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Monthly variations of benthic community in relation to hydrological parameters in the ponds of Bangladesh agricultural university, Bangladesh

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Abstract
A study on the monthly abundance of benthic fauna in accordance with different depths related to physico-chemical characteristics of water was conducted in the Bangladesh Agricultural University Fish Farm Pond, Mymensingh, during the period from July to December, 2007. During the study period monthly sampling of benthic fauna were collected from three depth ranges 100-170 cm, 170-230 cm and 230-290 cm from three stations (east, middle and west) in the pond and the samples were analyzed. Monthly changes in physico-chemical characteristics were observed in the ponds which were divided into three treatments (1 meter, 2 meters and maximum depth) from three stations. Twelve genera such as *Branchiura, Ophidonais, Dero, Choaborus,* Aelosoma, *Peloscolex, Chironomus, Pelopia, Vviparous, Pila, Planorbis* and *Lymnaea* under three groups such as Oligochaeta, Chironomidae and Mollusca were encountered during the study period. The successive position of five genera such as *Branchiura, Ophidonais, Chironomus, pelopia and Dero* were found the most dominant genera. Benthos was most dominant in treatment II followed treatment I and III. The benthic fauna was mostly made up of Oligochaetes, Chironimids and Mollusks constituting the most dominant groups. The maximum number of organisms (Number/m^2) was collected in July followed by October, November, August, September and December in the pond. The fluctuations of benthic fauna were found to be more or less related to pH, temperature, dissolved oxygen and as well as depth of the water body. Stations, where raw cow-dung was used as fertilizer, resulted in dead gastropods.

Keywords: Benthic fauna, water quality parameters, fish farm

Introduction

Fisheries are one of the sub-sectors of agriculture which plays a very important role in the socio-economic development of Bangladesh. Fish contributes about 60% of animal protein to our daily diet, 5% to our gross national production (GNP) and 16.71% to Agricultural production (DoF, 1998) [1]. About 10% of total population of Bangladesh is directly or indirectly dependent on fisheries sector for their livelihood. It provides employment for about 1.2 million full time and 12 million part time fishermen and others related to fisheries sector (DoF, 1998) [1]. However, the food requirement as well as the protein requirement in our everyday diet is declining day by day. Population growth and malnutrition problem is most alarming now. So, effective measures should be taken to increase the fish production to meet these requirements through aquaculture.

By studying the food and the feeding habits, one can easily ascertain, at least to some extent, what are the most important food organisms and what measures should be taken to grow them abundantly in the fish ponds. The growth of fish depends upon the availability of food organisms namely, plankton and benthos, the growth of which again depends on soil conditions and physico-chemical characteristics of pond water. Hoskin (1977) [2] reported that fish culture can be enhanced by the improvement of the substratum by the use of fertilizers along with other pond management measures. Also, numerous evidences are there to show that scientific culture and efficient management of fisheries can provide excellent yields. Benthos is an important part of the pond ecosystem. In scientific culture and management of fisheries resources, there is great need for the understanding of bottom fauna as they play an important role in the aquatic environment. The benthos, as being defined as that assemblage of animal living in or on the sediments and depend upon the decomposition cycle for most if not all of its basic food supply (Brinkhurst, 1974) [3].

A major component of any aquatic ecosystem, the benthic fauna constitute an important food items for many fishes including carps and thus play an important role in aquatic food chains (Petr, 1968) [4]. Benthic organisms are rich in amino acids, fatty acids, vitamins, minerals, etc. and these can alone provide complete diet for many bottom dwelling fishes as well as catfishes. Benthos is not only important food item of fishes it is also an indicator of productivity of a water body (Dewan, 1973) [5]. The abundance and distribution of different species of benthic fauna vary from one depth range to another (Habib, 1981) [6] due to their differential biological nature. They are important to the aquatic environment as they take part in nutrient release from the bottom sediments into the overlying waters, so as to enrich the water bodies. However, it is noteworthy to assume that the growth, quantity and abundance of benthic fauna fluctuate due to variation of the inherent physico-chemical factors of the soil (pond mud) (Banerjea, 1967) [7]. The physico-chemical characteristics of pond water, being in close contact with pond mud, the biogeochemical cycles of chemical factors of pond water are more or less a reflection of the properties of the bottom soil and water play the most important role in governing the production, abundance and growth of aquatic organisms, especially plankton and benthos. Much of the work on freshwater benthic fauna had been done on lakes and reservoirs (Oliver, 1960; Buscemi, 1961) [8-9]. In India, Srivastava (1950), Micheal (1968), Mandal and Moitra (1976) [10-12] have studied the bottom fauna of freshwater ponds. Here, it could be mentioned that the systematic studies of freshwater Oligochates from Dacca city by Ali and Ishaque (1975) [13] and from Dhanmondi lake by Ali and Rashiduzzaman (1976) [14] were the pioneering works in Bangladesh. Few attempts have been made to study the benthic ecology by Mollah and Haque (1978) [15], Ali and Begum (1978) [16] and Habib, (1981) [6] in the fish ponds in and around Bangladesh Agricultural University campus. But these are lacking in focusing any contribution of benthos to the diet of cultured fishes. The present work was, therefore, undertaken to study the monthly abundance of various benthic organisms and relate to water characteristics with a view to find out the relationship between them in the Bangladesh Agricultural University Fish Farm pond, Mymensingh.

Materials and Methods

Descriptions of pond

Study area

The study was conducted in a Fish Farm pond in Bangladesh Agricultural University campus, located three miles south of Mymensing town on the western side of the river old Brahmaputra and situated between latitude $25^0$25’ and $25^0$25’ and longitude $89^0$38’ and $91^0$15’ for a period of six months from July to December 2007. The average elevation of the area is 11.59 meter above the sea level (Habib, 1981) [6].

The experiment was conducted at 6 selected ponds of fisheries faculty which were L-shaped, covering an area of 6.0 acres approximately and was more or less surrounded by other small ponds. The basin was gradual, having partly unbroken embankment and mostly sandy and clayish bottom. The depth of water at the sampling stations was found to range from 100-270 cm. The water was semi bluish in color and almost free from any vegetation except very few in the shallow shore area (only some *Eichhornia* sp; *Leersia hexandra*; *Polygonum* sp etc. were found).

Location of the sampling stations

Collection of the samples was made from three locations of a pond. Each location there was three treatments namely T-I at 1 meter depth and T-II in 2 meter depth and T-III in maximum depth (2.9 m) in the pond.

Sampling procedure

Water quality parameters

Water quality monitoring

Water quality measurements and sample collection were made between 9.00 and 10.00 am on each sampling day. Transparency (cm), water temperature (^{0}c), pH and dissolved oxygen (mg/L) were measured by standard Secchi disc of 20 cm diameter, centigrade thermometer, pH meter (Jenway model 3020, USA) and dissolved oxygen meter (YST MODEWL 58, USA) respectively during each sampling day at the pond site.

Collection of benthic fauna

Benthic samples were collected from nine locations of three stations with the help of Ekman-dredger covering an area of 225 cm^2. Contents of the dredge, along with any materials caught, were transferred to a bucket and taken to the shore for washing. Each sample was then washed through a series of standard brass sieves of mesh size 0.5, 1.0 and 2.0 mm. The benthic residue under contrasting background of black and white was observed for benthos and any benthos found were collected by means of fine forceps and kept into separate vials containing 10% formalin for preservation (Wetzel and Lickens, 1979) [17]. These vials were marked properly with a marker pen and taken to the laboratory for analysis. In the same way benthos were collected from different locations in a sampling.

Separation of benthic fauna

The samples were kept for 48 hours in the laboratory to allow the animals for hardening (Maitland, 1979) [18]. The preserved animals were then transferred to a petridish and washed with tap water to remove the remaining washable detritus and mud. Then the benthic fauna were cleared by means of distilled water and then separated the organisms from each other with the help of sorting needles and fine forceps, which were again sorted into major taxonomic groups by means of hand lens and low-power-microscope (magnification:10×10) wherever necessary. Then the organisms were counted according to different taxonomic groups and preserved group wise in 10% formalin into vials and labeled properly for further study.

Identification and counting of benthic fauna

The preserved specimens were identified under a dissecting microscope. The preserved specimens were taken out from preservative (10% formalin) and kept on tissue paper for drying. Then the worms and larvae were placed on a clean slide with a few drops of polyvinyl lactophenol and covered with a coverslip. Care was taken to avoid air bubbles before placing the coverslip. Then the slides were kept in disturbed in the laboratory for 24 hours for making the specimens transparent for proper identification. A binocular microscope (NOVA ES-950 U.S.A.) was used to identify the specimens. Then the benthic organisms were identified and counted according to different taxonomic groups and genera. Identification was done according to Chu (1949) [19], Pennak (1953) [20], Usinger (1963) [21], Needham (1966) [22] and Brinkhurst (1974) [3]. The number of benthos in respect of genera or total abundance was expressed as follows:

Number of benthos/m^2 = Number found in one sample x 44.44.

Result and Discussion

Water Quality Parameters

Among water quality parameters only temperature, transparency, pH and dissolved oxygen were measured during the experimental period which are briefly presented further down (Table 1).

Table 1: Monthly variation in water quality parameters in a BAU fish farm pond during the study period from July to December, 2007.

Parameters		Months					
		July	August	September	October	November	December
Transparency (cm)	Location-I	129	126	125	128	127	82
	Location II	126	123	128	129	128	85
	Location III	119	111	129	127	128	76
Temperature (^{0}C)	Location-I	27	29	27	28	29	26
	Location II	28	29.5	26	27	29	27
	Location III	28	30	27	27	27	26
D.O (mg/L)	Location-I	7.98	8.1	7.47	7.75	7.57	7.6
	Location II	9.23	9.78	8.22	8.15	8.51	8.36
	Location III	10.1	10.91	8.98	7.94	7.93	9.4
P^H	Location-I	7.23	7.16	7.12	8.22	7.97	7.85
	Location II	7.30	7.82	8.25	7.87	8.12	7.88
	Location III	8.12	8.32	7.87	7.68	7.99	7.95

Transparency (cm)

The maximum value of water transparency (129 cm) was in July and the minimum (82 cm) in December in location-1. In location-2, maximum transparency (129cm) was observed in October and the minimum (85 cm) in December (Table-1). A maximum (129 cm) and a minimum (76 cm) transparency were recorded in September and December in location-3 respectively (Table-1) with mean values of (128cm) in October and (81cm) in December (Table-1).

Temperature (^{0}C)

Water temperature plays a vital role in aquatic production through influencing physical, chemical and biological conditions of a water body. Optimum temperature helps to obtain maximum production. The water temperature was found to vary from 26 ^{0}C to 29 ^{0}C, 26 ^{0}C-29.5 ^{0}C and 26 ^{0}C-30 ^{0}C, in different locations 1, 2 and 3 respectively during the experimental period (Table-2). The mean values of water temperature were 29.5 ^{0}C and 26.33 ^{0}C in the month of August and December, respectively.

Dissolved oxygen (mg/L)

Dissolved oxygen concentration in all locations showed an irregular pattern of fluctuation from the beginning to the end of the experiment without definite seasonal treads. In location -1, the maximum value (8.10 mg/L) was recorded in August and minimum (7.47 mg/L) on September (Table-1). In location-2, the maximum value (9.78 mg/L) was recorded on August and the minimum (8.15 mg/L) in October. The highest value (10.91 mg/L) of dissolved oxygen was recorded in August and the minimum (7.93 mg/L) on November in location -3 with mean values of 9.60 mg/L in August and 7.95 mg/L on October (Table-1).

Hydrogen-ion concentration (pH)

The maximum and minimum values of pH were recorded in August and September respectively in all the treatments. In location-1, the highest and the lowest values of pH were found as 8.32 and 7.12 respectively (Table-1). In location -2 higher values was recorded as 8.25 and the lowest value was 7.30 whereas 8.32 and 7.68 were found the maximum and minimum values respectively in location -3 (Table-1). The mean values of pH were recorded ranging from 7.55 in July to 8.03 in November (Table-1).

Water quality parameter plays an important role on the growth and abundance of benthos as well as on the growth and production of fish and other aquatic organisms. The suitable water quality parameters are prerequisites for a healthy aquatic environment and for the production of sufficient fish food organisms. The primary productivity of a water body depends on the physical, chemical and other factors of the environment (Rahman, 1992) [23]. Water temperature is an important physical parameter having the greatest direct effect on primary production of water body. In the present study, average water temperature was found to vary from 26.33 ^{0}C to 29.5 ^{0}C.The highest temperature was found in August and lowest on December. Ehshan *et al.* (1997) [24] have found highest water temperature (31.7 ^{0}C) in June and the lowest (25.2 ^{0}C) on January in Chanda beel. The range of transparency was found 76 to 129 cm in the present study. Water transparency is affected by several factors such as site, microscopic organisms, suspended organic matters, seasons of the year, latitude and intensity of incident light, grazing pressure of fishes and rainfall. Rahman (1992) [23] has stated that the transparency of a productive water body should be 40 cm or less. On the basis of above observation, the transparency values of this study were not within the productive range. pH is an important factor in the aquatic environment. In the present study, the value of pH ranged from 7.12 to 8.32. The highest pH was in August and lowest was in September. Ehshan *et al.* (1997) [24] have observed the pH values remained around neutral throughout the study period in Chanda *beel.* He observed that the highest pH value (7.46) was the highest in the month of January. Requirements of dissolved oxygen by fish vary with temperature, physiological activities, age, time of day, species, season, food consumption etc. A general statement of Ellis *et al.* (1946) [25] on dissolved oxygen requirement, which is very important for warm water fishes, is that "dissolved oxygen at levels of 3 mg/L or less should be regarded as hazardous to lethal under average stream and lake conditions, and that 5 mg/L or more dissolved oxygen should be present in water, if condition are to be favorable for freshwater fishes. Ahmed *et al.* (1999) [26] have recorded dissolved oxygen level ranging from 6.4 to 9.1 mg/L in Kaptai lake. Ehshan *et al.* (1997) [24] recorded dissolved oxygen content prevailing around or above 6 mg/L in Chanda *beel* situated in Faridpur-Madaripur area. In the present study, the highest value (9.60 mg/L) and lowest value (7.95 mg/L) of dissolved oxygen were recorded on August and on October respectively which agreed with the findings.

Benthic fauna

A total number of 12166.58 benthic organisms/m^2 were obtained during the whole experimental period from the selected pond in three locations comprising eleven genera such as *Ophidonais Branchiura, Peloxcolex, Dero, Aelosoma, Chaoborus Lymnaea,* under Oligochaeta, *Chironomus, Pelopiai,* under Chironomidae*;* and *Viviparous, Planorbis, Pila* under the Mollusca were recorded. The Total number organisms average number/m^2 and percentage composition of different genera presented in Table 4. In T- I (1 m) a total 4205.89 /m^2 of benthic organisms were found, the maximum abundant of benthic fauna was recorded (1246.90 /m^2) in the month of July, 2007 and minimum abundance was (224.21 /m^2) on December, 2007. In T- II (2 m depth) a total of 4149.17 /m^2 of benthic organisms were found where the highest number was (1154.05 /m^2) on October and the lowest was (391.11 /m^2) on December, 2007. In T- III (maximum depth) total 3811.52 /m^2 benthos was observed, among them highest number (862.41/m^2) on October and lowest (356.58 /m^2) benthic organisms were found on December, 2007. Among the three treatments the highest abundance (4205 /m^2) of benthos was observed in the T- I (1 meter depth) and the lowest was (3811.52 /m^2) in T- III (Table 2).

Table 2: Depth wise distribution of benthos (Number /m^2) in a BAU Fish Farm pond during the study period from July to December, 2007.

Benthos	Treatment	Study period						Average total (No./m^2)	Percentage (%)	Average mean (No./m^2)
		July	August	September	October	November	December			
Branchiura	T-I	234.35	32.18	175.92	221.43	174.79	42.65	146.87	7.24	156.00
	T-II	152.09	206.70	93.21	216.53	132.35	87.80	148.11	7.30	
	T-III	131.12	234.48	161.42	234.84	102.06	174.03	172.99	8.53	
Ophidonais	T-I	310.05	175.60	103.44	250.95	592.37	54.92	247.88	12.22	201.57
	T-II	57.00	173.72	101.68	354.45	413.55	55.95	192.72	9.50	
	T-III	174.22	73.28	311.86	293.92	131.35	00.00	164.10	8.09	
Dero	T-I	34.56	24.10	14.12	43.76	00.00	43.87	26.72	1.31	25.29
	T-II	87.64	19.31	34.02	73.84	19.21	4.49	39.75	1.96	
	T-III	43.88	44.72	34.46	48.75	4.36	00.00	29.36	1.44	
Peloxcolex	T-I	131.98	13.01	12.71	25.60	12.92	00.00	32.70	1.61	4.21
	T-II	14.10	13.70	13.74	13.19	13.11	00.00	11.30	0.55	
	T-III	144.50	85.42	27.72	25.38	00.00	9.74	48.79	2.40	
Aelosoma	T-I	174.73	73.54	28.22	28.22	00.00	13.07	52.96	2.61	40.20
	T-II	57.65	73.30	28.42	57.59	00.00	00.00	36.15	1.78	
	T-III	102.60	00.00	00.00	86.30	00.00	00.00	31.48	1.55	
Chironomous	T-I	161.22	56.71	72.16	143.85	27.42	42.64	83.99	4.14	102.84
	T-II	102.00	145.90	56.96	290.20	86.49	174.44	142.66	7.03	
	T-III	102.65	115.91	72.17	43.13	102.08	55.29	81.87	4.03	
Pelopia	T-I	87.13	29.62	24.67	131.79	00.00	27.05	50.04	2.46	48.81
	T-II	86.76	44.44	26.21	42.36	00.00	00.00	33.29	1.64	
	T-III	27.55	133.32	12.74	72.25	57.93	74.86	63.11	3.11	
Choaborus	T-I	27.94	14.81	12.24	42.96	13.50	00.00	18.57	0.91	25.70
	T-II	56.92	74.06	41.62	41.23	28.04	00.00	40.31	1.98	
	T-III	44.44	25.62	00.00	25.61	13.55	00.00	18.20	0.89	
Viviparous	T-I	27.63	29.62	25.82	11.16	13.05	00.00	17.88	0.88	17.13
	T-II	14.18	12.20	13.67	26.26	42.04	42.04	25.06	1.23	
	T-III	8.90	00.00	00.00	00.00	12.96	28.78	8.44	0.41	
Lymnaea	T-I	43.80	00.00	12.22	27.90	28.36	00.00	18.71	0.92	109.17
	T-II	00.00	00.00	00.00	9.87	41.98	26.39	13.04	0.64	
	T-III	00.00	14.18	00.00	13.67	00.00	00.00	4.64	0.22	
Planorbis	T-I	13.50	00.00	00.00	14.06	00.00	00.00	4.59	0.22	8.64
	T-II	13.75	00.00	12.27	28.50	00.00	00.00	9.08	0.44	
	T-III	28.45	00.00	00.00	18.53	12.61	13.85	12.24	0.60	
Total		2697.28	1939.30	1523.76	2958.18	2076.13	971.91	2027.76	100	
Percentage		22.17	15.94	12.52	24.31	17.06	7.98	100	Grand total	
	T-I	1246.90	449.10	481.54	941.71	862.42	224.21	4205.896		12166.58
	T-II	642.10	763.30	421.83	1154.05	776.79	391.11	4149.174		
	T-III	808.30	726.90	620.39	862.41	436.91	356.58	3811.512		
Grand Total		2697.28	1939.30	1523.76	2958.18	2076.13	971.9167			

In the present study, five dominant genera of benthos such as *Branchiura Ophidonais, Chironomus, Dero* and *Pelopia* were recorded. Total number, average number/m^2 and percentage composition of five genera are given in Table 3.

Table 3: A comparative study of five dominant genera of three treatments during the study period from July to December, 2007

Benthos	Treatment	Study period						Ground total (No)
		July	August	September	October	November	December	
Ophidonais	T-I	310.05	175.60	103.44	250.95	593.30	54.92	3628.31
	T-II	57.00	173.72	101.68	354.45	413.55	55.95	
	T-III	174.22	73.28	311.86	293.92	131.35	00.00	
	Total	541.27	422.6	516.98	899.32	1137.27	110.87	
Branchiura	T-I	237.01	32.18	175.92	221.43	174.79	40.20	2807.95
	T-II	152.09	206.70	93.21	216.53	132.35	87.80	
	T-III	131.12	234.48	161.42	234.84	102.06	174.03	
	Total	517.56	473.36	430.55	672.8	409.2	304.48	
Chironomous	T-I	161.22	56.71	72.16	143.85	25.31	42.64	1851.22
	T-II	102.00	145.90	56.96	290.20	86.49	177.76	
	T-III	102.65	115.91	72.17	43.13	102.08	55.29	
	Total	365.87	318.52	201.29	477.18	215.99	272.37	
Dero	T-I	34.56	24.10	14.12	43.76	00.00	43.87	575.09
	T-II	87.64	19.31	34.02	73.84	19.21	4.49	
	T-III	43.88	44.72	34.46	48.75	4.36	00.00	
	Total	166.08	88.13	82.6	166.35	23.57	48.36	
Pelopia	T-I	87.13	29.62	24.67	131.79	00.00	27.05	878.68
	T-II	86.76	44.44	26.21	42.36	00.00	00.00	
	T-III	27.55	133.32	12.74	72.25	57.93	74.86	
	Total	201.44	207.38	63.62	246.4	57.93	101.91	

Group wise abundance of benthic fauna

Oligochaeta

Under the group Oligochaeta the abundance of benthos varied in three different treatments. Total 4190.24 /m^2 Oligochaeta were found. In the T-I the maximum abundance (885.70 /m^2) of Oligochaetes were observed on July and minimum (154.52 /m^2) were observed on December, 2007. In the T-II, 715.61 /m^2 was the maximum on October and 148.23 /m^2 was the minimum on December, 2007. In the T-III the highest abundance was 689.21 /m^2 on October and the minimum abundance was 183.78 /m^2 in the month of December, 2007 (Table- 4).

Chironomids

The benthos under the group Chironomid total 4150.31 /m^2 were recorded. In the T-I the maximum abundance was 318.61 /m^2 in the month of October where 40.92 /m^2 was the minimum on November, 2007. In the T- II the maximum abundance was 373.80 /m^2 on October and minimum was 114.53 /m^2 on November, 2007. In the T-III the maximum abundance was 274.84 /m^2 on August and the lowest 84.91 /m^2 were on September, 2007 (Table 4).

Mollusca

The molluscan benthos showed variation in abundance on different months and treatments. Total 3826.01 /m^2 Mollusca were found. In the T-I the highest abundance was 84.92 /m^2 on July where the minimum abundance was 00.00 /m^2 on December, 2007. In the T-II the highest was 84.03 /m^2 on November and lowest was 12.20 /m^2 on August, 2007. In the T-III the highest number was 42.64 /m^2 on December and lowest was 00.00 /m^2 was on September, 2007 (Table 4).

In T-I, the total number of benthic organisms was 4205.89 /m^2 and in treatment II total number of benthic organisms was 4149.17 /m^2 and in treatment III the organisms was 3811.51 /m^2. I showed higher abundance of benthos than treatment II and III. Three groups of macrobenthos had been reported earlier by Das and Islam (1983) [27], Habib *et al.,* (1986) [28] and Shamsi and Jafri (1994) [29] from tropical freshwater pond, Ignat *et al.* (1994) [30] from Delta Lake. The possible cause of the occurrence of these groups of benthic fauna might be due to the suitable and favorable ecological condition of the ponds that favored their growth. Olighcoaeta was the most dominant group than other two groups of benthos. This might be due to ecological suitability, food availability and breeding facilities for Oligocheates in comparison to other two groups. Bais *et al.,* (1992) [31] have found that Oligochaeta was the most dominant groups of benthos in lake. In the present study Oligochaeta was higher dominant in treatment I than treatment II and III. This might be due to higher preference to graze of carp fishes to Oligochaeta. *Branchiura* was higher dominant in treatment III than treatment I and II. This might be due to suitable bottom condition and less grazing pressure of tilapia on *Branchiur A.* Chironomidae ranked the second dominant group of benthic fauna in both treatment recorded during the study period. Chiromidae was higher in treatment II than treatment I and III. Khan (1990) [32], Das (1997) [33] and Rahman (1992) [23] support this finding. This might be due to higher grazing pressure of carps on Chironomidae. The dominant genera of Chironomidae was *Chironomus*. Habib (1981) [6] has stated that the highest number of chironomids and oligochaetes were collected in the pond which was due to the bottom type, light penetration, almost alkaline pH. *Chironomus* was also higher in T- II than T-I and T-III. This might be due to higher grazing pressure of carps on *Chironomus* and suitable ecological conditions. Mollusca was the least abundant benthic group recorded during the study period in both the treatment. This was probably due to their inability to thrive the adverse environmental conditions and migration from one pond to another pond for better life. The abundance of Mollusca was higher dominant in T-I than T-II. This finding was more or less similar to the findings of Khan (1990) [32] and Das (1997) [33]. This might be due to no grazing pressure of cultured species such as tilapia *(Oreochromis niloticus*), silver carp (*Hypophthalmichthys molitrix*), rui (*Labeo ruhita*) and mrigal (*Cirrhinus mrigala*). *Viviparous* was dominant under the group of mollusca. *Viviparous* was higher dominant in T-I than T-II and T-III.

Table 4: A comparative study of three groups of benthos of six sampling during the study period from July to December, 2007

Group name	Benthic organisms	Treatment No	Sampling months						Average Total	(%)	Average/m²	Grand total (No/m²)
			July	August	September	October	November	December				
Oligochaeta	*Branchiura*	T-I	234.35	32.18	175.92	221.43	174.79	42.65	146.89	10.62	155.99	4205.89
		T-II	152.09	206.70	93.21	216.53	132.35	87.80	148.11	10.72		
		T-III	131.12	234.47	161.42	234.85	102.06	174.04	172.99	12.52		
	Dero	T-I	34.60	24.02	14.12	43.76	00.00	43.87	26.72	1.94	31.94	
		T-II	87.63	19.31	34.03	73.84	19.21	4.49	39.75	2.88		
		T-III	43.88	44.72	34.47	48.75	4.36	00.00	29.36	2.12		
	Ophidonais	T-I	310.05	175.60	103.44	250.95	592.37	54.92	247.89	17.93	201.57	
		T-II	57.00	173.72	101.68	354.45	413.55	55.95	192.73	13.95		
		T-III	174.22	73.27	311.86	293.92	131.35	00.00	164.10	11.87		
	Aelosoma	T-I	174.73	73.54	28.22	28.22	00.00	13.08	52.96	3.83	40.20	
		T-II	57.65	73.29	28.42	57.59	00.00	00.00	36.16	2.61		
		T-III	102.60	00.00	00.00	86.30	00.00	00.00	31.48	2.27		
	Peloscolex	T-I	132.00	13.01	12.71	25.60	12.92	00.00	32.70	2.36	30.93	
		T-II	14.10	13.69	13.74	13.19	13.11	00.00	11.30	0.82		
		T-III	144.50	85.42	27.72	25.38	00.00	9.74	48.79	3.53		
	Total	Monthly total	1850.5	1242.93	1140.91	1974.77	1596.08	486.54	1381.94	100		
		T-I	885.70	318.34	334.41	569.96	780.10	154.52	Total Oligochaeta			
		T-II	368.48	486.71	271.08	715.61	578.22	148.23	4205.89			
		T-III	596.32	437.88	535.47	689.21	237.77	183.78				
Chaironomid	*Choaborus*	T-I	27.94	14.81	12.24	42.96	13.50	00.00	18.58	3.49	25.69	4149.17
		T-II	56.92	74.06	41.62	41.23	28.04	00.00	40.31	7.58		
		T-III	44.44	25.61	00.00	25.61	13.55	00.00	18.20	3.42		
	Chironomus	T-I	161.21	56.71	72.16	143.85	27.42	42.65	83.99	15.79	102.84	
		T-II	102.00	145.90	56.96	290.20	86.49	174.44	142.66	26.82		
		T-III	102.65	115.91	72.17	43.13	102.08	55.29	81.87	15.38		
	Pelopia	T-I	87.13	29.62	24.67	131.79	00.00	27.05	50.04	9.41	48.81	
		T-II	86.76	44.44	26.21	42.36	00.00	00.00	33.29	6.25		
		T-III	27.55	133.32	12.74	72.25	57.93	74.86	63.11	11.86		
	Total	Monthly total	696.59	640.37	318.79	833.42	329.02	374.30		100		
		T-I	276.27	101.14	109.08	318.61	40.92	69.70	Total Chaironomids			
		T-II	245.67	264.40	124.80	373.80	114.55	174.44	4149.17			
		T-III	174.64	274.84	84.91	141.00	173.57	130.16				
Mollusca	*Viviparous*	T-I	27.62	29.62	25.82	11.16	13.06	00.00	17.88	15.73	17.12	3811.51
		T-II	14.18	12.20	13.67	26.26	42.05	42.05	25.07	22.05		
		T-III	8.89	00.00	00.00	00.00	12.97	28.78	8.44	7.43		
	Planorbis	T-I	13.50	00.00	00.00	14.07	00.00	00.00	4.59	4.04	8.64	
		T-II	13.75	00.00	12.27	28.50	00.00	00.00	9.08	8.00		
		T-III	28.44	00.00	00.00	18.53	12.61	13.85	12.24	10.76		
	Lymnaea	T-I	43.80	00.00	12.22	27.90	28.36	00.00	18.71	16.46	12.131	
		T-II	00.00	00.00	00.00	9.87	41.99	26.39	13.04	11.47		
		T-III	00.00	14.18	00.00	13.67	00.00	00.00	4.64	4.08		
	Total	Monthly total	150.19	14.18	64.00	149.96	151.03	111.07	113.70	100		
		T-I	84.92	29.62	38.05	53.13	41.42	00.00	Total Mollusca			
		T-II	27.93	12.20	25.94	64.63	84.03	68.43	3811.51			
		T-III	37.34	14.18	00.00	32.20	25.58	42.64				
Total-I			1246.90	449.09	481.5	941.714	862.42	224.21	4205.89			12166.58
Total –II			642.077	763.30	421.82	1154.05	776.79	391.11	4149.17			
Total –III			808.30	726.90	620.39	862.41	436.91	356.58	3811.51			

Conclusion
Variations in the abundance of benthic organisms were found correlated with water parameters (transparency, temperature, pH and DO) and organic debris content. The production of benthic organisms were found to increase with lesser water depth (100~170), higher temperature, higher pH and higher organic debris. The higher production of benthic fauna as live fish food will accelerate the growth of bottom feeder fishes which result higher fish production. This knowledge therefore might be helpful for fish farmers and aquaculturists to increase fish production of Bangladesh.

Conflict of interest
The authors declared that they have no confliction interests.

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