Article

Morphometric study of banded gourami (*Colisa fasciata*) in Jessore, Bangladesh

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Abstract: Population morphometry including population demography, size group distribution, length weight relationship and sex ratio of an important freshwater fish, *Colisafasciata* was studied which collected fromJessore and Jhenaidah districts in Bangladesh during May, 2014 to April, 2015. Random samples of 201 individuals (108males and 93 females) were collected from different fish markets in Jessore (Monirampur, Borobazar, Chowgasa) and Jhenaidah (Mohespur, Barobazar, Kotchandpur) districst. The mean size of the specimen was recorded 65.08 ±14.32 mm in length and 7.43 ±3.09 g in body weight. Females were found little smaller than males. The specimens were larger in winter than summer and monsoon season. But in monsoon season the females were larger than males. The maximum length of the specimen collected from Jhenaidah district was smaller compare to the specimen of Jessore district. Most of the population (29%) was observed under 55-64 mm size class. Linear relationship was obtained between the log length (mm) and log weight (g) of the species in respects of sexes, seasons, and districts. The allometric coefficient *'b'* of the relationship indicated negative allometric growth of the species as *'b'* value was less than 3. The overall sex ratio (male: female=1:0.86)showed significant difference from the expected value 1:1. Overall males showed non-significant over females (χ^2 =1.119) in all season of both districts but in November males showed the significant (P<0.01) dominance over females. However, the findings of the present study have helped us to understand more about the species is the prerequisites in fishery management strategy and culture system.

1. Introduction

The banded gourami, *Colisa fasciata* (Bloch and Schneider, 1801) is the largest gourami in its genus. The species belonging to the family Anabantidae is one of the perch commonly found in Asia. It is locally known as "khoilsha". The fish is popular due to attractive color and food value. Hobbyists like these fish for their excellent color and behavior and commonly reared all over the world in the aquarium together with its relative *C. chuna* and *C. lalia*. In eastern and northeastern Bangladesh, the fish has very high consumer demand. The fish is found in the swamps, ponds, ditches, marshes (Rahman, 1989) and the shallow margins of rivers covered with thick vegetation and weeds (Menon, 1999). It is found all fresh water areas in Bangladesh (Rahman, 2005).The natural resources of this species are fast declining in Bangladesh due to drastic reduction of the natural feeding and breeding ground as a result of human intervention, climate change and modification of its

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habitats. Themorphometry is a powerful tool to distinct the fish stock in order to describe the intraspecific diversity. The word morphometrics is derived from two Greek words: morph meaning shape or form and metron meaning measurement. Daly (1985) defined morphometrics as a measurement and quantitative analysis for morphology or shape. Generally, it is a method of extracting measurements from shape and in most cases it is applied to biological topics in the widest sense. Recently in our country Hossen *et al.,* 2014 studied on the effect of polyunsaturated fatty acids on gonadal maturation and spawning of *C. fasciata* and performance of different dietary lipids on growth indices and survival of *C. fasciata* fry. In India, Mitra *et al*. (2007) studied on biology and fishery of *C. fasciata*in a floodplain wetland of Ganga river basin. But in Bangladesh there is no such study on morphometry of the species. The present study was covered on the population demography, size group distribution, length weight relationship and sex ratio in order to have baseline information which may helpful to manage and conserve of *C. fasciata.*

2. Materials and Methods

Khoilsa were collected randomly from six stations namely Monirampur(A1), Borobazar(A2), Chowgasa (A3) of Jessore district and Mohespur (B1), Barobazar (B2), Kotchandpur (B3) of Jhenaidah district (Figure 1). Samples were collected for a period of one year (May, 2014 to April, 2015) in each month of each station. Samples were taken from fish market and preserved in 10% formalin and brought back to laboratory of the department of Fisheries and Marine Bioscience, Jessore University of Science and Technology, Jessore for mormophometric measurements.
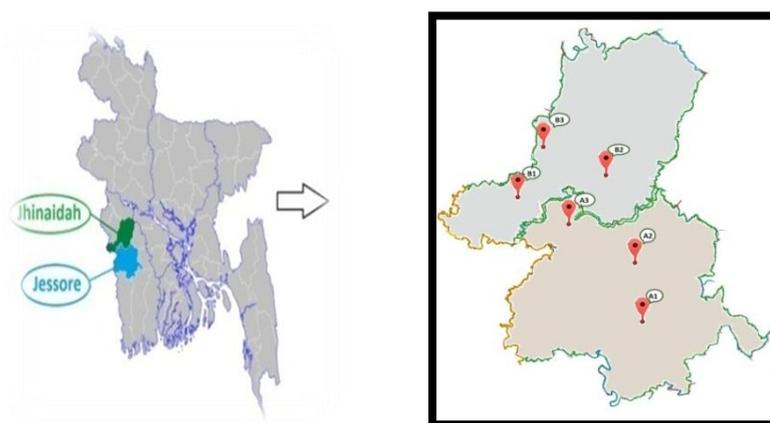

Figure 1. Map showing the six sampling station (bold circle) of Jessore and Jhenaidah district in Bangladesh.

2.1. Morphometric measurement

The total length and standard length of the fish specimens was measured in mm by using slide calipers. After blotting off the excess water from their body, total body weight of the fishwas taken by an electric balance in gm (A & D company, Model: EK 1200i; Made in Japan).

2.2. Size frequency distribution

A total of 201 specimens, ranging from 25 to 91.8 mm were randomly collected from the local fish markets of Jessore and Jhenidah district. The fishes were arranged into seven size group having 10 mm total length interval. Size frequency histogram was obtained by plotting frequency in percentage against different total length of both males and females of the two districts in different season.

2.3. Length-weight relationship

The length-weight relationships of the collected specimens were estimated by the allometric formula,

W=a + bL

Where, W is dependent variables (i.e., total body weight in g) and L in independent variables (i.e., total length in mm),a is the intercept of the regression and b is the regression coefficient (slope).

Parameters a and b of the length-weight relationship was estimated by linear regression analysis based on natural logarithms:

ln (W) =ln (a) + ln (L)

Linear correlation coefficient, measures the strength and the direction of a linear relationship between two variables. The determined coefficient (r^2) was used as an indicator of the quality of the linear regressions (Scherrer, 1984).

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The mathematical formula for computing r is:

$$r = \frac{n\sum xy - (\sum[(x)(\sum y)])}{\sqrt{n(\sum x^{()2}) - (\sum x)\ 2}\sqrt{n(\sum y^2) - (\sum y)^2}}$$

bvalue equal to 3, obtained in liner regressions indicate the isometric growth.
b>3 indicate the positive allometric growth
b<3 indicate the negative allometric growth

2.4. Sex ratio

Sexes were separated by external morphology (Swarup*et al.* 1972): the upper lip of the male is more pronounced and the dorsal ventral fins are more pointed at the posterior while those of the females are rounded. Then the fishes were dissected and confirm the sex by observing the gonads. In other hand, males are more colorful and longer than females. Females are pale gray or silvery color. After identifying the sex of 201 specimens' sex ratio was analyzed by Chi-square (χ^2):

$\chi^2 = \frac{\sum(O-E)2}{E}$

Where, O= observed value and E=expected value

The observed ratio was tested against an expected ratio that is for the difference from the hypothetical ratio 1:1 by the method of F test. Male-female distribution of the fish was observed for different months and season. The formula used for calculating male-female distribution is,

$$\% \text{ male or female} = \frac{\text{No. of male or female} \times 100}{\text{No. of female} + \text{No. of male}}$$

The obtained data from the experiment was analyzed by using the software Microsoft excel 2007 and presented in tabular and graphical forms.

3. Results

3.1. Population demography

Females were found a bit smaller in size than males. Among different seasons the specimens were larger in winter. But in monsoon the females were larger than males. The maximum length of the specimens collected from Jhenaidah region was smaller compare to the specimens of Jessore region. The regression parameters *'b'* value in all seasons for all individuals was less than 3 and the value of linear regression was maximum (0.844) for male in summer (Table 1).

Table 1. Population demography of *C. fasciata* collected from different fish market in Jessore and Jinaidah districts.

Characters	TL*		BW*		Ave*		Reg* para*		R^2
	Max	Min	Max	Min	Length	weight	a	b	
All ind*	91.8	25.00	17.58	1.89	65.08 ± 14.32	7.43±3.09	- 2.036	1.592	0.853
All male	91.8	25.00	17.58	1.89	66.41±14.39	7.40±3.16	-2.171	1.657	0.856
All female	90.1	28.00	16.47	1.89	63.53±14.16	7.47±3.03	-1.943	1.553	0.877
All summer	72.42	25.00	8.88	1.89	57.10±12.10	5.68±1.77	-1.685	1.383	0.855
M* summer	72.1	25.00	7.6	1.89	56.76±11.59	5.33±1.59	-1.547	1.290	0.822
F* summer	72.42	28.00	8.88	1.89	55.10±13.67	5.78±2.02	-1.807	1.465	0.909
All monsoon	82.1	30.70	14.57	2.02	61.50±12.72	6.64±2.27	-1.924	1.527	0.818
M* monsoon	80.9	32.9	12.12	2.0	61.10±14.98	6.23±2.48	-2.024	1.565	0.865
F* monsoon	82.1	30.70	14.57	2.34	60.12±10.25	6.93±2.02	-1.750	1.448	0.822
All winter	91.8	40.3	17.58	3.64	73.65±12.54	9.49±3.18	-2.292	1.739	0.802
Male winter	91.8	46.7	17.58	4.67	74.90±10.05	9.49±3.18	-2.717	1.962	0.780
F* winter	90.1	40.3	16.47	3.64	72.89±15.81	9.56±3.98	-2.102	1.644	0.839
All Jessore	91.8	28.00	17.58	1.96	65.46±14.39	7.53±3.39	-2.222	1.693	0.850
M*Jessore	91.8	32.87	17.58	2.02	66.45±14.58	7.40±3.44	-2.406	1.783	0.862
F* Jessore	90.1	28.00	25.10	22.40	65.00±14.25	7.80±3.36	-2.038	1.606	0.872
All Jhenaidah	86.1	25	14.93	1.89	63.72±14.26	7.18±2.67	-1.833	1.482	0.867
M*Jhenaidah	86.1	25.00	14.93	1.89	66.36±14.29	7.39±2.79	-1.892	1.506	0.864
F* Jhenaidah	85.02	28.00	13.77	1.89	61.75±14.01	7.07±2.55	-1.837	1.493	0.885

Ind*= Individual, TL*= Total length, BW*= Body weight, Par*=parameters, M*=Male, F*=Female, Reg*=Regression

3.2. Size group distribution

The most of the individuals (28.4%) were belong to 55-64 mm size class in length. Very few individuals (only 3%) were below35-44 mm size class (Figure 2A).The maximum males (31.48%) and females (38.71%) were recorded in the size group 65-74 mm and 55-64 mm, respectively (Figure 2B).In summer season, the most individuals (47.55%) were found in the size group 55-64 mm and there was no specimen recorded which size group is >75 mm (Figure 3). The size group 55-64 mm represent the maximum individuals (36.99%) in monsoon season and there was no specimen found under the size group of >84 mm. The maximum individuals (34.29%) in winter season were observed in 75-84 mm size group and no specimen was recorded in size group of 25-34 mm (Figure 3). In Jessore and Jhenaidah district the most of the individuals (32.74% and 32.95%) were reported in 55-64 mm and 65-74 mm size group respectively (Figure 4).
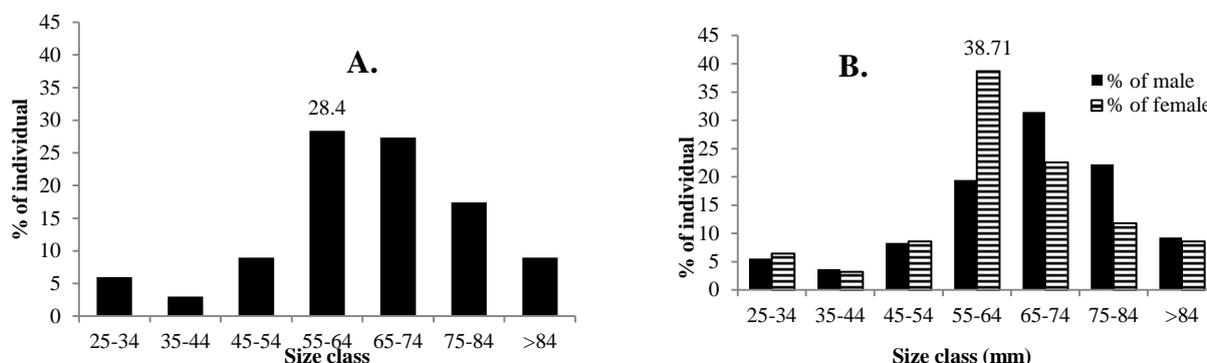

Figure 2. Size class distribution for all individual (A) and for male and female (B) of *C. fasciata* collected from Jessore and Jhenaidah fish market.
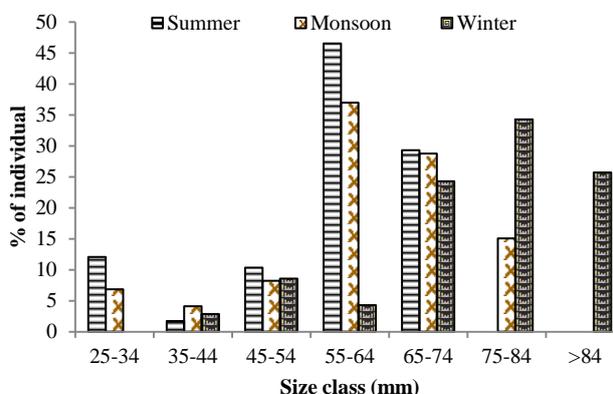

Figure 3. Size class distribution for all individual in summer monsoon and winter season of *C. fasciata* collected from Jessore and Jhenaidah fish market.
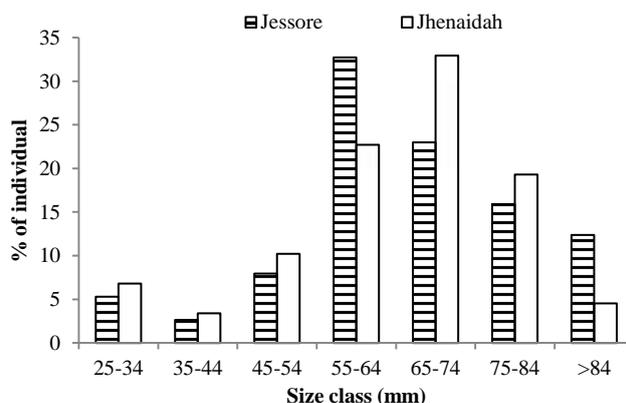

Figure 4. Size class frequency distribution for total individuals of *C. fasciata* collected in Jessore and Jhenaidah fish market during May, 2014 to April, 2015.

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3.3. Length-weight relationship

The regression line of log length (mm) and log weight (mm) was found to be linear and negative in case of sex wise, season wise and district wise specimens of *Colisa fasciata*. Linear relationship between log length (mm) and log weight (g) is shown in Figure 5, Figure 6 and Figure 7.
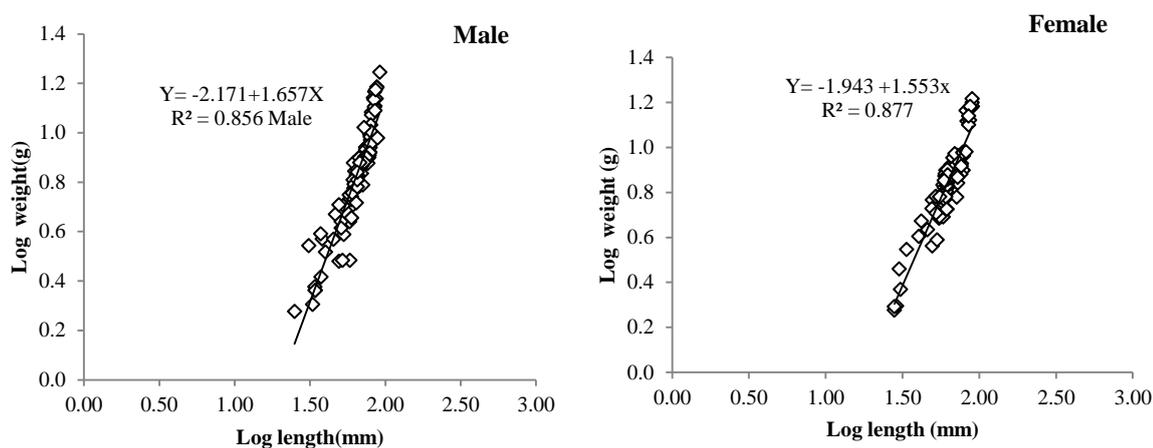

Figure 5. Length weight relation of male and female of *Colisa fasciata* collected from Jessore and Jhenaidah district.
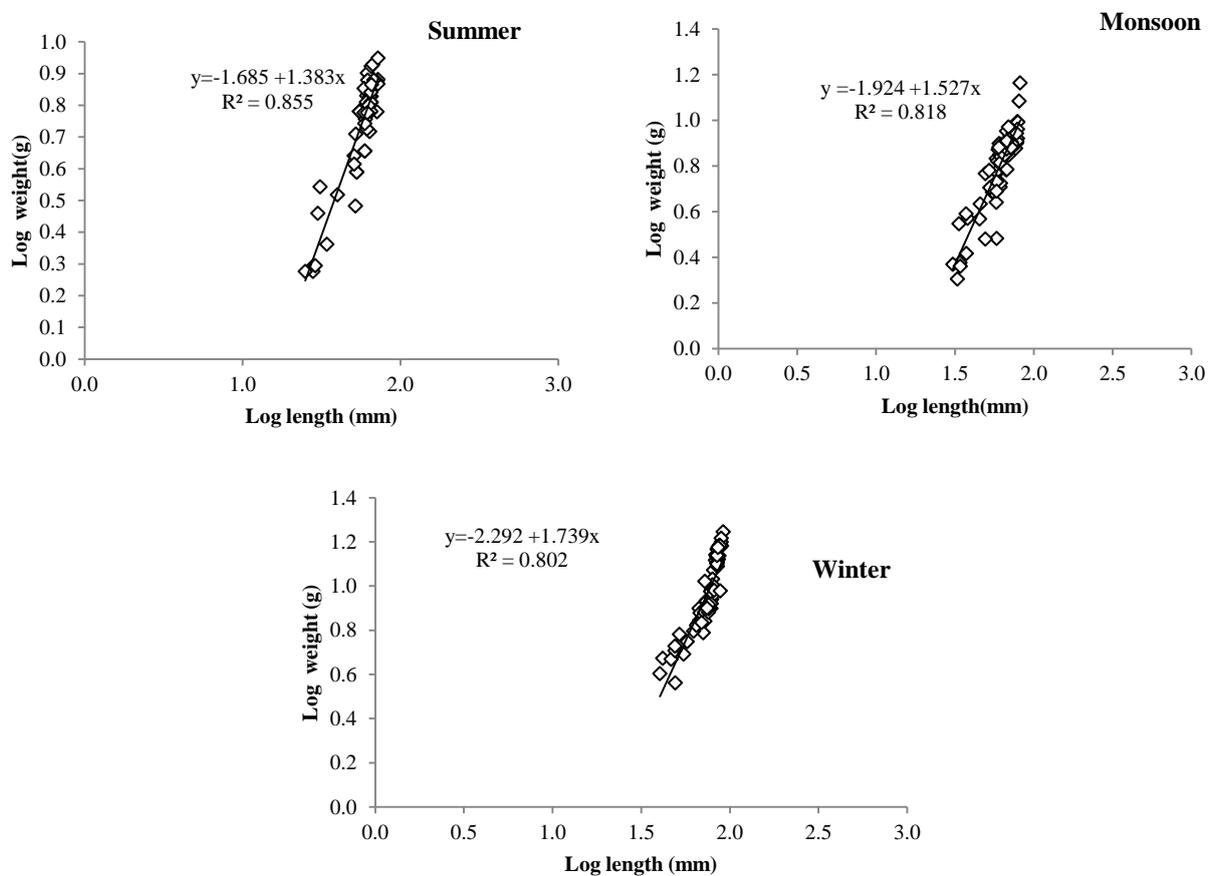

Figure 6. Length weight relation of *Colisa fasciata* in different season collected from Jessore and Jhenaidah district.
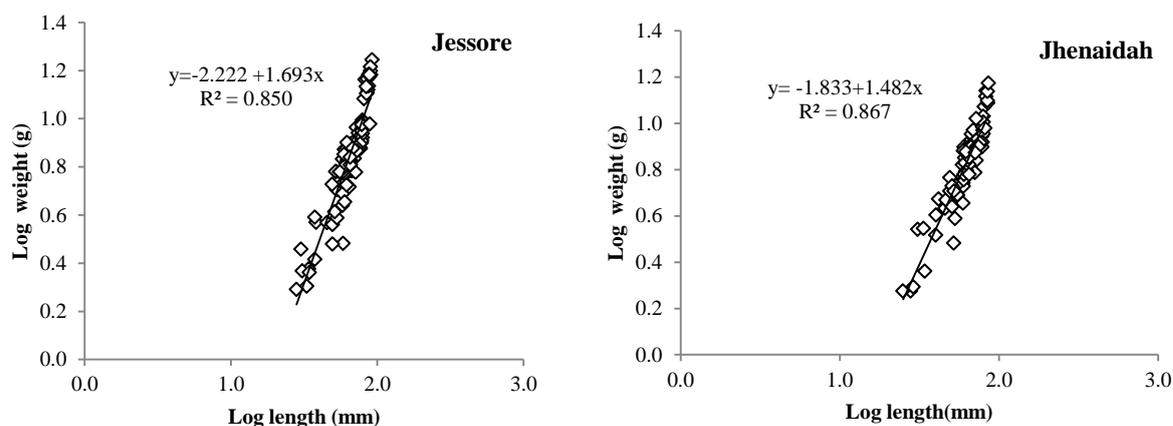
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Figure 7. Length weight relation of *Colisa fasciata* collected from Jessore and Jhenaidah district.

3.4. Sex ratio

Among the 201 specimens, 108 and 93 were observed to be male and female, respectively (Table 2). The overall sex ratio of *C. fasciata* for the whole sample captured over a period of 12 months was significantly in favor of males. The sex ratio ranged from 1:0.43 to 1:2.2 with an overall ratio of 1:0.86. In March females were dominated over male and the sex ratio (male: female) was recorded 1: 2.2. Chi square (χ^2) was used to test whether the sex ratio observed were significantly different from the expected sex ratio of 1:1. Overall males showed non-significant over females. But in November males showed the significant (P<0.01) dominance over females (Table 2). In seasonal sex distribution there were no significant variation noticed (Table 3).

Table 2. Monthly variation of sex ratio (male: female) of *C. fasciata*.

Month	No. of found	Male	Female	%Male	%Female	M:F	X^2	Remark
May	15	9	6	60	40	1:0.67	0.60	NS
June	13	7	6	53.8	46.2	1:0.85	0.08	NS
July	13	6	7	46.2	53.8	1:1.17	0.08	NS
August	12	5	7	41.7	58.3	1:1.40	0.03	NS
September	23	12	11	52.2	47.8	1:0.91	0.04	NS
October	12	6	6	50.0	50.0	1:1	0.00	NS
November	33	23	10	69.7	30.3	1:0.43	5.12	S**
December	16	10	6	62.5	37.5	1:0.60	1.00	NS
January	11	6	5	54.5	45.5	1:0.83	0.09	NS
February	10	4	6	40	60	1:1.50	0.40	NS
March	16	5	11	31.3	68.8	1:2.20	2.25	NS
April	27	15	12	55.6	44.4	1:0.80	0.33	NS
Overall	201	108	93	53.7	46.3	1:0.86	1.119	NS

X^2= Chi square, NS =Non Significant, S**= significant at 1% level

Table 3. Seasonal variation of sex ratio (male: female) of *C. fasciata*.

Season	No. of found	Male	Female	%Male	%Female	M:F	X^2	Remark
Summer	58	29	29	50.0	50.0	1:1	0.00	NS
Monsoon	73	36	37	49.3	50.7	1:1.02	0.01	NS
Winter	70	43	27	61.4	38.6	1:0.62	3.66	NS
Total	201	108	93	53.7	46.3	1: 0.86	1.12	NS

X^2= Chi square, NS =Non Significant

4. Discussion

4.1. Population demography of *C. fasciata*

In the present study the maximum and minimum length of the species was recorded 91.8 mm and 25 mm respectively during sampling period (Table 1). This finding was not supported by Menon (1999) and Talwar and Jhingran (1991). Menon (1999) reported that the maximum length for *Colisa fasciata* is 125 mm and Talwar and Jhingran (1991) also reported that the species attains a length about 120 mm. The results was more or less supported by Mitra *et al.* (2007). They recorded the maximum length for the species is 97 mm in Ganga River,

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India. The size of the male and female was observed in the present study 91.8 mm and 90.1 mm. The females are little smaller than males in the present study which is similar to the findings of Mitra *et al.* (2007) in case of the same species in India. The average length of male and female of *C. fasciata* was recorded 66.41±14.39 mm and 63.41±14.16 mm in the present study. This also indicates that a fully grown male is larger size than female. In the summer, monsoon and winter season there was slight variation in the length of the specimen due to environmental condition in greater Jessore region. In summer the maximum and minimum length was found 72.1 mm and 25.00 mm for male and 72.42 mm and 28.00 mm for female. But in monsoon and winter season the maximum length for male 80.9 mm and 91.8 mm and for female 82.10 mm and 90.1 mm, respectively. In case of average length (57.10±12.10) of the specimen in summer season was smaller than the average length (73.65±12.54) in winter season in this paper (Table 1). Among summer, monsoon and winter season the specimens were larger in size in winter than the two. But in monsoon the females were larger than males. In case of all individuals collected from Jessore and Jhenaidah district there was slight variation in the average length. The average length of the fish in Jessore and Jhenaidah district was 65.46 ±14.39 and 63.72±14.26 mm, respectively (Table 1). The maximum length of the specimens collected from Jhenaidah region was little smaller compare to the specimens of Jessore region.

4.2. Size group distribution of *C. fasciata*
From the present study it is showed that all the species was observed less than 25 to 92 mm in length.In aspects of seasonal size class distribution of *C. fasciata* for all individuals, they were evenly distributed in summer, monsoon and winter season. In summer and monsoon season, most of the individuals were under the size group 55-64 mm. There was no specimen in summer season >75 mm and in monsoon season >84 mm in length. In winter season no specimen was recorded in size group of 25-34 mm (Figure 3).In Jessore and Jhenaidah district the most of the individuals (32.74% and 32.95%) were reported in 55-64 mm and 65-74 mm size group respectively (Figure 4).

4.3. Length weight relationship
The relationship is also useful in differentiating populations as variations occur in populations of different localities (Le Cren, 1951; Chonder, 1972). According to Hile (1936) and Martin (1949) the values of the exponent '*b*' usually remain between 2.5 and 4.0 and in majority of the cases the value was not equal to'3'. Considering the closeness of the value and the possible influence of sex and other internal and external factors on growth, as described by Le Cren (1951). Mitra *et al*. (2007) reported that the exponent '*b*' and regression (R^2) obtained in the length weight relation for male and female separately were highly significant. They reported that the equation for log weight =3.0207 log length- 4.7137; R^2= 0.92 for female and log weight =2.7868 log length- 4.2865; R^2= 0.9272 for male. This result indicated that positive allometric growth of the species. Verghese (1961) and Talwar (1962) also reported the positive relation of the species. The present study of *C. fasciata* showed that the values of the exponent '*b*' value1.657, R^2 = 0.856 and for femaleexponent '*b*' value 1.553, R^2= 0.877. This result indicates that the negative allometric growth of the species. These findings were not supported by Mitra *et al*. (2007) and Verghese (1961) and Talwar (1962). The present study of *C. fasciata* showed that the value of regression coefficient '*b*' tends to be bit higher during winter season than summer and monsoon season. There was no significant variation of R^2 value in three seasons. In Jessore and Jhenaidah district regression R^2 was obtained 0.850 and 0.867 respectively. There was closeness of the value of regression R^2 in both districts.

4.4. Sex ratio
In the present study the overall sex ratio of *C. fasciata* was significantly in favor of males (male: female=1:0.86) indicating more males than females (Table 2) which is supported by Mitra *et al*. (2007) who reported that the overall sex ratio of the same fish in favor of males in India. This indicates that there were more males than females in the population. However, the deviation from expected 1:1 (male: female ratio) is to be attributed as differential growth (Haefner, 1990) or segregation by sex and size according to depth, temperature, and other environmental factor.

5. Conclusions
Colisa fasciata has gained importance for its food and ornamental value. The maximum and minimum length of the species was 98.1 and 25 mm, respectively. Females were little smaller than males. The maximum length of the specimen collected from Jhenaidah district was little smaller compare to Jessore district. The sampled male species was mostly belonging to the size class 65-74 mm and the female species mostly belong to the 55-64 mm

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size class. The relationship between log length (mm) and log weight (g) was found to be linear. The relation also showed negative allometric growth as the 'b' value was less than 3. Sex ratio was in favor of males (male: female =1:0.86). Overall males showed non-significant over females (χ^2 test). The findings of this study will provide valuable information to the fisheries biologist and fisheries management authorities.

Conflict of interest
None to declare.

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