

Lengths, length-length relationships and condition factor of Indian catfish *Gagata cenia* (Hamilton, 1822) in the Padma River, Bangladesh

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Abstract

This study described some biological parameters including lengths, length-length relationships and Fulton's condition factors of *Gagata cenia* in the Padma River of Bangladesh, based on 1120 specimens collected from May to November, 2012. Maximum 39.78% female fishes were belonging to the length category of 55-60 mm whereas 51.06% male were belonging to 50-55 mm. The highest mean total lengths were found 66.51±10.28 mm (combined sex), 70.12±09.49 mm (female) and 61.08±09.45 mm (male) in the month of June. Similar findings are also presented for standard length, fork length, body depth, dorsal length, pectoral length, pelvic length and anal length. Linear relationships were also studied among mentioned lengths. Strong positive correlations were observed in all cases. Speraman's Rank test indicated that there was a strong, positive correlation between total length and condition factor in female, which was statistically significant ($r_s=0.210$, $P=0.044$). In male, there was no significant correlation between these two ($r_s=0.167$, $P=0.262$). The Mann-Whitney U-test showed that the female individuals had the highest condition factor (Mean rank of 79.76). There was a statistically significant differences in the Fulton's condition factor between males and females (two tailed, Mann-Whitney U = 1324).

Keywords: *Gagata cenia*, Padma River, length-length relationship, condition factor

INTRODUCTION

Gagata cenia (Hamilton, 1822) is a small indigenous fish species in Bangladesh, considered a wholesome food fish (Talwar and Jhingran 1991). In Bangladesh, the contribution of inland capture fisheries to the total fish production has been declined in recent times, which contributed 41.83% in 1998-99 (FRSS 2009) and 29.34% in 2009-10 (DoF 2013). Moreover, at present, our indigenous fish species are at stake due to various reasons both man-made and natural causes (Thompson *et al.* 1999, Mijkherjee *et al.* 2002, Amin *et al.* 2009, Flowra *et al.* 2009, Galib *et al.* 2009). Already a total of 54 freshwater fish species of country have been declared threatened by IUCN Bangladesh (2000). However this already became an antiquated effort and there is a need for updated research which will reveal present status of fish species.

G. cenia is not a common species in water bodies of Bangladesh. This species is also found in India, Pakistan, Nepal and Myanmar; it inhabits both freshwater and tidal rivers (Talwar and Jhingran 1991).

Amount of catch of this fish is not much in water bodies of Bangladesh (Samad *et al.* 2010, Galib *et al.* 2013). Also *G. cenia* is not focused much to the scientists and researchers of Bangladesh and other countries of the world. For this purpose research work is needed for collecting necessary information about this fish and its present status for better management.

The condition factor of fishes is the most important biological parameter which provides information on condition of fish species and the entire community and is of high significance for management and conservation of natural populations (Sarkar *et al.* 2009, Muchlisin *et al.*

2010). It is also a quantitative parameter of the state of well-being of the fish that determines present and future population success because of its influence on growth, reproduction and survival (Richter 2007).

This study would provide basic information on the lengths, length-length relationships (LLRs), and condition factor of *G. cenia* that would be useful for fishery biologists or managers to impose adequate regulations for sustainable fishery management in the Padma River and nearby areas of Bangladesh.

METHODOLOGY

Sampling area and duration: Samplings were conducted in the Padma River at the Rajshahi City Corporation area (Latitude 24° 22' North; Longitude 88° 35' East) (Figure 1). Fish specimens were collected for seven months from May 2012 to November, 2012.



Figure 1: Map of Rajshahi district showing the study area, the Padma River (blue colored).

Sampling framework and measurements: A total of one hundred and sixty (160) specimens were collected every month for study. Fish specimens were collected with the help of fishermen who used their own fishing nets, traps and craft for capturing this fish. Collected specimens were preserved in 10% buffered formalin solution. After collection they were brought to the laboratory of the Department of Fisheries, University of Rajshahi and preserved in labeled plastic for further study.

Total length (TL), standard length (SL), fork length (FL), dorsal length (DL), pectoral length (P₁L), pelvic length (P₂L) and anal length (AL) of the collected specimens were measured. All the measurements were taken by digital slide calipers.

Study of length-length relationships: Following relationships were studied: TL vs. SL, TL vs. FL, SL vs. FL, TL vs. DL, TL vs. P₁L, TL vs. T₂L, TL vs. AL by linear regressions for males, females, and combined sexes separately.

The relationships among all body parameters were calculated by least square method to fit a simple linear regression as:

$$Y = a + bX$$

Where

Y = various body lengths,

X = total length,

a = Proportionality constant, and

b = Regression coefficient

Condition factor: The Fulton's condition factor (K) was calculated using the following equation,

$$K = 100 \times (W/L^3) \text{ (Htun-Han 1978)}$$

Where W is the body weight (BW) in g, and L, the standard length (SL) in cm.

Statistical analyses: Statistical analyses were done using computer software Statistical Package for Social Science (SPSS) version 15.00 and Microsoft Excel 2007.

RESULTS AND DISCUSSIONS

Size-frequency distribution

In case of female specimens, maximum 39.78% fishes were belonging to the length category of 55-60 mm followed by 50-55 mm (23.66%), 60-65 mm (17.20%) and so on (Figure 2). In males, majority 51.06% fishes were belonging to the length category of 50-55 mm (Figure 3).

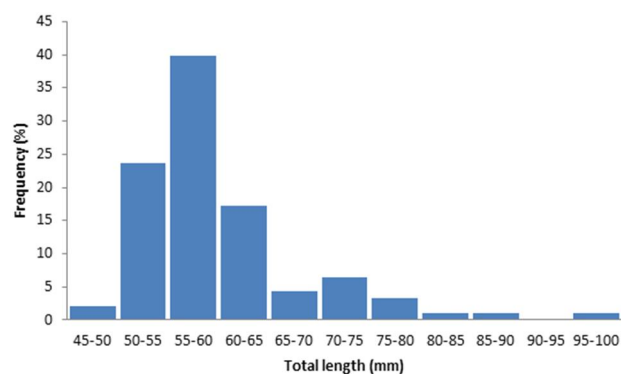


Figure 2: Frequency distribution of female fishes according to their total length

There was no previous study found on lengths of *G. cenia* that is why it is not possible to compare present findings with the previous one. However, it is established that morphometric studies are essential for the determination of growth form and growth rate of a species (Alam *et al.* 2012). So the present findings would help biologist in this regard.

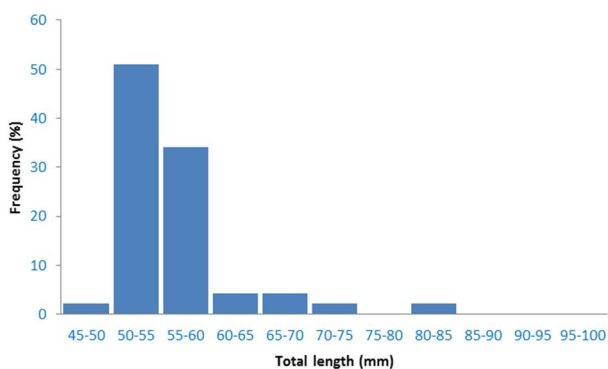


Figure 3: Frequency distribution of male fishes according to their total length

Lengths analyses

Total length: In case of combined sexes, the highest TL (66.51±10.28 mm) was found in the June whereas the lowest mean TL (54.99±02.96 mm) was in September (Table 1). The highest TL for male was recorded 61.08±09.45 mm in the month of June whereas the lowest (52.71±02.68 mm) was recorded in September. On the other hand the highest TL for female was found as 70.12±09.49 mm (June) and the lowest TL (56.03±03.23 mm) was found in October (Table 1).

Table 1: Analyses regarding total length of *Gagata cenia*

Month	Sex	n	Total length (mm)			
			Min	Max	Mean±SD	95% CL
May	M	72	50.75	70.70	58.36±06.75	53.17-63.54
	F	88	55.55	90.66	70.04±09.30	63.80-76.29
	C	160	50.75	90.66	64.79±10.01	60.10-69.47
Jun	M	64	51.99	81.42	61.08±09.45	53.18-68.98
	F	96	56.28	85.30	70.12±09.49	64.09-76.15
	C	160	51.99	85.30	66.51±10.28	61.69-71.32
Jul	M	40	51.34	55.59	53.48±01.74	51.32-55.64
	F	120	49.96	69.02	57.69±05.14	54.84-60.53
	C	160	49.96	69.02	56.63±04.86	54.36-58.91
Aug	M	40	51.05	59.04	54.56±02.96	50.88-58.23
	F	120	51.27	62.31	57.20±03.40	55.32-59.09
	C	160	51.05	62.31	56.54±03.42	54.94-58.15
Sep	M	56	49.50	56.78	52.71±02.68	50.24-55.19
	F	104	53.48	61.90	56.21±02.38	54.77-57.65
	C	160	49.50	61.90	54.99±02.96	53.60-56.37
Oct	M	48	50.90	58.96	54.36±03.06	51.15-57.57
	F	112	49.41	60.23	56.03±03.23	54.16-57.89
	C	160	49.41	60.23	55.53±03.20	54.03-57.02
Nov	M	56	52.64	58.92	55.06±02.23	53.00-57.13
	F	104	51.95	59.45	56.40±02.80	54.71-58.09
	C	160	51.95	59.45	55.93±02.64	54.70-57.17

Sex: M=male, F=female, C=combined sex

Standard length: The highest SL of combined specimens was found 51.16±07.97 mm in June with the lowest (43.83±05.99 mm) in the month of September (Table 2).

In female, the highest SL was found 55.02±06.55 mm in the month of May and the lowest value of standard length (44.57±02.87 mm) was recorded in the month of October (Table 2). In males, the highest SL was found 46.81±07.68 mm in the month of June and the lowest value of SL (40.06±03.43 mm) was found in October (Table 2).

Table 2: Analyses regarding standard length of *Gagata cenia*

Month	Sex	n	Standard length (mm)			
			Min	Max	Mean±SD	95% CL
May	M	72	39.99	54.90	45.54±04.90	41.78-49.31
	F	88	43.85	69.21	55.02±06.55	50.62-59.42
	C	160	39.99	69.21	50.75±07.49	47.25-54.26
Jun	M	64	39.20	63.02	46.81±07.68	40.39-53.24
	F	96	43.44	64.56	54.06±07.02	49.60-58.52
	C	160	39.20	64.54	51.16±07.97	47.43-54.89
July	M	40	41.11	45.87	42.43±01.95	40.00-44.85
	F	120	39.40	52.81	45.45±03.73	43.39-47.52
	C	160	39.40	52.81	44.70±03.59	43.02-46.38
Aug	M	40	41.51	46.81	43.63±02.40	40.65-46.60
	F	120	42.20	50.62	47.10±02.74	45.58-48.62
	C	160	41.51	50.62	46.23±03.02	44.82-47.64
Sep	M	56	38.87	48.04	42.53±03.20	39.57-45.49
	F	104	43.52	50.40	46.06±02.00	44.86-47.27
	C	160	38.87	50.40	43.83±02.96	43.44-46.21
Oct	M	48	39.32	47.90	40.06±03.43	39.46-46.67
	F	112	39.58	48.96	44.57±02.87	42.91-46.22
	C	160	39.32	48.96	44.12±03.04	42.70-45.54
Nov	M	56	39.78	48.83	44.57±02.84	41.94-47.20
	F	104	39.40	48.89	45.46±03.03	43.63-47.30
	C	160	39.40	48.89	45.15±02.92	43.78-46.52

Sex: M=male, F=female, C=combined sex

Fork length: In case of combined sexes, the highest FL was found in June, 55.27±08.96 mm with the lowest (46.67±02.80 mm) in September (Table 3). In female, the highest FL was found 59.66±07.25 mm in the month of May and the lowest value of FL (47.44±03.17 mm) was found in October (Table 3). In males, the highest FL was found 49.94±08.12 mm in the month of June and the lowest value of FL (44.56±02.67 mm) was recorded in the month of September (Table 3).

Dorsal length: In combined sexes, the highest DL 21.21±3.09 mm was found in the month of June whereas the lowest mean DL (15.92±1.44 mm) was recorded in the month of August (Table 4). In female, the highest DL was found 22.79±3.13 mm in the month of May and the lowest value of DL (16.17±1.49 mm) was recorded in the month of August (Table 4). In males, the highest DL was found 19.22±2.73 mm in the month of July and the lowest value of DL (15.16±1.04 mm) was recorded in the month of August (Table 4).

Table 3: Analyses regarding fork length of *Gagata cenia*

Month	Sex	n	Fork length (mm)			
			Min	Max	Mean±SD	95% CL
May	M	72	42.00	61.06	48.66±06.09	43.98-53.35
	F	88	46.77	75.25	59.66±07.25	54.79-64.54
	C	160	42.00	75.25	54.71±08.65	50.66-58.76
Jun	M	64	43.83	67.52	49.94±08.12	43.15-56.73
	F	96	46.25	70.82	58.82±07.90	53.80-63.84
	C	160	43.83	70.82	55.27±08.96	51.07-59.46
July	M	40	44.37	49.98	45.97±02.30	43.11-48.82
	F	120	44.37	57.12	48.98±03.75	46.91-51.06
	C	160	44.37	57.12	48.23±03.64	46.53-49.93
Aug	M	40	43.99	51.41	47.30±02.78	43.85-50.76
	F	120	45.61	52.85	49.69±02.39	48.37-51.02
	C	160	43.99	52.85	49.06±02.64	47.86-50.33
Sep	M	56	41.26	48.90	44.56±02.67	42.09-47.04
	F	104	45.84	52.22	47.94±02.13	46.66-49.23
	C	160	41.26	52.22	46.76±02.80	45.45-48.07
Oct	M	48	41.79	50.02	46.16±03.30	42.70-49.62
	F	112	42.02	51.08	47.44±03.17	45.61-49.29
	C	160	41.79	51.80	47.06±03.18	45.57-48.54
Nov	M	56	44.23	51.10	47.48±02.66	45.02-49.95
	F	104	41.71	51.90	47.97±02.93	46.20-49.74
	C	160	41.71	51.90	47.80±02.78	46.50-49.10

Sex: M=male, F=female, C=combined sex

Table 4: Analyses regarding dorsal length of *Gagata cenia*

Month	Sex	n	Dorsal length (mm)			
			Min	Max	Mean±SD	95% CL
May	M	72	15.03	22.05	18.41±2.11	16.79-20.04
	F	88	16.86	28.41	22.79±3.13	20.69-24.90
	C	160	15.03	28.41	20.82±3.47	19.20-22.45
Jun	M	64	16.75	24.69	19.22±2.73	16.94-21.50
	F	96	18.39	26.68	22.54±2.64	20.86-24.22
	C	160	16.75	26.68	21.21±3.09	19.76-22.66
July	M	40	15.78	18.72	16.75±1.17	15.30-18.20
	F	120	14.85	21.86	17.62±2.02	16.50-18.75
	C	160	14.85	21.86	17.41±1.88	16.54-18.28
Aug	M	40	13.82	16.60	15.16±1.04	13.87-16.45
	F	120	13.56	19.44	16.17±1.49	15.34-16.99
	C	160	13.56	19.44	15.92±1.44	15.24-16.59
Sep	M	56	14.07	16.65	15.33±0.99	14.41-16.24
	F	104	14.48	20.02	16.45±1.31	15.66-17.24
	C	160	14.07	20.02	16.06±1.30	15.45-16.66
Oct	M	48	13.47	17.10	15.37±1.20	14.11-16.62
	F	112	15.01	17.39	16.23±0.74	15.81-16.66
	C	160	13.47	17.39	15.97±0.96	15.52-16.42
Nov	M	56	15.70	16.99	16.20±0.41	15.81-16.58
	F	104	15.70	17.20	16.39±0.48	16.10-16.68
	C	160	15.70	17.20	16.32±0.46	16.11-16.54

Sex: M=male, F=female, C=combined sex

Pectoral length: The highest P₁L (13.88±2.22 mm) of combined sexes was found in the month of June whereas the lowest mean P₁L (10.67±0.51 mm) was recorded in the month of October (Table 5). In female, the highest P₁L was found 14.79±1.96 mm in the month of June and the lowest value of P₁L (10.74±0.54 mm) was recorded in the month of October (Table 5). In males, the highest P₁L was found 12.51±1.96 mm in the month of June and the lowest value of P₁L (10.32±0.69 mm) was recorded in the month of September (Table 5).

Table 5: Analyses regarding pectoral length of *Gagata cenia*

Month	Sex	n	Pectoral length (mm)			
			Min	Max	Mean±SD	95% CL
May	M	72	09.81	14.38	11.64±1.71	10.32-12.95
	F	88	09.99	19.66	14.66±2.39	13.05-16.26
	C	160	09.81	19.66	13.20±2.60	11.94-14.45
Jun	M	64	10.90	16.87	12.51±1.96	10.88-14.15
	F	96	11.95	17.79	14.79±1.96	13.55-16.03
	C	160	10.90	17.79	13.88±2.22	12.84-14.92
July	M	40	10.15	11.34	10.70±0.52	10.05-11.34
	F	120	09.52	14.31	11.31±1.40	10.54-12.09
	C	160	09.52	14.31	11.16±1.25	10.57-11.75
Aug	M	40	09.33	11.00	10.49±0.67	09.66-11.33
	F	120	09.29	12.60	11.02±0.92	10.51-11.52
	C	160	09.29	12.60	10.89±0.88	10.48-11.29
Sep	M	56	09.45	11.40	10.32±0.69	09.68-10.96
	F	104	9.73	11.63	10.98±0.57	10.64-11.33
	C	160	09.45	11.63	10.75±0.68	10.44-11.07
Oct	M	48	10.01	11.20	10.50±0.40	10.07-10.92
	F	112	09.94	12.01	10.74±0.54	10.43-11.05
	C	160	09.94	12.01	10.67±0.51	10.43-10.90
Nov	M	56	10.40	11.82	10.96±0.45	10.54-11.38
	F	104	10.10	12.10	11.34±0.67	10.94-11.74
	C	160	10.10	12.10	11.21±0.62	10.92-11.50

Sex: M=male, F=female, C=combined sex

Pelvic length: The highest P₂L (28.20±3.82 mm) of combined sexes was found in the month of June whereas the lowest mean P₂L (22.56±1.25 mm) was recorded in September (Table 6). In female, the highest P₂L was found 30.44±3.39 mm (May) and the lowest P₂L (23.14±0.84 mm) was recorded in September. In males, the highest P₂L (25.70±3.27 mm) was in June and the lowest value of P₂L (21.48±1.21 mm) was in September (Table 6).

Anal length: In case of combined sexes, the highest AL 39.94±6.07 mm was found in July whereas the lowest mean AL (32.67±1.58 mm) was recorded in September (Table 7). In female, the highest AL was found 42.41±5.56 mm in June and the lowest value of AL (33.34±1.17 mm) was recorded in September. In males, the highest AL was found 36.25±5.03 mm June and the lowest value of AL (31.43±1.55 mm) was recorded in September (Table 7).

Table 6: Analyses regarding pelvic length of *Gagata cenia*

Month	Sex	n	Pelvic length (mm)			
			Min	Max	Mean±SD	95% CL
May	M	72	20.85	28.35	24.28±2.58	22.30-26.26
	F	88	24.28	36.57	30.44±3.39	28.16-32.72
	C	160	20.85	36.57	27.67±4.33	25.64-29.69
Jun	M	64	22.29	32.74	25.70±3.27	22.96-28.43
	F	96	24.71	34.40	29.88±3.29	27.79-31.96
	C	160	22.29	34.40	28.20±3.82	26.42-29.99
July	M	40	21.93	23.35	22.81±0.54	22.14-23.47
	F	120	20.90	28.95	24.40±2.21	23.18-25.66
	C	160	20.90	28.95	24.00±2.04	23.05-24.98
Aug	M	40	20.90	23.90	22.65±1.13	21.24-24.06
	F	120	21.10	26.10	23.70±1.52	22.85-24.54
	C	160	20.90	26.10	23.43±1.48	22.74-24.13
Sep	M	56	19.90	22.90	21.48±1.21	20.36-22.60
	F	104	21.94	25.10	23.14±0.84	22.63-23.65
	C	160	19.90	25.10	22.56±1.25	21.97-23.14
Oct	M	48	21.01	24.50	22.30±1.26	22.98-23.62
	F	112	21.01	24.98	23.29±1.22	22.58-23.99
	C	160	21.01	24.98	22.99±1.29	22.39-23.59
Nov	M	56	21.50	24.10	22.77±1.06	21.79-23.75
	F	104	21.70	25.80	23.61±1.10	22.94-24.27
	C	160	21.50	25.80	23.32±1.14	22.78-23.85

Sex: M=male, F=female, C=combined sex

Table 7: Analyses regarding anal length of *Gagata cenia*

Month	Sex	n	Anal length (mm)			
			Min	Max	Mean±SD	95% CL
May	M	72	29.87	40.30	33.94±3.51	31.24-36.64
	F	88	32.27	52.76	41.98±5.45	38.32-45.64
	C	160	29.87	52.76	38.36±6.13	35.49-41.23
Jun	M	64	31.30	46.45	36.25±5.03	32.04-40.45
	F	96	33.99	52.02	42.41±5.56	38.87-45.94
	C	160	31.30	52.02	39.94±6.07	37.10-42.78
July	M	40	29.49	32.77	31.20±1.42	29.43-32.96
	F	120	30.63	40.96	34.58±2.85	33.00-36.16
	C	160	29.49	40.96	33.74±2.95	32.36-35.12
Aug	M	40	30.28	35.80	33.10±1.98	30.64-35.55
	F	120	30.80	39.10	34.61±2.59	33.17-36.08
	C	160	30.28	39.10	34.23±2.49	33.06-35.39
Sep	M	56	30.10	34.74	31.43±1.55	29.99-32.86
	F	104	31.66	36.09	33.34±1.17	32.63-34.05
	C	160	30.10	36.09	32.67±1.58	31.93-33.41
Oct	M	48	30.04	34.56	32.41±1.79	30.54-34.29
	F	112	30.96	35.98	33.63±1.64	32.69-34.58
	C	160	30.04	35.98	33.27±1.74	32.45-34.08
Nov	M	56	31.10	36.10	32.51±1.66	30.97-34.05
	F	104	30.10	35.60	33.45±1.59	32.49-34.42
	C	160	30.10	36.01	33.12±1.64	32.35-33.89

Sex: M=male, F=female, C=combined sex

No previous data on specific lengths *i.e.* those revealed in the present study, of *G. cenia* were found so that present findings are not comparable. Though Bhuiyan (1964) and Rahman (1989 and 2005), Talwar and Jhingran (1991) and Raknuzzaman (2007) described this species in their books but those descriptions lack measurements considered in this study. However, the maximum TL described by Rahman (1989 and 2005) 96 mm which is higher than that of the highest TL recorded in the present study (90.66 cm) which was a female species captured in the month of May. SL mentioned (150 mm) by Talwar and Jhingran (1991) is more than concerned length. However, this was also observed that length of female specimen was more than that of male in all the month which indicates that female grow more than male.

Length-length relationships: Sex-based relationships among various lengths of *G. cenia* are shown in table 8. Almost all the LLR equations clearly revealed that the lengths of the body parts proportional to the TL.

Table 8: Various Length-length relationships of *Gagata cenia*

Relationship	Sex	n	a	b	r
TL vs. SL	M	376	3.658	0.750	0.938**
	F	744	6.463	0.690	0.972**
	C	1120	4.981	0.710	0.965**
TL vs. FL	M	376	2.408	0.801	0.956**
	F	744	3.032	0.800	0.984**
	C	1120	2.290	0.810	0.979**
SL vs. FL	M	376	1.146	1.042	0.961**
	F	744	-2.916	1.127	0.984**
	C	1120	-1.592	1.101	0.980**
TL vs. DL	M	376	-1.795	0.332	0.873*
	F	744	-4.666	0.379	0.934**
	C	1120	-3.701	0.364	0.918**
TL vs. P ₁ L	M	376	-0.752	0.211	0.901**
	F	744	-2.738	0.245	0.951**
	C	1120	-2.201	0.236	0.943**
TL vs. P ₂ L	M	376	2.297	0.374	0.939**
	F	744	-3.230	0.426	0.967**
	C	1120	-0.056	0.420	0.963**
TL vs. AL	M	376	3.128	0.590	0.969**
	F	744	0.277	0.594	0.982**
	C	1120	0.385	0.590	0.979**

P<0.05

No comparison was possible because of absence of previous research findings on *G. cenia* in Bangladesh, most probably outside Bangladesh too. However, Alam *et al.* (2012) stated similar results while working with pool

barb, *Puntius sophore*, collected from the Padma River; the same river from where the specimens have been collected in the present study. These findings also reported by Tandon et al. (1993) based on freshwater fish, *Cirrhinus reba*.

The findings of present investigation are similar to the findings of Bhuiyan and Biswas (1982), Hoque and Hossain (1992), Sinović (2004), Hossain et al. (2006) and Dadzie et al. (2008); their findings were based on *Puntius chola*, *Mystus vittatus*, *Engraulis encrasicolus*, *M. vittatus* and *Parastromateus niger* respectively.

Condition factors: In case of combined sexes, the highest condition factor (2.01±0.26) was recorded in the month of June and the lowest condition factor (1.62±0.28) was recorded in the month of November (Table 9).

In female specimens, the highest condition factor (1.99±0.24) was recorded in the month of May and June and the lowest condition factor (1.68±2.29) was recorded in the month of November (Table 9). In male specimens, the highest condition factor (2.04±0.30) was recorded in the month of June and the lowest condition factor (1.52±0.23) was recorded in the month of November (Table 9).

Table 9: Fulton's condition factor of *Gagata cenia*

Month	Sex	n	Condition factor (K)			
			Min	Max	Mean±SD	95% CL
May	M	72	1.55	2.42	1.88±0.26	1.68-2.08
	F	88	1.67	2.40	1.99±0.24	1.84-2.15
	C	160	1.55	2.42	1.88±0.22	1.77-1.98
Jun	M	64	1.68	2.58	2.04±0.30	1.79-2.28
	F	96	1.67	2.40	1.99±0.24	1.84-2.15
	C	160	1.67	2.58	2.01±0.26	1.89-2.13
July	M	40	1.44	2.17	1.67±0.29	1.30-2.03
	F	120	1.46	2.47	1.90±0.32	1.72-2.08
	C	160	1.44	2.47	1.84±0.33	1.69-2.00
Aug	M	40	1.28	1.73	1.56±0.17	1.35-1.78
	F	120	1.47	2.29	1.79±0.25	1.65-1.93
	C	160	1.28	2.29	1.73±0.25	1.62-1.85
Sep	M	56	1.59	2.10	1.80±0.19	1.62-1.98
	F	104	1.51	1.93	1.78±0.13	1.70-1.86
	C	160	1.51	2.10	1.79±0.15	1.72-1.86
Oct	M	48	1.21	2.02	1.72±0.28	1.42-2.01
	F	112	1.61	2.23	1.83±0.17	1.73-1.92
	C	160	1.21	2.23	1.79±0.21	1.70-1.89
Nov	M	56	1.19	1.73	1.52±0.23	1.30-1.73
	F	104	1.27	2.49	1.68±2.29	1.50-1.86
	C	160	1.19	2.49	1.62±0.28	1.49-1.76

Sex: M=male, F=female, C=combined sex

There was a strong, positive correlation between TL and

K, which was statistically significant (Spearman's correlation coefficient, $r_s = 0.210$, $P = 0.044$) (two tailed, $p < 0.005$). While in case of male, there was no significant correlation between TL and K was found (Spearman's correlation coefficient, $r_s = 0.167$, $P = 0.262$). In case of combined sexes, there was a strong, positive correlation between TL and K, which was statistically significant (Spearman's correlation coefficient, $r_s = 0.228$, $P = 0.007$) (two tailed, $p < 0.001$). The Mann-Whitney U-test showed that the female individuals had the highest condition factor (Mean rank is 79.76). There was a statistically significant differences in the Fulton's condition factor between males and females (Two tailed, Mann-Whitney U = 1324). Condition factor is a quantitative parameter associated with determination of present and future population success through its influence on biology (growth, reproduction and survival) of an animal (Hile 1936, Hossain et al. 2006, Tareque et al. 2009). Recent physical and biological circumstances reflect the condition of a fish, and this condition fluctuates by interaction among feeding conditions, parasitic infections and physiological factors (Le Cren 1951).

CONCLUSION

Though the amount of catch of *G. cenia* is not much in water bodies of Bangladesh but it is important from the point of view of biological conservation. The present research findings would help to update and enhance the existing morphological measurements of *G. cenia* in both Bangladesh and outside the country.

Condition factors would allow biologist to understand its population status and future success. Further in depth research efforts on other aspects of *G. cenia*, which are not included in present study, are recommended.

REFERENCES

- Alam MM, Galib SM, Islam MM, Flowra FA and Hussain MA (2012) Morphometric study of the wild population of pool barb, *Puntius sophore* (Hamilton, 1822) in the river Padma, Rajshahi, Bangladesh. Trends in Fisheries Research 1(2): 10-13.
- Amin AKMR, Parvez I, Zaman MB and Amin HA (2009) Study of the Present Status of Endangered Small Indigenous Species (SIS) of Fish in the Natural Waters of the North-West Part of Bangladesh. Journal of Environmental Science & Natural Resources 2(2): 163-168.
- Bhuiyan AL (1964) Fishes of Dacca. Asiatic Society of Pakistan, Dacca, pp. 65-66.
- Bhuiyan AS and Biswas B (1982) Studies on the morphometry of *Puntius chola* (Hamilton-Buchanan)

- (Cyprinidae: Cypriniformes). University Journal of Zoology, Rajshahi University 1: 29-34.
- Dadzie S, Abou-Seedo F and Manyala JO (2008) Length-length relationship, length-weight relationship, gonadosomatic index, condition factor, size at maturity and fecundity of *Parastromateus niger* (Carangidae) in Kuwaiti waters. Journal of Applied Ichthyology 24(3): 334-336. DOI: 10.1111/j.1439-0426.2008.01061.x
- DoF (2013) Compendium National Fish Week 2013. Department of Fisheries, Ministry of Fisheries and Animal Resources, Dhaka, Bangladesh, p. 129
- Flowra FA, Alam MB, Hossain MA, Samad MA and Galib SM (2009) Livelihood Aspects of Fishermen of the Dahia Beel under Natore District, Bangladesh. Bangladesh Journal of Progressive Science and Technology 7(2): 283-284.
- FRSS (2009) Fisheries Statistical Yearbook of Bangladesh 2007-2008, Fisheries Resource Survey System, Department of Fisheries, Bangladesh 25(1): 1-42.
- Galib SM, Samad MA, Mohsin ABM, Flowra FA and Alam MT (2009) Present status of fishes in the Chalan Beel- The largest beel (wetland) of Bangladesh. International Journal of Animal and Fishery Science 2(3): 214-218.
- Galib SM, Naser SMA, Mohsin ABM, Chaki N and Fahad MFH (2013) Fish diversity of the river Choto Jamuna, Bangladesh: Present status and conservation needs. International Journal of Biodiversity and Conservation 5(6): 389-395. DOI: 10.5897/IJBC2013.0552
- Hamilton F (1822) An account of the fishes found in the river Ganges and its branches. Edinburgh & London. An account of the fishes found in the river Ganges and its branches. pp. 1-405.
- Hile R (1936) Age and growth of the cisco, *Liucichthya artedi* (Le Sueur) in the lakes of the northern highlands, Wisconsin. Fishery Bulletin U.S. 48(19): 211-317.
- Hoque MA and Hossain MA (1992) Length-weight relationship and condition factor of the cat fish *Mystus vittatus* (Bloch) (Cypriniformes: Bagridae). University Journal of Zoology, Rajshahi University 10 & 11: 113-114.
- Hossain MY, Ahmed ZF, Leunda PM, Jasmine S, Oscoz J, Miranda R and Ohtomi J (2006) Condition, length-weight and length-length relationships of the Asian striped catfish *Mystus vittatus* (Bloch, 1794) (Siluriformes: Bagridae) in the Mathabhanga River, southwestern Bangladesh. Journal of Applied Ichthyology 22(4): 304-307. DOI: 10.1111/j.1439-0426.2006.00803.x
- Htun-Han M (1978) The reproductive biology of the dab *Limanda limanada* (L.) in the North Sea: gonadosomatic index, hepatosomatic index and condition factor. Journal of Fish Biology 13(1): 351-377
- IUCN Bangladesh (2000) Red book of threatened fishes of Bangladesh. IUCN- The world conservation union. xii+116 pp.
- Le Cren ED (1951) The length weight relationship and seasonal cycle in gonad weights and condition in the perch (*Perca fluviatilis*). Journal of Animal Ecology 20: 201-219
- Mijkherjee M, Praharaj A and Das S (2002) Conservation of endangered fish stocks through artificial propagation and larval rearing technique in West Bengal, India. Aquaculture Asia 2: 8-11.
- Muchlisin ZA, Musman M and Azizah MNS (2010) Length-weight relationships and condition factors of two threatened fishes, *Rasbora tawarensis* and *Poropuntius tawarensis*, endemic to Lake Laut Tawar, Aceh Province, Indonesia. Journal of Applied Ichthyology 26(6): 949-953. DOI: 10.1111/j.1439-0426.2010.01524.x
- Rahman AKA (1989) Freshwater fishes of Bangladesh, first edition. The Zoological Society of Bangladesh, Dhaka, Bangladesh, pp. 220-221.
- Rahman AKA (2005) Freshwater fishes of Bangladesh, second edition. The Zoological Society of Bangladesh, Dhaka, Bangladesh, pp. 240-242.
- Raknuzzaman M (2007) *Gagata cenia* (Hamilton, 1822). In: Siddiqui KU, Islam MA, Kabir SMH, Ahmed M, Ahmed ATA, Rahman AKA, Haque EU, Ahmed ZU, Begum ZNT, Hassan MA, Khondoker M and Rahman MM (eds.) Encyclopedia of flora and fauna of Bangladesh Vol. 23 freshwater fishes. Asiatic Society of Bangladesh, Dhaka, pp. 141-142.
- Richter TJ (2007) Development and evaluation of standard weight equations for bridgelip suckers and largescale suckers. North American Journal of Fisheries Management 27(3): 936-939. DOI: 10.1577/M06-087.1
- Samad MA, Asaduzzaman M, Galib SM, Kamal MM and Haque MR (2010) Availability and Consumer Preference of Small Indigenous Species (SIS) of the River Padma at Rajshahi, Bangladesh. International Journal of BioResearch 1(5): 27-31.

- Sarkar UK, Deepak PK and Negi RS (2009) Length-weight relationship of clown knifefish *Chitala chitala* (Hamilton 1822) from the River Ganga basin, India. *Journal of Applied Ichthyology* 25(2): 232-233. DOI: 10.1111/j.1439-0426.2008.01206.x
- Sinovčić G (2004) Growth and length-weight relationship of the juvenile anchovy, *Engraulis encrasicolus*, in the nursery ground (Zrmanja River estuary-eastern Adriatic Sea). *Journal of Applied Ichthyology* 20(1): 79-80. DOI: 10.1046/j.0175-8659.2003.00517.x
- Talwar PK and Jhingran AG (1991) *Inland Fishes of India and Adjacent Countries*, Vol. 2. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi-Calcutta, pp. 637-638.
- Tandon KK, Johal MS and Bala S (1993) Morphometry of *Cirrhinus reba* (Hamilton) from Kanjli wetland, Punjab, India. *Panjab University Research Journal (Science)* 43(1-4): 73-78.
- Tareque AMHB, Biswas B, Hossain MS, Rahman MM and Rahman MM (2009) Some aspects of biology of *Puntius sophore* (Hamilton) collected from the Mouri River, Khulna, Bangladesh. *Bangladesh Research Publications Journal* 2(2): 406-422.
- Thompson PM, Sultana P, Islam MN, Kabir MM, Hossain MM and Kabir MS (1999) Overview of the community based fisheries management project achievements and implications. Paper presented in the national workshop on community based fisheries management and future strategies for inland fisheries in Bangladesh, 1999. Dhaka, pp. 1-11.