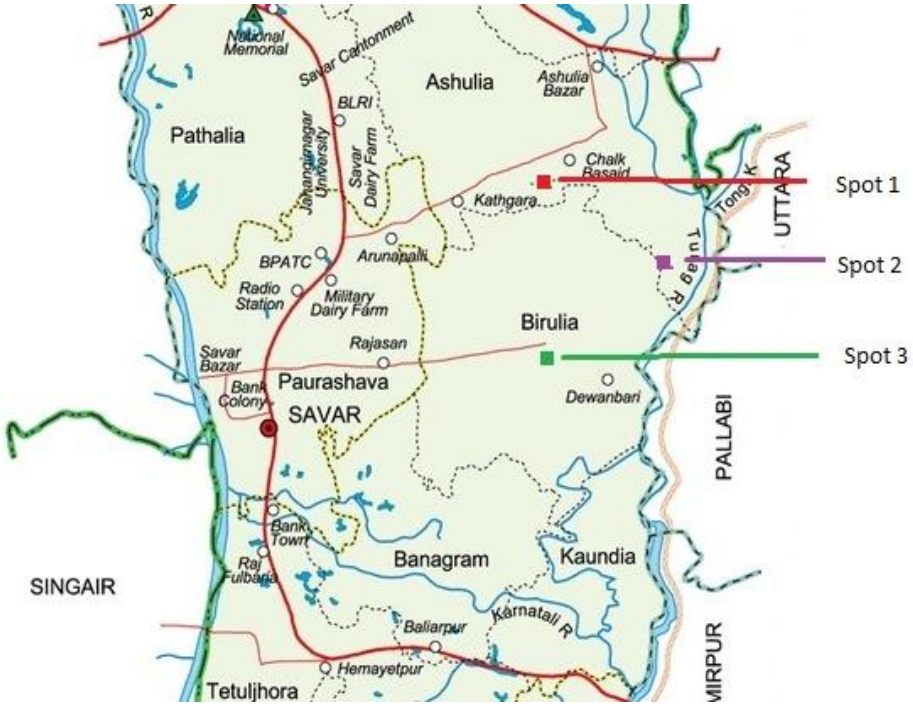

Fig. 1. Map of Birulia Union, Savar, Dhaka showing sampling spots (Source: Google map).

Sampling Procedure

The present study was carried out for a period of one year and three spots were selected randomly for sampling at the birulia union namely, Kheyaghat beel, Turag River and Zinzira pond assigned as spot-1, spot-2 and spot-3 respectively. Water samples were taken for six times from each selected spot during the period of March 2016 to January 2017. Every sampling was done at two months interval.

A time frame was following during sampling. The water samples were collected from selected sampling spots and immediately brought to the fisheries laboratory of Jagannath University. For plankton sampling, water was taken by a two liter plastic container and then passed it through plankton net (mesh size 25µm) to filter the plankton. 20-liter waters were filtered from different portions of each water body. Each filtered sample was transferred to a measuring cylinder chamber then buffer solution (87% H_2O, 4.5% $H\text{-}CHO_{(aq)}$, 8.5% glycerin) was added and preserved in a sealed plastic bottle until identification. Then the planktons were identified by adding Lugol's solution. The chamber was left overnight for complete sedimentation. For qualitative analysis, the concentrated plankton was analyzed on a glass slide using a binocular microscope with phase contrast facilities and following the plankton determination keys from Edmonton (1959), Prescott (1970), and Sharma (1986). For quantitative analysis, 1ml of concentrated plankton was taken in a Sedgewick Rafter Counting Cell (SRCC) followed by counting methods described by Boyd (1979).

For water quality analysis, fresh water samples were also collected from the selected spots and kept into separate bottles for the investigation of some physico-chemical parameters. Then the bottles were labeled with spot name and sampling date. The physico-chemical parameters of water such as pH, dissolved oxygen (DO), transparency were recorded by using pH meter (HANNA instruments), DO meter (Lutron DO-5509), and Secchi disk respectively. For measuring air and water temperature, a thermometer was placed in the air or immersed into the water for one minute and then noted the reading from the thermometer. GPS was used to detect the coordination of sampling spots.

Results and Discussion

Abundance of Plankton Community

In scientific culture and management of fisheries resources, there is great need for understanding of qualitative and quantitative status of plankton as they play an important role in aquatic environment. It is not only important for food item of fishes but also an indicator of productivity of a water body (Hossain *et al*., 2007). The abundance of different species of plankton varies from one season to another due to their different biological nature. A total of 32 genera of planktons belonging to 9 classes including Mastigophora (5 genera), Sarcodina (2 genera), Monogononta (3 genera), Ciliata (2 genera), Secernentea (1 genera), Eurotatoria (6 genera), Oligochaeta (1 genera), Crustacea (10 genera), Insecta (3 genera) were identified during the study period (Table 1). Among them 26 species were Zooplankton (*Amoeba, Amoeba radiosa, Brachionus, Trichocerca, Brachionus nilsoni, Notholca, Stentor, Paradoxo rhabditis, Lecane, Pseudoharringia, Keratella, Platyias, Collotheca, Moina, Bosmina, Ceriodaphina, Daphnia, Cyclops, Mysis, Cypris, Diaptomus, Nauplius* larvae, *Zoaea* larvae, *Anopheles* larvae, *Culex* larvae, *Mosquito* larvae.) and 6 species were Phytoplankton (*Chrysamoeba, Euglena, Volvox*, Zoospore of *Volvox*, *Volvox* Colony, *Paramecium*). Among the identified planktons, Zoospore of *Volvox* was dominant in numerical form as well as percentage composition (26%) exhibiting its peck period in the month of March. It seems that Volvox can be best adapted in the fluctuation of physical and chemical variability. The abundance of following planktons like *Chrysamoeba, Trichocerca, Lacane, Pseudoharringa, Collotheca, Cypris, Mysis, Culex* larva were lowest due to the lack of optimum growth condition throughout the study period (Table 1).

The quantitative status of planktons was also estimated as 9.2/L in Beel, 0.6/L in River and 7.8/L in Pond water. The present findings reveal that plankton species were abundant in beel water than others.

Table 1. Name of the plankton species and their number in three water bodies of Birulia union Savar, Dhaka.

Class	Order	Genus	Number of individuals																			Total
			March			May			July			September			November			January			
			Beel	River	Pond	Beel	River	Pond	Beel	River	Pond	Beel	River	Pond	Beel	River	Pond	Beel	River	Pond	
Mastigophora	*Chrysomonadina*	*Chrysamoeba*	-	-	-	-	-	01	-	-	-	-	-	-	-	-	-	-	-	-	01
	Euglenoidina	*Euglena*	05	-	-	-	-	-	-	-	-	-	-	01	05	-	-	18	-	-	29
	Phyomonadina	*Volvox*	-	-	-	07	-	01	-	-	-	-	-	-	-	-	-	-			08
		Zoospore of *Volvox*	-	-	50	-	-	-	-	-	01	-	-	-	-	-	-	40	-	-	91
		Volvox Colony	-	03	03	-	-	-	01	01	01	-	-	-	01	-	01	-	-	-	11
Sarcodina	Lobosa	*Amoeba sp*	-	-	03	-	-	-	-	-	-	-	-	-	-	-	03	-	-	-	6
		Amoeba radiosa	-	-	-	-	-	-	-	-	01	-	01	-	-	-	-	-	-	-	2
Monogononta	Plioma	*Brachionus sp.*	02	-	07	09	-	-	01	-	02	-	-	-	10	-	15	05	-	-	51
		Brachionus nilsoni	-	-	-	36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36
		Notholca	-	-	-	01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	01
Ciliata	Holotricha	*Paramecium*	-	-	09	-	-	-	-	-	-	-	-	01	-	-	05	-	-	01	16
	Spirotracha	*Stentor*	-	-	01	-	-	-	-	-	-	-	-	02	-	-	-	-	-	-	03
Secernentea	Rhabditida	*Paradoxo rhabditis*	-	-	-	-	-	-	-	-	01	01	-	-	-	-	-	-	-	-	02
Eurotatoria	Ploima	*Trichocerca sp.*	-	-	01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	01
		Lecane	-	-	01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	01
		Pseudoharringia	01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	01
		Keratella	-	-	01	09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
		Platyias	-	-	-	05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	05
		Collotheca	-	-	-	01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	01
Crustacea	Cladocera	*Moina*	02	01	-	-	-	03	02	01	08	-	-	-	-	-	-	-	-	-	17
		Bosmina	-	-	-	01	-	-	-	-	02	-	-	-	-	-	-	-	-	-	03
		Ceriodaphina	-	-	-	-	-	-	01	-	02	-	-	-	-	-	-	-	-	-	03
		Daphnia	-	-	01	-	-	-	-	-	-	-	-	-	01	-	-	-	-	-	02
	Cyclopoidea	*Cyclops*	03	-	-	-	-	11	02	01	-	-	-	01	-	-	01	-	-	-	19
	Mysidae	*Mysis*	-	01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	01
	Ostracoda	*Cypris*	-	-	-	-	-	-	-	-	-	-	-	01	-	-	-	-	-	-	01
	Copepoda	*Diaptomus*	-	-	-	01	-	05	-	-	02	-	-	-	-	-	-	-	-	-	08
		Nauplius larvae	04	-	-	-	-	-	-	-	01	-	-	-	01	-	03	02	-	-	11
		Zoaea larvae	-	-	-	-	-	-	01	-	-	-	-	-	-	-	-	-	-	-	01
Insecta	Diptera	*Anopheles* larvae	04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	04
		Culex larvae	-	-	-	01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	01
		Mosquito larvae		02	02	-	-	-	-	01	-	-	-	-	-	-	-	-	-	-	05
Total			21	07	79	71	0	21	08	04	21	01	01	06	18	0	28	65	0	01	352

It was observed that maximum 39% (71 individuals) and minimum 1% (1 individual) planktons were recorded in May and September respectively from spot 1. Rainy season comes in May and ends at September in Bangladesh. These findings proved that at early of the rainy season number of plankton was higher and heavy rainfall increases the sedimentation of essential nutrients for

plankton growth (Chowdhury *et al.*, 2007). Alam (2017) reported similar condition in wetland at National Monument of Bangladesh, but it gradually decreases in other months (4% in July and 1% in September) and increased in the winter (10% in November and 35% in January) (Fig. 2). These findings were comparable to the findings of (Chowdhury *et al.*, 2007) who recorded the maximum plankton density in the month of May in Borobila beel of Rangpur district. From spot-2 (River), the highest 58% (7 individuals) plankton community was observed in March but lowest 8% (1 individual) in September. No plankton was found in May, November and January which indicates the low productivity of this water body (Fig. 2).

This river is one of the polluted rivers in Bangladesh (Rahman 2012), and it has very poor water quality due to dense, congested and unplanned growth of industries and housing on the bank of the river which turns the river as extensively dumping grounds might be responsible for the lower abundance of plankton community.

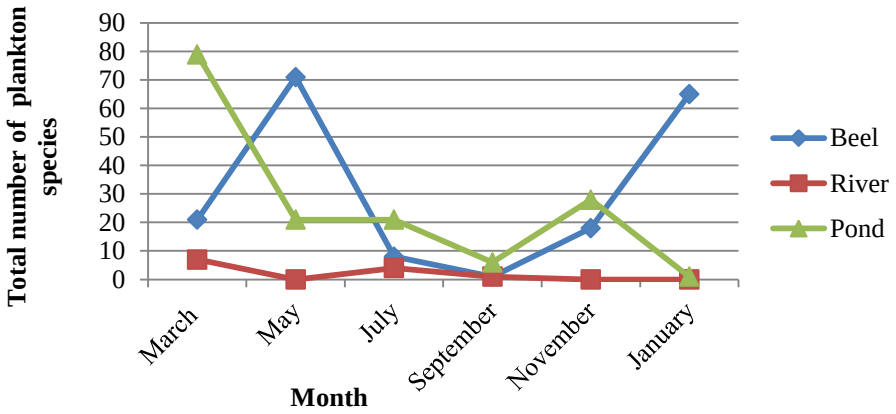

Fig. 2. Total number of plankton species in different months at three water bodies.

Simpson (1949) observed that high density of plankton's assemblage may be due to good ecological condition for its growth. Hossain *et al.* (2017) reported the similar observation in Meghna River. On the other hand Spot-3 (Pond) was most diverse and the density of plankton was highest than other two spots. Highest 51% (79 individual) and lowest 1% (1 individual) in March and January respectively. (Table 1). But Shariful *et al.* (2009) reported that the most abundant plankton community was observed in June and lowest in December in a selected pond of Bangladesh Agricultural University.

Whereas Rahman and Hossain (2009) observed more or less similar result in the pond of Rajshahi city corporation area. The water quality of this spot was better than other two spots. Water was clean and transparency was good which support the high productivity of this spot.

Water Quality Parameters

The growth and productivity of planktons and other aquatic organisms mainly depends on different physico-chemical parameters such as temperature, pH, dissolved oxygen, transparency,

alkalinity etc. pH is a fundamental water quality parameter that affects other chemical reactions such as metal toxicity and solubility (Dara 2002) and significantly influences the biological activity. In the present study, the pH levels of selected water bodies (beel, river and pond) were ranged from 6.6 to 9.6, 6.5 to 9.6, and 6.5 to 9.8 respectively which were more or less identical to the finding of Swingle (1967) (Table 2).

Table 2. Physico-chemical parameters recorded from the three water bodies of Birulia union, Savar.

Parameter	Month																	
	March			May			July			September			November			January		
	Beel	River	Pond	Beel	River	Pond	Beel	River	Pond	Beel	River	Pond	Beel	River	Pond	Beel	River	Pond
Temperature ˚C (Environment)	20	23	23	30	30	30	31	29	29	32	29	32	27	23	28	25	22	25
Temperature˚C (Water) (Water)	19	20	20	28	28	28	28	30	32	30	31	31	25	24	25	22	20	21
pH	7.6	8.0	8.0	6.6	6.5	6.5	7.4	7.5	7.3	7.4	7.6	7.3	7.6	7.8	7.3	9.6	9.6	9.8
DO (mg/l)	4.6	5.0	5.5	6.9	5.2	5.2	4.5	5.3	4.6	8.4	4.7	5.8	4.9	9	8.8	10.7	10.8	9.7
Transparency (cm)	22	22	7	13.5	18	18	32.5	15.5	32	38	18.5	27	66.5	26	37.5	15	12.6	24.5

The maximum pH (9.8) value was noted during January in pond water whereas the minimum pH (6.5) value was recorded during May in river water. Fish growth is limited in water when pH less than 6.5 and fish fry can die at pH less than 5 (Martyshev 1983). The pH acts as a good indicator of water quality and also controls the amount of ions in water (Hasan and Bhuiyan 2013). According to EQS (1997) and WHO (1997) the standard range for inland surface water pH is 6.5-8.5. Temperature is an important water quality parameter that directly or indirectly influences the volume of dissolved oxygen (Ahmed *et al*., 2003). The observed water temperature was varied in selected water bodies (beel, river and pond) ranged from 19°C to 30°C, 20°C to 31°C, and 20°C to 32°C respectively. Both water and air temperature showed an analogous pattern of fluctuation with few exceptions during the study period (Table 2). This observation was similar to the findings of Bhuiyan *et al*. (2010). Begum *et al*. (2007) reported that the water temperature 18.3°C to 37.8°C suitable for plankton production. The highest temperature (32°C) was recorded during the month of July in pond water whereas the lowest water temperature (19°C) was recorded during March in beel water. Mollah and Haque (1978) reported that water temperature of ponds ranged from 26.0 ˚C to 32.4 ˚C. The cause of higher temperature is a result of solar radiation and environmental facts. Beside this, there are many mills and factories are constructed near the water bodies and they use the water for cooling purposes during the manufacturing of their goods and finally release their wastes

into the water after cooling operations, which increases the water and air temperature. Adequate dissolve oxygen (DO) is essential for the survival of planktons and other aquatic organisms (Chowdhury and Raknuzzaman 2005). Dissolved oxygen is one of the important factors in water bodies as a controller of metabolic process.

Therefore, its concentration is an indicator of organic pollution (Hasan and Bhuiyan 2013). At present study the observed dissolved oxygen was varied in selected water bodies (beel, river and pond) ranged from 4.5 to 10.7 mg/l, 4.7 to 10.8 mg/l and 4.6 to 9.7 mg/l respectively. It was evident from the study that lowest value of DO (4.5 mg/l) was observed in the month of July in beel. This reduction in value may be caused by high level of industrial sewage effluent and discharge of organic materials into the water which deteriorate DO content. However, the highest value of DO (10.8 mg/l) was recorded during January in river water. In that time the environmental temperature was low. Ahmed *et al*. (2003) reported that temperature directly or indirectly influences the availability of dissolved oxygen. According to environmental quality standard, the standard level of DO is 6 mg or less for drinking purposes, 5.0 mg/l for industrial application and 4.0 to 6.0 mg/l for fish and domestic animals (EQS 1997). Another physical parameter transparency has an important role in the growth of plankton in different water bodies (Begum *et al*., 2007). The transparency of water was ranged between13.5 to 66.5 cm, 12.6 to 26 cm and 7 to 37.5 cm in studied beel, river and pond respectively. Among the three spots (beel, river and pond) the maximum transparency (66.5 cm) was found in the month of November in beel water but the lowest transparency (7 cm) was recorded during March in pond water (Table 2). Stepenuck *et al*. (2002) stated that the transparency of productive water bodies should be 40 cm or less which was dissimilar to the present findings. It might be depended on the amount of particles in water, sediments, organic matters, sampling time and geographical location etc. Transparency of water related to the depth that light can penetrate the water but large accumulations of organic and inorganic components make the light rapidly absorbed therefore light unable to reach greater depths which may be the lower transparency.

Conclusion:

Concerning all the parameters of the study, it is evident that the water of selected spots is now in crucial condition. Water being polluted day by day by chemical and organic wastes. In a consequence the dissolved oxygen concentration and pH level in these water bodies becomes very low at some locations. In near future the pollution of water leads to death or decreased in abundance of plankton and other aquatic organism. As we know the plankton plays a fundamental role in aquatic ecosystem, so we have to know about the effect of water parameters that strongly influences the abundance of plankton community. In addition, this study will provide an idea regarding water physico-chemical parameters and planktonic community that may also be helpful to assess the quality of water body or other extensive research works in different water bodies of Bangladesh.

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