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PLANKTON COMPOSITION, ABUNDANCE AND DIVERSITY IN HILSA (*TENUALOSA ILISHA*) MIGRATORY RIVERS OF BANGLADESH DURING SPAWNING SEASON

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Abstract

Hilsa (*Tenualosa ilisha*) is one of the flagship diadromous fish species of Bangladesh that migrate only through the Ganges-Meghna river system route. The biological profile of plankton from the Padma, Meghna and Tetulia reference river sites during 2011 spawning season of hilsa showed that in total of 58 taxa of plankton were present. Of which, 19 taxa (32.76%) were of phytoplankton and 39 taxa (67.24%) of zooplankton. Phytoplankton group belonged to Cyanophyceae (6 taxa), Chlorophyceae (7 taxa) and Bacillariophyceae (6 taxa) while zooplankton including Protozoa (10 taxa), Rotifera (19 taxa), Copepoda (4 taxa), Cladocera (5 taxa) and Ostracoda (1 taxon). The average abundance of plankton was recorded as 194.05 ± 82.58 indiv/l. The highest abundance of total plankton (692 indiv/l) was observed in Godagari, Rajshahi (Station 3) and was lowest (4.00 indiv/l) in Charghat, Rajshahi (Station 2). The highest abundance (49 indiv/l) of total zooplankton was observed in Godagari and lowest (1 indiv/l) in Charghat with mean value of 19.46 ± 4.12 indiv/l. The highest species richness (SR = 45) was observed in Daulotkhan, Vhola (Station 9) and the lowest (SR = 3) in Charghat (Station 2), with mean value of 17.10±4.408. Shannon-Weiner species diversity index (H') ranged from 3.334 in Daulotkhan (Station 9) to 1.5 in Charghat, (Station 2) with mean value of 2.717 ± 0.147. Based on the plankton profile it may be concluded that the biological quality of hilsa migratory river was not alike throughout the route which may restrict the migration up to up steam and spontaneous spawning of hilsa.

Introduction

Biological potentiality of an aquatic ecosystem depends on the biomass of plankton. The knowledge on the abundance, composition and seasonal succession of the same is a prerequisite for the successful management of an aquatic ecosystem. Phytoplankton are the primary producers for the entire aquatic body and comprise the major portion in the ecological pyramids(1). The community of phytoplankton especially the different species of diatoms are also used as indicator of water pollution(2). In the consumer food chain of aquatic ecosystems zooplankton play an important role in the transfer of energy from the

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primary producer to fish. They play an important role in the natural food chain which constitute important food item of omnivorous and carnivorous fishes. To a large extent production of fish is dependent on the plankton community.

Information on the productivity of the lotic waters of Bangladesh in relation to biological factors is very scanty[3], a few belongs to the study on river systems[4-9].

The confluences of Padma-Meghna and Tetulia river is a very significant water body. It plays an important role as the major nursery and breeding ground of national fish, hilsa (*Tenualosa ilisha*) and many other commercially important riverine fishes[10]. Hilsa is primarily a plankton feeder and its food includes blue green algae, diatoms, desmids, copepods, cladocera, rotifera etc.[11]. Hence, studies on the planktonic organisms are necessary especially in fishery science, to understand their dynamics. So, the present work was undertaken to know the species composition, abundance and diversity of plankton in the riverine route of hilsa particularly in the Padma, Meghna and Tetulia river of Bangladesh during spawning season.

Materials and Methods

Ten sampling stations were selected in the river Padma, Meghna and Tetulia. They were: Padma river: (1) Poba; (2) Charghat and (3) Godagari of Rajshahi; Meghna river: (4) Mawa ghat of Munshiganj (Padma river); (5) Charvoirobi and (6) Madrasaghat of Chandpur; Tetulia river: (7) Bauphol of Patuakhali (Tetulia river); (8) Tajumuddin; (9) Daulotkhan and (10) Lalmohon of Bhola district.

Plankton samples were collected on 15/09/11, 23/09/11, 30/09/11 and from 06/10/11 to 16/10/11. Collection of plankton was made by sieving 50 litres of habitat water from approximately 10 - 12 cm below the surface level passed through a 25 μm mesh net and finally concentrated to 25 ml. The population of plankton accumulated in the container were then transferred to other bottle and immediately preserved in 4% formalin, labeled and then transferred to laboratory for further experimentation. Each sample was stirred smoothly just before microscope examination. One ml from agitated sample was transfer to a Sedge-wick Rafter counting cell with a wide mouth graduated pipette. The abundance of plankton was estimated by counting their presence per focus of the microscopic field. Plankton were identified by several workers[12-15]. The total number of plankton per litre of water were estimated by the following formula:

$$N = \frac{A \times C}{L}$$

where, A = Average number of plankton counted per ml concentrated sample, C = Volume of concentrated sample in ml, L = Volume of original water in Litre passed through the plankton net, N = Total number of plankton per liter of original water.

Shannon-Weiner diversity index (H`) and evenness (J`) were also estimated. Diversity index of plankton during each month was calculated by using the formula:

$$H \text{ or } H` = -\sum_{i=1}^{s} (pi)(\log_2 pi)$$

where, S= number of species, *p*i = the proportion of individuals belonging to i^{th} species.

Species evenness (J`) was calculated from the observed species diversity and from the equation of Hmax[16]. Index of species evenness was measured by using the following formula:

$$J` = \frac{H`}{H\,max}$$

where, H` = Observed species diversity, H max = Maximum species diversity = Log_2 S where, S = The number of species in the community. Statistical analysis was done using SPSS, a computer based program for Windows (Version 11.5, 2007. Systat, Inc. USA).

Results and Discussion

Results indicated the occurrence of 58 taxa in which 19 were of Phytoplankton and 39 of zooplankton. Phytoplankton belonged to Cyanophyceae, Chlorophyceae and Bacillariophyceae (Table 1) while zooplankton including Protozoa, Rotifera, Copepoda, Cladocera and Ostracoda (Table 2). In the present study zooplankton formed 67.24% and phytoplankton formed 32.76% of total plankton taxa (Fig. 1). The highest number of phytoplankton taxa (17) were recorded in Daulotkhan (Station 9) and it was lowest (1 taxon) in Poba (Station 1, Table 1) while maximum number of zooplankton taxa (28) were found in Daulotkhan (Station 9) and it was found lowest(1) in Charghat (Station 2, Table 2). The average abundance of total plankton was recorded as 194.05 ± 82.58) indiv/l. Among the station the highest abundance of total plankton (692 indiv/l) was observed in Godagari (Station 3) and it was lowest (4.00 indiv/l) in Charghat (Station 2, Table 3). Such variations in population may be due to variation in nutrient and other favorable conditions of water during plankton production.

Among 19 taxa of phytoplankton, 6 belonged to Cyanophyceae, 7 to Chlorophyceae and 6 to Bacillariophyceae (Table 1). A study on Halda river recorded the phytoplankton population as algal flora under the classes Chlorophyceae, Cyanophyceae, Bacillariophyceae and Myxophyceae[6]. In the present investigation phytoplankton formed 90% of the total plankton abundance (Fig. 1C). Shafi *et al.*[4] reported as higher percentage composition of phytoplankton (76.0 - 93.6%) from the Meghna river. The highest phytoplankton abundance (643.00 indiv/l) was observed in Godagari (Station 3) and lowest (1 indiv/l) in Poba (Station 1, Fig. 2). The average abundance of total

phytoplankton was recorded as 174.59 ± 79.21 indiv/l (Table 3). Phytoplankton abundance is discussed in the following headings:

Cyanophyceae: Cyanophyceae was the most dominant group among phytoplankton and it formed 84% of the total phytoplankton abundance (Fig. 1A). Representatives of Cyanophyceae were present in all the stations except Poba (Station 1), Charghat (Station 2) and Mawaghat (Station 4) during the study period. In Godagari (Station 3) the highest density of Cyanophyceae was recorded as 561.00 indiv/l and it was lowest (1 indiv/l) in Lalmohon (Station 10). The highest population of cyanophyceae in Godagari (Station 3) may be due to variation in nutrient and other favorable conditions of water during plankton production. In case of all ten stations combined, the average value of Cyanophyceae was recorded as 147.72 ± 72.16 indiv/l (Table 3).

Chlorophyceae: Chlorophyceae was the least dominant group and it constituted 5% of the total phytoplankton abundance (Fig. 1A). Mahmud et *al*.[9] found Chlorophyceae as the most dominant group among phytoplankton abundance from Mouri river of Khulna. The abundance of Chlorophyceae ranged from 1 indiv/l in Poba (Station 1), Charghat (Station 2), Bauphol (Station 7) and Lalmohon (Station 10) to 21 indiv/l in Godagari (Station 3) and Charvoirobi (Station 6) respectively. In all the stations combined average Chlorophyceae abundance was found to occur 9.44 ± 2.69 indiv/l (Table 3).

Bacillariophyceae: Bacillariophyceae formed 11% of the total phytoplankton abundance and it placed 2nd in position among phytoplankton abundance (Fig. 1A). Similar result also reported from Mouri river of Khulna[9]. In the present study the representative of Bacillariophyceae was found in all the stations except Poba (Station 1) with mean value of 18.44 ± 6.34 indiv/l. The highest abundance of Bacillariophyceae (61.00 indiv/l) was found in Godagari (Station 3) and lowest (1 indiv/l) in Bauphol (Station 7, Table 3).

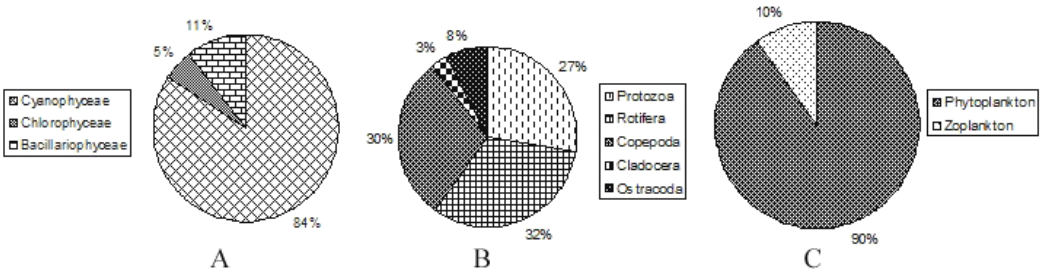

Fig.1. (A) Percentage composition of different groups of phytoplankton abundance; (B) Percentage composition of different groups of zooplankton abundance and (C) Percentage composition of total phytoplankton and total zooplankton abundance from all ten stations combined.

Table 1. Phytoplankton and its distribution at different sampling stations.

	Species/station	Poba (1)	Char-ghat (2)	Goda-gari (3)	Mawa-ghat (4)	Char-voirobi (5)	Madrasa-ghat (6)	Bauphol (7)	Tajum-uddin (8)	Daulot-khan (9)	Lal-mohon (10)
	Cyanophyceae										
1	*Microcystis* sp.	-	-	+	-	+	+	-	+	+	+
2	*Polycistis* sp.	-	-	+	-	-	-	-	+	+	-
3	*Spirulina* sp.	-	-	+	-	+	+	-	+	+	-
4	*Anabaena* sp.	-	-	+	-	-	-	+	+	+	-
5	*Nostoc* sp.	-	-	-	-	+	-	-	-	-	-
6	*Oscillatoras* sp.	-	-	+	-	-	-	-	+	+	-
	Sub total	0	0	5	0	3	2	1	5	5	1
	Chlorophyceae										-
7	*Spirogyra* sp.	-	-	+	+	-	+	+	-	+	-
8	*Pediastrum* sp.	+	+	+	-	+	+	+	+	+	+
9	*Microspora* sp.	-	-	+	-	+	+	-	+	+	-
10	*Synedra* sp.	-	-	+	+	-	-	-	+	+	-
11	*Ulothrix* sp.	-	-	-	-	-	-	-	-	+	-
12	*Oedogonium* sp.	-	-	-	-	-	-	-	-	+	-
13	*Closterium* sp.	-	-	+	-	-	-	-	-	+	-
	Sub total	1	1	5	2	2	3	2	3	7	1
	Bacillariophyceae										
14	*Tabellaria* sp.	-	-	+	+	-	+	-	+	+	+
15	*Gomphonema* sp.	-	-	-	-	-	+	-	-	-	-
16	*Navicula* sp.	-	+	+	+	+	-	+	+	+	+
17	*Ditoma* sp.	-	-	-	-	-	-	-	+	+	+
18	*Nitzchia* sp.	-	-	+	-	-	-	-	-	+	+
19	*Anomoeoneis* sp.	-	-	+	-	-	-	-	-	+	+
	Sub total	0	1	4	2	1	2	1	3	5	5
	Total	1	2	14	4	6	7	4	11	17	7

'+' sign indicates present and ' -' sign indicates absent.

Table 2. Zooplankton and its distribution at different sampling stations.

	Species/station	Poba (1)	Char-ghat (2)	Goda-gari (3)	Mawa-ghat (4)	Char-voirobi (5)	Madrasa-ghat (6)	Bauphol (7)	Tajum-uddin (8)	Daulot-khan (9)	Lal-mohon (10)
	Protozoans										
1	*Euglena acus*	-	-	+	-	-	-	-	-	-	-
2	*E. oxyuris*	-	-	+	-	-	-	+	+	+	-
3	*E. sanguinea*	-	-	-	-	-	-	+	-	-	-
4	*Phacus* sp.	-	-	-	-	-	-	+	+	-	-
5	*Volvox* sp.	+	-	+	+	-	+	+	+	+	+
6	*Difflugia* sp.	-	-	+	+	-	+	-	+	+	-
7	*Colpoda* sp.	-	-	-	-	-	-	-	+	+	-
8	*Arcella* sp.	-	-	+	+	-	-	-	-	+	-
9	*Euglepha* sp.	-	-	-	-	-	-	-	-	+	-
10	*Ceratium hirundinella*	-	-	-	-	-	-	-	+	-	-
	Sub total	1	0	5	3	0	2	4	6	6	1
	Rotifers										
11	*Brachionus angularis*	-	-	+	-	-	+	+	+	+	-
12	*B. falcatus*	-	-	-	-	-	-	-	-	-	-
13	*Polyarthra vulgaris*	-	-	-	-	-	+	+	-	+	-
14	*Asplanchna priodonta*	-	-	-	-	-	-	-	+	+	-
15	*Anuraeopsis fissa*	-	-	+	-	-	-	-	+	+	-
16	*Keratella vulga*	-	-	+	-	-	-	-	+	+	-
17	*Keratella cochlearis*	-	-	+	-	-	+	-	+	+	-

(Contd.)

Table 2 contd.

	Species/Station	Poba (1)	Char-ghat (2)	Goda-gari (3)	Mawa-ghat (4)	Char-voirobi (5)	Madrasa-ghat (6)	Bauphol (7)	Tajum-uddin (8)	Daulot-khan (9)	Lal-mohon (10)
18	*Filinia longiseta*	-	-	-	-	-	+	-	-	+	-
19	*F.brachiata*	-	-	-	-	-	-	-	-	+	-
20	*Kelicotia* sp.	-	-	-	-	+	+	-	-	-	-
21	*Hexerthra* sp.	-	-	-	-	-	-	-	-	+	-
22	*Monostyla bula*	-	-	-	-	-	-	-	+	-	-
23	*Lecane* sp.	-	-	-	-	-	-	-	-	+	-
24	*Rotaria neptunia*	-	-	-	-	-	-	-	+	+	-
25	*Lindia* sp.	-	-	-	-	-	-	-	-	+	-
26	*Ascomorpha* sp.	-	-	-	-	-	-	-	-	+	-
27	*Cephalodella* sp.	-	-	-	-	-	-	-	-	+	-
28	*Trichocerca* sp.	-	-	+	-	-	-	-	+	-	-
29	*Platyias patulus*	-	-	+	-	-	-	-	-	-	-
	Sub total	0	0	6	0	1	5	2	8	14	0
	Copepods										
30	*Mesocyclops edax*	+	-	-	-	-	-	+	-	+	-
31	*Cyclops* sp.	+	-	+	-	-	+	+	+	+	-
32	*Diaptomus* sp.	-	+	+	+	-	+	+	+	+	+
33	*Bryocvamptus* sp.	-	-	+	-	-	-	-	-	+	-
34	Naupleus	-	-	+	-	+	+	+	+	+	-
	Sub total	2	1	4	1	1	3	4	3	5	1

(Contd.)

Table 2 contd.

	Species/Station	Poba (1)	Char-ghat (2)	Goda-gari (3)	Mawa-ghat (4)	Char-voirobi (5)	Madrasa-ghat (6)	Bauphol (7)	Tajum-uddin (8)	Daulot-khan (9)	Lal-mohon (10)
	Cladocerans										
35	*Bosmina* sp.	-	-	+	-	-	+	-	-	-	-
35	*Diaphanosoma brachyurum*	-	-		-	-	-	-	+	+	-
37	*Macrothrix* sp.	-	-		-	-	-	-	-	+	-
38	*Cydorus* sp.	-	-	+	-	-	-	-	-	+	-
39	*Moina* sp .	-	-	+	-	-	-	-	-	-	-
	Sub total	0	0	3	0	0	1	0	1	3	0
	Ostracods										
40	*Cypris* sp.	-	-	+	-	-	-	+	-	-	-
	Sub total	0	0	1	0	0	0	1	0	0	0
	Total	3	1	19	4	2	11	11	18	28	2

'+' sign indicates present and ' -' sign indicates absent.

Table 3. Group wise plankton abundane (indiv/l) at different stations.

Station	Cyano-phyceae	Chloro-phyceae	Bacillario-phyceae	Total phyto-plankton	Proto-zoa	Roti-fera	Cope-poda	Clado-cera	Ostra-coda	Total zoo-plankton	Total plankton
Poba (1)	-	1.00	-	1.00	2.00	-	2.00	-	-	4.00	5.00
Charghat (2)	-	1.00	2.00	3.00	-	-	1.00	-	-	1.00	4.00
Godagari (3)	561.00	21.00	61.00	643.00	11.00	18.00	13.00	1.00	6.00	49.00	692.00
Mawaghat (4)	-	2.00	4.00	6.00	5.00	-	1.00	-	-	6.00	12.00
Charvoirobi (5)	3.00	21.00	2.00	26.00	-	3.00	1.00	-	-	4.00	30.00
Madrasaghat (6)	14.00	13.00	24.00	51.00	2.00	15.00	6.00	2.00	-	25.00	76.00
Bauphol (7)	1.00	1.00	1.00	3.00	1.00	1.00	4.00	-	1.00	7.00	10.00
Tajumuddin (8)	5.00	4.00	2.00	11.00	2.00	2.00	3.00	1.00	-	8.00	19.00
Daulotkhan (9)	5.00	8.00	3.00	16.00	6.00	3.00	5.00	1.00	-	15.00	31.00
Lalmohon (10)	1.00	1.00	31.00	33.00	1.00	-	1.00	-	-	2.00	35.00
Mean (±SE)	147.72 ±72.16	9.44 ±2.69	18.44 ±6.34	174.59 ±79.21	5.26 ±1.09	6.26 ±2.07	5.67 ±1.46	0.56 ±0.25	1.44 ±0.91	19.46 ±4.12	194.05 ±82.58

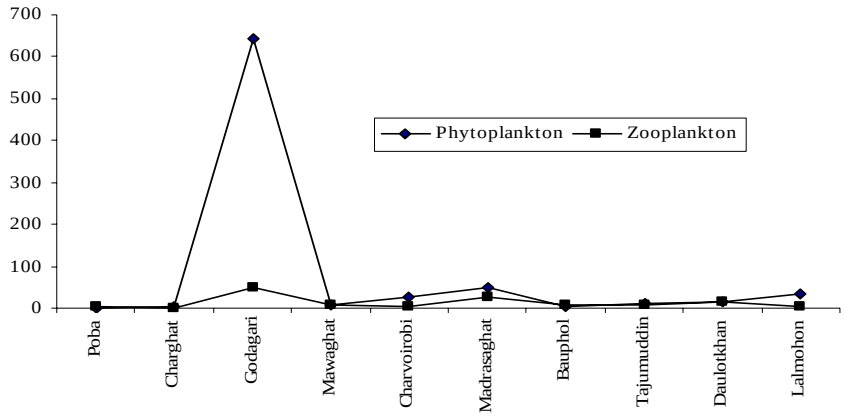

Fig. 2. Plankton abundance (indiv/l) at different sampling stations.

Zooplankton: Among 39 zooplankton taxa, 10 belonged to Protozoa, 19 to Rotifera, 4 to Copepoda, 5 to Cladocera and 1 to Ostracoda (Table 2). Chowdhury and Raknuzzaman[8] reported 23 taxa of zooplankton, of which 12 belonged to Rrotifers, 4 to Copepods, 6 to Cladocerans and 1 to Ostracods from the river Buriganga. In 2003, four groups of zooplankton population, namely Copepods, Rotifers, Cladocera and Ostracods from the river Meghna were reported[7]. In the present study zooplankton constituted 10% of the total plankton abundance (Fig. 1C). Ahmed *et al*.[7] found that zooplankton contributed more than 3% to the total planktonic organisms. The abundance of total zooplankton ranged from 1 indiv/l in Charghat (Station 2) to 49 indiv/l in Godagari (Station 3, Fig. 2). The average value of zooplankton abundance in all ten stations was recorded as 19.46 ± 4.12 indiv/l (Table 3). Low population of zooplankton in a lotic water is not uncommon. Sundar *et al*.[17] reported the major contribution of phytoplankton (> 97.0%) and lower concentration of zooplankton (0.13 - 2.4%) at three stations in the Guala river of Uttar Pradesh, India. Fluctuations of major zooplanktonic groups are discussed in the following headings:

Protozoans: Protozoans formed 27% of the total zooplankton abundance and it placed 3rd in position among zooplankton (Fig. 1B). This result is not similar to the findings of previous studies[6,8]. In the present study the representative of Protozoa was found in all the station except of Charghat (Station 2) and Charvoirobi (Station 5). The average value of protozoans abundance was 5.26 ± 1.09 indiv/l (Table 3). The highest abundance of Protozoa was observed in Godagari (Station 3) with value of 11 indiv/l and it was found lowest (1 indiv/l) in Bauphol (Station 7) and Lalmohon (Station 10).

Rotirers: Rotifers constituted 32% and it was placed 1st in position of the total zooplankton abundance (Fig. 1B). Similar results also reported from the Buriganga river, Dhaka, Bangladesh[8]. The representative of rotifers was not found to occur in Poba (Station 1), Charghat (Station 2), Mawaghat (Station 4) and Lalmohon (Station 10).The

rotifers abundance ranged from 1 to 18 indiv/l with mean value of 6.26 ± 2.07 indiv/l. The highest value was observed in Godagari (Station 3) and the lowest in Bauphol (Station 10, Table 3).

Copepods: Copepods was the second dominant group and it formed 30% of the total zooplankton abundance (Fig. 1B). Ahmed *et al*.[7] recorded Copepods (51.2%) as the most dominant group among total zooplankton abundance. In the present investigation Copepods was found in all the station with mean value of (5.67 ± 1.46). It ranged from 1 indiv/l to 13 indiv/l. The highest abundance was observed in Godagari (Station 3) and lowest in Charghat (Station 2), Mawaghat (Station 4), Charvoirobi (Station 5) and Lalmohon (Station 10, Table 3).

Cladocerans: Cladocerans was the least abundant group which formed 3% of the total zooplankton abundance (Fig. 1B). But Cladocera contributed 13.5% of total zooplankton abundance which was observed in 2003[7]. In the present study the representative of Cladocera was found to be absent in Poba (Station 1), Charghat (Station 2), Mawaghat (Station 4), Charvoirobi (Station 5), Bauphol (Station 7) and Lalmohon (Station 10). The average abundance of cladocerans was recorded as 0.56 ± 0.25 indiv/l. The highest value (2 indiv/l) was observed in Madrasaghat (Station 6, Table 3).

Ostracods: In the present study Ostracods placed on 4th in position and it constituted 8% of the total zooplankton abundance (Fig. 1B). Ahmed *et al*.[7] reported in their study that Ostracods formed only 2.5% of total zooplankton abundance. In the present study the average abundance of Ostracods was 1.44 ± 0.91). The representative of Ostracods was found only in Godagari (Station 3) as 6 indiv/l and 1 indiv/l in Bauphol (Station 7) among ten stations (Table 3).

Plankton species diversity: Species diversity is a measure of the diversity within an ecological community that incorporates both species richness and the evenness of species abundances. In the present study, Species richness (SR), Shannon-Weiner diversity (H`), Maximum species diversity (Hmax) and Evenness (J`) were used to describe the diversity in a community. Station wise species diversity indices (species richness, Shannon-Weiner index, Hmax and evenness) are presented in Table 4. In the present investigation species richness (SR) ranged from 3 to 45 taxa. The highest species richness (SR) was observed in Daulotkhan (Station 9) and the lowest in Charghat (Station 2) with mean value of 17.10 ± 4.408). Shannon-Weiner species diversity index (H`) ranged from 3.334 in Daulotkhan (Station 9) to 1.500 in Charghat (Station 2) with mean value of 2.717 ± 0.147). Chughtai *et al*.[18] have carried out the biological parameters of Chenab River at Muzaffargarh, Pakistan having diversity index of phytoplankton ranged from 3.34 to 6.79 and zooplankton ranged from 0.51 to 2.58. Maximum species diversity (H max) varied from 1.584 to 4.169 with the average value of 3.275 ± 0.142). The highest H max was observed in Madrasaghat (Station 6) and lowest in Charghat (Station 2). Evenness or equitability

(J`) was maximum (J` = 0.972) in Mawaghat (Station 4) and minimum (J` = 0.601) in Charvoirobi (Station 5) with mean value of (J` = 0.834 ± 0.027) [Table 4].

Table 4. Plankton diversity indices [Shannon-Weiner species diversity (H`), species richness (SR), maximum species diversity (Hmax) and evenness (J`)] at different stations.

Station	H'	SR	H max	J'
Poba (1)	1.921	4	2.000	0.960
Charghat (2)	1.500	3	1.584	0.946
Godagari (3)	2.056	32	3.357	0.634
Mawaghat (4)	2.918	8	3.000	0.972
Charvoirobi (5)	1.800	8	3.000	0.601
Madrasaghat (6)	3.239	18	4.169	0.777
Bauphol (7)	2.374	15	2.468	0.965
Tajumuddin (8)	3.098	29	3.274	0.946
Daulotkhan (9)	3.334	45	3.648	0.890
Lalmomon (10)	2.350	9	3.459	0.679
Mean (± SE)	2.717 ± 0.147	17.10 ± 4.408	3.275 ± 0.142	0.834 ± 0.027

Human population growth has significantly altered the environment for many natural water bodies. As a result the composition of the biota of these water bodies is affected. Rivers, reservoirs and estuaries are ecologically deteriorated due to unabated discharge of pollutants and heavy fishing pressures. Diversity indices are good indicator of pollution in aquatic ecosystem. In the present study, diversity index ranged from 1.500 to 3.334 with mean value of 2.717 ± 0.147. Diversity index value greater than 3.00 indicates clean water. Values in the range of 1.00 to 3.00 are characteristics of moderately healthy conditions and values less than 1.00 characterize heavily deterioration condition[19]. Based on diversity index, it may be concluded that the abundance of plankton is not alike throughout the migratory route of Hilsa during the spawning period which might be one of the major restrictions for the easy migration of Hilsa as plankton is the major food for this flagship migratory fish. However, more studies are warranting affirming this postulation.

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References

1. Odum EP 1971. *Fundamentals of Ecology*. 3rd edn., WB Saunders Co., Phil, USA, p. 574.
2. Mishra SR 1996. *Assessment of water pollution*. Alpha publishing, New Delhi, India. 43-60.

3. Khondker M 1994. The status of limnological research in Bangladesh. Internat. Verein. Limnol. **24**: 147- 154.
4. Shafi M, MMA Quddus and N Islam 1978. Studies on the limnology of the river Meghna. Bangladesh J. Fish. **1**(2): 85-97.
5. Khan YSA, AMA Salam and MK Ahmed 1978. Cladocera of the river Buriganga, Dhaka, Bangladesh. Bangladesh J. Zool. **6**(2): 73-83.
6. Patra RWR and MA Azadi 1985. Ecological studies on the planktonic organisms of the Halda river. Bangladesh J. Zool. **15**(2): 109-123.
7. Ahmed KKU, SU Ahmed, MRA Hossain, T Ahmed and S Rahman 2003. Quantitative and qualitative assessment of plankton: some ecological aspect and water quality parameters of the river Meghna, Bangladesh. Bangladesh J. Fish Res. **7**(2): 131-140.
8. Chowdhury MM and M Raknuzzaman 2005. Zooplankton communities in the polluted water of the river Buriganga, Dhaka, Bangladesh. Bangladesh J. Zool. **33** (2): 177-182.
9. Mahmud MM, AN Khan, D Kamal, MA Rahman and MA Hossain 2007. Abundance and distribution of phytoplankton in Mouri river. Bangladesh. J. Asiat. Soc. Bangladesh. Sci. **33**(2): 161-168.
10. Haroon AKY 1998. Hilsa shad: Fish for the teeming millions, new management alternatives needed for the hilsa young. Shad Journal. **3**(1):1-12.
11. Ward HB and CC Whipple 1959. *Freshwater Biology*,2nd ed. John Willy and Sons Inc., New York, London, pp. 1248.
12. Needham JG and PR Needham 1966. *A guide to the freshwater biology*. 5th Edition. Holden day Inc. San. Fransisco, Calif. pp. 108.
13. Bhouyain AM and SM ASMAT 1992. *Freshwater Zooplankton from Bangladesh,* 1st ed., Gazi Publishers, 37, Banglabazar, Dhaka, Bangladesh. pp. 137.
14. Ali S and T Chakrabarty 1992. *Bangladesher Mitha Panir Amerudandi Prani (A book of freshwater invertebrates of Bangladesh*), 1sted. Bangla Academy, Dhaka Bangladesh. pp. 207.
15. Lloyd M and RJ Ghelardi 1964. A table for calculating the "equitability'' component of species diversity. J. Animal Ecol. **33**: 217-225.
16. Sundar S, HS Raina, M Mohon and B Singh 1995. Ecology and fiheries potentials of the Guala river with special reference to proposed impoundment (Jamrani dam) on the system. Inland Fish. Soc. India **27**(2): 33-45.
17. Chughtai MI, K Mahmood and AR Awan 2011. Assessment of planktonic diversity in river chenab as affected by sewage of multan city. Pak. J. Bot. **43**(5): 2551-2555.
18. Mason CF 1998. *Biology of freshwater pollution*. Longman scientific and technical paper. pp. 142

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