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Food and feeding habit of chapila (*Gudusia chapra*)

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Abstract
Abundance of diatom (Bacillariophyceae) in the plankton population and the dietary role of it in chapila (*Gudusia chapra*) in pond were studied. A total of 25 genera of phytoplankton belonging to Bacillariophyceae (7), Chlorophyceae (11), Cyanophyceae (5) and Euglenophyceae (2) and 9 genera of zooplankton belonging to Crustacea (3) and Rotifera (6) were recorded from the water. Among the phytoplankton, highest abundance of Chlorophyceae was observed, and Bacillariophyceae, Cyanophyceae and Euglenophyceae ranked the second, third and fourth position in the planktonic population, respectively. Among the zooplankton, Rotifera was recorded as the most dominant group and Crustacea as the least one. From the gut content analysis, 4 groups of phytoplankton consisting of 33 genera of plankton were identified and recoded of which 25 belonging to phytoplankton and 8 belonging to zooplankton. This study reveals that the Chlorophyceae and Cyanophyceae were the most dominant food items of chapila. Bacillariophyceae (diatom) and Euglenophyceae were less important and Crustacea and Rotifera were the least important in the diet of Chapila. The present investigation showed that chapila appeared to be a plankton feeder with a preference for phytoplankton to zooplankton. Electivity analysis showed that the fish avoided zooplankton and strongly selected phytoplankton. In the gut contents of fish, Chlorophyceae was positively and Bacillariophyceae (diatom) was negatively selected throughout the experimental period, in the pond water.

Key words : Food and feeding habit, *Gudusia Chapra*, Phytoplankton and Zooplankton

Introduction

Fish is the main source of animal protein and to supply essential nutrients in the diet of the people of Bangladesh. It contributes about 63% of animal protein to our daily diet (DoF 2003). The majority of fish eaten by the rural poor people is the small indigenous fish species. Karim (1975) listed 34 freshwater fishes of Bangladesh as small fish, which include *Puntius spp. Osteobrama cotio, Colisa fasciata, Chela phulo, Chelo cachius, Amblypharyngodon mola, and Gudusia chapra.* These fishes are quite familiar and popular among the rural and urban people. Landless and marginal farmers as well as people of low income groups can not afford costly fish like carps but they can afford to buy and consume small fish these are made easily available from the small homestead

ponds, tanks and ditches. Chapila (*Gudusia chapra*) is one of the small indigenous species, which is available throughout the country. This species is now under severe threat of extinction and need to be put under cultured fishery. This is not only to protect but also to preserve the species from being extinct.

Plankton is also a vital factor for influencing the fish production. There are different groups of plankton such as phytoplankton (Bacillariophyceae, Chlorophyceae, Cyanophyceae, Euglenophyceae) and Zoopankton (Crustacea, Rotifera). The food and feeding behaviours and the extent of food competition between coinhabiting fish species, evaluation of electivity index and dietary overlap are of great importance. Electivity index is made to observe the preference and avoidance for various food items. The positive value electivity index indicates selection for certain food items, while negative value means avoidance. Study of feeding habits helps to take necessary steps for proper management of water to increase the production of fishes.

Extensive works have done on the food and feeding habits of fishes notably by Dewan *et al.* (1997), Rahmatullah *et al.* (1997) and Shafiqul (2000). Alam (1995) studied on food and feeding habit of Chapila (*Gudusia chapra*) in polyculture system and reported that fish fed on a range of food items including phytoplankton, zooplankton and debris but *Gudusia chapra* fed mainly detritus and phytoplankton having a change of food habit to phytoplankton and debris. He also stated that the fish strongly selected some genera of phytoplankton like *Cosmarium, Haematcoccus* and *Euglena* and avoided zooplankton. But no studies have so far been reported on feeding of chapila in the natural condition.

Considering the above facts, the present study was undertaken to determine the pattern of food and feeding performance of chapila (*Gudusia chapra*) by calculating the electivity index in natural condition.

Materials and methods

The present study was undertaken in large L-Shape pond in the Field Laboratory, Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh, Bangladesh. The study was conducted for the period of January- June 2004.

Water quality determination

A large number of environmental parameters such as transparency (cm), water temperature (°C), pH, dissolved oxygen (mg/L), total alkalinity (mg/L), Nitrate-nitrogen (mg/L), phosphate-phosphorus (mg/L), and chlorophyll-a (µg/L) were measured monthly during the study period. Analyses were done in the Water Quality and Pond Dynamics Laboratory of the Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh.

Plankton population in pond water

Collections, preservation and plankton enumeration: Plankton samples were collected from different place of the experimental ponds by passing 30 litre of water through fine

mesh size plankton net and made sample 50ml., stored in a white plastic bottle with crock until examine. Buffered formalin was added as a preservative. One ml of concentrated plankton sample was taken by a dropper and then put on the S-R (Sedgewick-Raffer) counting cell. The S-R counting cell was placed under a compound electrical microscope and the plankton was counted. All the plankton present in 10 squares of the cell chosen randomly were counted and used for quantitative estimation by using the following formula (Rahman 1992).

$$N = \frac{A \times 1000 \times C}{V \times F \times L}$$

Where,

N = No. of plankton cells per liter
A = Total no. of plankton counted
C = Volume of final concentration of samples in ml
V = Volume of a field in cubic millimeter.
F = Number of the fields counted
L = Volume of original water in litre

Collection of fish sample

Twenty fish samples of chapila were collected every month from different places of the experimental ponds. Fishes were collected randomly with the help of a small seine net throughout the experimental period. There are several methods used for the determination of food items taken by the fish, these are: i) Numerical method, ii) Weight method, iii) Volumetric method, iv) Points method, v) Percentage of frequency of occurrence method. Of the above methods, the points methods were used in this study because they were the best and most simple and easy method give better results [Dewan (1973) and Ali and Islam (1981)].

Electivity index (E) : Electivity index (E) was calculated by applying the formula of Ivlev, 1961 which is as follows:

$$E = \frac{Pg - Pw}{Pg + Pw}$$

Where,

E = Electivity index
Pg = the relative content of any ingredient in the ration, expressed as percentage to total ration.
Pw = the relative proportion of the same in the pond water

The resultant value of E ranges from + 1 to -1, where positive values indicate selection of a particular food item and negative values indicate avoidance.

Results and discussion

Water quality parameters : The results of some water quality parameters, viz. transparency (cm), water temperature (°C), pH, dissolved oxygen (mg/L), total alkalinity (mg/L), Nitrate-nitrogen (mg/L), phosphate-phosphorus (mg/L), and chlorophyll-a (µg/L) are shown in Table 1. The highest (40 cm) and the lowest (28 cm) transparency were recorded in January and June, respectively. The highest temperature (34°C) and the lowest temperature (18°C) were recorded in May and January, respectively. The highest value of pH was observed in February (8.88) and the lowest in January (6.70). The highest content of dissolved oxygen was observed in February (8.7 mg/L) and the lowest value (5.6 gm/L) in March. In the present study, the highest total alkalinity was found in March (68 mg/L) and the lowest total alkalinity value was (52 mg/L) in January. The lowest 0.01 mg/L and the highest 0.09 mg/L of nitrate-nitrogen were found in May and June, respectively. The highest value 0.09 mg/L was recorded in February and lowest value 0.02 mg/L was recorded in June. The mean value of chlorophyll-a (µg/L) ranged from 74.76 µg/L in April to 191.89 µg/L in January. The highest concentration (195.16 µg/L) was found in January and lowest concentration (72.73 µg/L) in April.

Table 1. Monthly variation in water quality parameters (mean±SD, n = 3 and range)

Parameters	January	February	March	April	May	June
Transparency (cm)	38.67±1.15, 38-40	37.33±0.58, 37-38	29.33±0.58, 29-30	32.33±1.53, 31-34	30.67±1.15, 30-32	29.33±1.15, 28-30
Temperature (°C)	18.33±0.58, 18-19	23.33±0.29, 23-23.5	27.16±0.29, 27-27.5	28.66±0.58, 28-29	33.67±0.29, 33.5-34	31.33±0.58, 31-32
pH	6.73±0.06, 6.70-6.80	8.82±0.05, 8.80-8.88	7.27±0.06, 7.20-7.30	7.56±0.08, 7.51-7.65	7.56±0.05, 7.70-7.80	7.87±0.04, 7.82-7.90
Dissolved oxygen (mg/L)	6.73±0.06, 6.7-6.8	8.67±0.06, 8.6-8.7	5.73±0.12, 5.6-5.8	6.7±0.10, 6.6-6.8	6.43±0.06, 6.4-6.5	6.63±0.06, 6.6-6.7
Total alkalinity (mg/L)	53.33±1.15, 52-54	61.33±1.15, 60-62	67±1, 66-68	60.67±1.15, 60-62	61.33±2.31, 60-64	57.33±1.53, 56-59
Nitrate-nitrogen (mg/L)	0.033±0.01, 0.03-0.04	0.057±0.01, 0.05-0.06	0.063±0.01, 0.06-0.07	0.057±0.01, 0.05-0.07	0.017±0.01, 0.01-0.03	0.08±0.01, 0.07-0.09
Phosphate-phosphorus (mg/L)	0.043±0.01, 0.04-0.05	0.076±0.01, 0.07-0.09	0.043±0.01, 0.04-0.05	0.037±0.01, 0.03-0.05	0.077±0.01, 0.07-0.08	0.026±0.02, 0.02-0.03
Chlorophyll-a (µg/L)	191.89±2.83, 190.25-195.16	120.78±0.60, 120.78-121.38	134.23±0.99, 133.28-135.27	74.76±1.93, 72.73-76.58	172.82±1.62, 171.36-174.56	122.374±2.08, 120.05-124.06

Six planktonic groups consisting of 34 genera were so far identified from pond waters during the study period. The total planktonic organisms consisted of 4 groups of phytoplankton and 2 groups of zooplankton. Phytoplankton belonging to Bacillariophyceae (7), Chlorophyceae (11), Cyanophyceae (5) and Euglenophyceae (2) were found. Nine genera of Zooplankton were also identified belonging to Crustacea (3) and Rotifera (6) (Table 2).

Table 2. Generic status of different groups of plankton recorded in the experimental pond

Phytoplankton	Zooplankton
Bacillariophyceae : *Cyclotella, Fragillaria, Nitzschia, Navicula, Surirella, Cocconies* and *Achanthrs*	**Crustacea** : *Cyclops, Daphnia* and Nauplius
Chlorophyceae : *Ankistrodesmus, Botryococcus, Chlorella, Zygnema, Oocystis, Pediastrum, Scenedesmus, Staurastrum, Stichococcus, Tetraedon* and *Ulothrix*	**Rotifera** : *Asplanchna, Brachionus, Filinia, Keratella, Polyarthra* and *Trichocerca*
Cyanophyceae : *Chroococcus, Gleocapsa, Gomphospheria, Merismopedia* and *Microcystis*	
Euglenophyceae : *Euglena* and *Phacus*	

In the experimental pond, the total numbers of phytoplankton was recorded to range between 19.91 $\times$ 10^3 cells/L and 30.56 $\times$ 10^3 cells/L with an average value 25.16 $\times$ 10^3 cells/L and that of zooplankton range between 2.08 $\times$ 10^3 cells/L and 5.25 $\times$ 10^3 cells/L with an average value 4.00 $\times$ 10^3 cells/L. The highest numbers of phytoplankton and zooplankton were recorded in April and May and the lowest numbers of the phytoplankton and zooplankton were recorded in January respectively (Table 3).

Table 3. Mean values of plankton number ($\times 10^3$ cells/L) in the experimental pond

Plankton group	Month						Mean
	January	February	March	April	May	June	
Bacillariophyceae	7.83	7.60	4.80	5.90	6.00	5.92	6.34
Chlorophyceae	8.83	11.67	12.5	16.5	13.83	10.75	12.35
Cyanophyceae	2.75	3.83	9.50	7.58	6.33	4.67	5.78
Euglenophyceae	0.50	0.58	0.58	0.58	1.08	0.83	0.69
Total Phytoplankton	19.91	23.68	27.38	30.56	27.24	22.17	25.16
Crustacea	0.33	0.17	0.33	0.33	0.33	0.67	0.36
Rotifera	1.75	2.83	4.17	4.00	4.92	4.17	3.64
Total Zooplankton	2.08	3.00	4.50	4.33	5.25	4.84	4.00

Plankton population in the water : Table 4 reveals that the Chlorophyceae was the dominant group among the phytoplankton, which is supported by Wahab *et al.* (1994), Nirod (1997), Kohinoor (2000), Raihan (2001) and Uddin (2002). Chlorophyceae dominated the plankton population in terms of number whereas the abundance of Bacillariophyceae, Cyanophyceae and Euglenophyceae was the 2nd, 3rd and 4th position in the phytoplankton population in terms of number respectively. Among the genera of phytoplankton, the most dominant genera were *Chlorella* and *Stichococcus* which were closely followed by *Cyclotella, Navicula, Tetreadon,* and *Microcystis.* Nine (9) genera of zooplankton belonging to Crustacea (3) and Rofifera (6) were recorded. Wahab *et al.* (1994) also recorded 5 genera of zooplankton consisted of Rotifera and Crustacea. Nirod (1997) identified 12 genera of zooplankton composed of Crustacea (5) and Rotifera (7). Dewan *et al.* (1991) identified 9 genera of zooplankton belonging to Hydrzoan (1)

Crustacea (5) and Rotifera (3). Among the genera of zooplankton *Brachionus* and *Keratella* were recorded as the most dominant genera. Results on plankton population obtained in this study showed a more or less similarity with the previous findings.

Table 4. Generic status and total points of plankton in gut contents of capila (*Gudusia chapra*)

Food item	Food organisms	% Total points
Bacillariophyceae	*Cyclotella* : *Fragillaria, Nitzschia, Navicula, Surirella, Cocconies, Achantrs*	9.63
Chlorophyceae	*Ankistrodesmus* : *Botryococcus, Chlorella, Zygnema, Oocystis, Pediastrum, Scenedesmus, Staurastrum, Stichococcus Tetreadon, Ulothrix*	67.24
Cyanophyceae	*Chlorococcus:: Gleocapsa, Gomphospheria, Merismopedia, Microcystis*	18.15
Euglenaphyceae	*Euglena* : *Phacus*	2.31
Crustacea	Daphnia : Nauplius	0.52
Rotifera	*Asplanchna*	2.15

Points method: Analysis of the different food items in the stomach is shown in Table 5, which indicate the variations in food items consumed during different months of the study period. The stomach contents of chapila consist of six broad groups were i) Bacillariophyceae, ii) Chlorophyceae, iii) Cyanophyceae, iv) Euglenophyceae, v) Crustacea and vi) Rotifera.

Table 5. Percentage of total points of different food categories by point's method

Month	Bacillariophyceae	Chlorophyceae	Cyanophyceae	Euglenophyceae	Crustacea	Rotifera
January	10.37	75.53	10.84	1.49	0.11	1.66
February	10.83	69.11	16.68	1.30	0.27	1.81
March	8.03	65.35	21.23	3.63	0.12	1.64
April	9.10	64.53	21.31	2.44	0.24	2.38
May	9.11	62.92	21.76	3.07	0.12	3.02
June	10.61	67.19	17.48	1.76	0.20	2.76

The findings of stomach content by occurrence and point methods confirmed the fact that chaplia is a plankton feeder and the fish showed highest preference for Chlorophyceae and Bacillariophyceae was negatively selected.

Electivity index : Electivity indices with their monthly changes of various food organisms are shown in Table 6. The present study showed that *Gudusia chapra* appeared to be selective phytoplankton feeder under the conditions in the experimental ponds. Bacillariophyceae was negatively selected in all month and the results revealed that electivity index varied with the different month and comparatively lower in March and April than other months. Cyanophyceae was positively selected in the month of February, May, and June and negatively selected in the months of January, March and

April. Chlorophyceae group was positively selected throughout the experimental period. Present investigation is in consistence with the findings of Alam (1995) and Anwar (1996). Euglenophyceae was positively selected in the month of March and April, while negatively selected in the month of January, February, May and June. Crustacea and Rotifera were negatively selected by fish during the experimental period.

Table 6. Plankton composition in water (Pw%), gut plankton composition (Pg%) and resultant electivity indices (E) of chapila during the study period

		Plankton group					
		Bacillariophyceae	Chlorophyceae	Cyanophyceae	Euglenophyceae	Crustacea	Rotifera
January	Pg %	10.37	75.53	10.84	1.49	0.11	1.66
	Pw %	35.61	40.15	12.5	2.27	1.52	7.95
	E	-0.55	0.31	-0.07	-0.21	-0.86	-0.65
February	Pg %	10.83	69.11	16.68	1.3	0.27	1.81
	Pw %	28.44	43.75	14.38	2.19	0.63	10.63
	E	-0.45	0.22	0.07	-0.25	-0.4	-0.71
March	Pg %	8.03	65.35	21.23	3.63	0.12	1.64
	Pw %	15.14	39.16	29.77	1.83	1.04	13.05
	E	-0.31	0.25	-0.17	0.33	-0.79	-0.78
April	Pg %	9.1	64.53	21.31	2.44	0.24	2.38
	Pw %	16.95	47.26	21.72	1.67	0.95	11.46
	E	-0.3	0.15	-0.01	0.19	-0.6	-0.66
May	Pg %	9.11	62.92	21.76	3.07	0.12	3.02
	Pw %	18.46	42.56	19.49	3.33	1.03	15.13
	E	-0.34	0.19	0.06	-0.04	-0.79	-0.67
June	Pg %	10.61	67.19	17.48	1.76	0.2	2.76
	Pw %	21.91	39.81	17.28	3.09	2.47	15.43
	E	-0.35	0.26	0.01	-0.27	-0.85	-0.7

The Chapila is a plankton feeder with a preference of phytoplankton to zooplankton. If we provide phytoplankton as a feed of Chapila that will be ensure higher production and nutrient supply for the poor people and also profit to the fish farmers in Bangladesh.

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