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Original article

Fecundity and gonadosomatic index of *Glossogobius giuris* (Hamilton, 1822) from the Payra River, Patuakhali, Bangladesh

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Abstract

Glossogobius giuris were collected during March to September 2013 from the Payra river to estimate the length-weight relationship with relative condition factor (K_n), fecundity, gonadosomatic index (GSI) and relation between fecundity and other parameters. The length-weight relationship was found to be Log W= 2.667 Log TL – 1.805 in male and Log W = 2.931 Log TL – 2.040 in female. The mean K_n were found to be 1.02±0.155 for male and 0.97±0.276 for female which indicates satisfactory condition of the fish population. The mean relative fecundity was ranged from 88495 to 264104 with a mean value of 171581±17855, having a average total length of 21.21±0.44 cm, body weight 70.22±4.62 g and gonad weight 2.74±0.31 g. The relationships among the fecundity, the total length, body weight, gonad weight were found to be linear and positively correlated. The mean GSI value was 3.42±0.33 and the highest GSI value was recorded 9.34±0.71 in the month of September. This study will help to introduce this species in sustainable aquaculture through proper management and for the development of induced breeding technique.

Keywords: Length-weight relationship, condition factor, gonadosomatic index, fecundity, *Glossogobius giuris*, tank goby, Payra River

INTRODUCTION

Glossogobius giuris, commonly known as Tank Goby and locally known as *Bele*, *Bailla* belongs to the family Gobiidae of order Perciformes. One of the Small Indigenous Species (SIS) of fish, G. *giuris*, has a special preference in the diet of South Asian people because of its unique taste, low fat and high protein content (Islam and Joadder 2005). This species is widely distributed in the freshwater and estuaries of Bangladesh (Rahman 2005). A maximum length of 45 cm has been observed in our country (Rahman 1989). Recently popularity of *G. giuris* has increased several times than the previous in the domestic as well as international market like Italy, India, Burma, Nepal and France (Pillay 1990). However, it is possible to earn huge foreign currency through the potential culture techniques as well as management system of these fish. On the other hand, some catfish cultures are well established and popular due to availability of broodstock, fry and fingerlings, but having negative impacts on environment. Now a day, the aquaculturists are looking for some indigenous fish species for culture through development hatchery. In this regards, *G. giuris* can be a sustainable aquaculture candidate for culture through development of broodstock management. Although there is a high demand for this fish in the markets but, it is very difficult to introduce it into the existing culture system due to scarcity of fry and fingerlings. In spite of having many potentialities, very few research attempts (Hossain *et al.* 1999, Islam 2004, Islam *et al*. 2014) have been made to popularize its commercial culture and mass production of fry and fingerlings. Study of morphometric and meristic characteristics applicable for evaluating the population structure, identifying stocks, studying short-term, environmentally induced disparities and the findings can be effectively used for improved fisheries management (Singh *et al*. 2012). Estimation of fecundity and GSI of a fish is essential for evaluating the commercial potentialities of its stock, life history, practical culture and actual management of the fishery (Saksena 1987, Gupta and Shrivastava 2001, Rahimibashar *et al*. 2012). Condition factor is determined with the intention to describe the condition of that individual (Froese 2006). Different values in K of a fish indicate the state of sexual maturity, the degree of food sources availability, age and sex of some species (Anibeze 2000) and the system of environment (Gomiero and Braga 2005). Recently, Islam *et al.* (2014) have carried out research on the induced breeding of this species. However, the fecundity and gonadosomatic index of *G. giuris* remains to be clarified. Taking into account the above realities the research was conducted to study the length-weight relationship, fecundity and gonadosomatic index of *G. giuris.*

METHODOLOGY

Sample collection: For this research work 115 specimens of *G. giuris* were collected from the Payra River. Location of the river is shown in Figure 1. Fish samples were collected from March to September 2013 from different fishermen. After collection fishes were kept in ice and carried immediately to the laboratory.

Length-weight relationship: Fishes were classified according to sex and total length of each fish was measured in centimeter with maximum accuracy and the body weight in gram was determined using a digital balance (model PA 214). Length-weight relationship was determined by fitting the data to a potential relationship based on the exponential equation (Le Cren 1951) in the form of $TW = aTL^b$ where, TW is the total weight (expressed in g), TL is the total length (expressed in cm), a is a coefficient related to body form and b is an exponent indicating isometric growth when equal to 3. This relationship was transformed into a linear form by the equation.

$$\text{Log } TW = \log a + b \text{ Log } TL$$ (Achakzai *et al.* 2013)

Where W = weight of fish in grams, TL = Total length of fish in cm, ‘a’ and ‘b’ are regression constants. The values of the constant ‘a’ and ‘b’ of the linear regression was determined by following Rounsefell and Everhart (1953) and Lagler (1966).

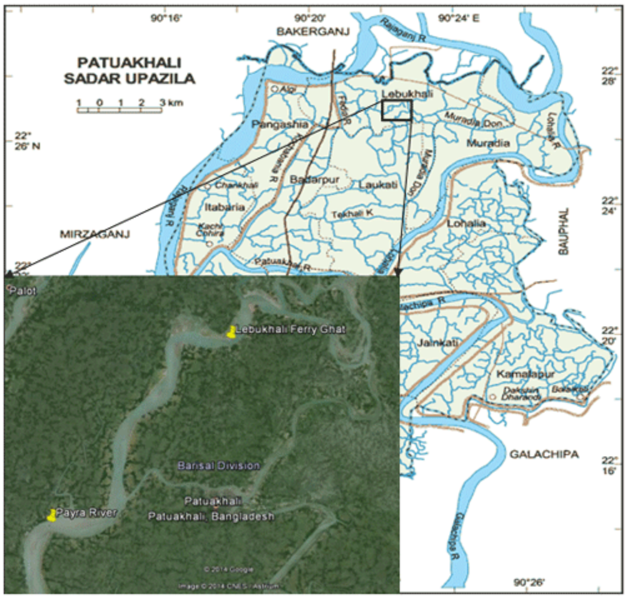

Figure 1: Map of Patuakhali Sadar Upazila showing location of the Payra River.

Condition factor: The relative condition factor ‘K_n’ refers to the relative robustness, or the total well being of the fish. Relative condition factor of the present study was determined by following formula-

$$K_n = W / \hat{}W$$ (Le Cren 1951)

Where W = observed weight, ^W = calculated weight derived from length- weight relationship.

Gonadosomatic index and fecundity: To determine the gonadosomatic index each fish was sacrificed to collect the ovaries and the ovaries were dried with the help of blotting paper and weighed individually by an electric balance and kept in 5% formalin for the preservation of the ovaries as well as to make it much easier to separate the eggs. Fecundity was determined by gravimetric method. Three sub samples were taken from the anterior, middle and posterior portion of the ovary. The numbers of eggs were counted for each sample and fecundity was determined by the following formula:

$$F = n \times G/g$$ (Alam and Pathak 2010)

Where “F” is fecundity, “n” is the average number of eggs, “G” is weight of the gonads and “g” is the weight of the sub sample. The GSI was determined by the following formula-

GSI= Gonad weight/ Body weight * 100 (Alam and Pathak 2010)

The linearity of the fecundity-weight relationships were determined using the equation.

Log Y = a + b Log x (Achakzai *et al.* 2013)

Where, Y = Fecundity estimate, X = Weight (g), '*a*' & '*b*' are regression constants.

Data analysis: Microsoft Excel and SPSS were used to determine linear relationship and correlation coefficient (r) between total length and fecundity, body weight and fecundity, gonad weight and fecundity.

RESULTS

The length-weight relationship of males and females were not significantly different (Figure 2). The regression equations obtained are as follows-

Log W (male) = 2.667 Log TL – 1.805

Log W (Female) = 2.931 Log TL – 2.040

The 95% confidence limits of '*b*' values were: male: 2.414 to 2.919 and female: 2.761 to 3.103.

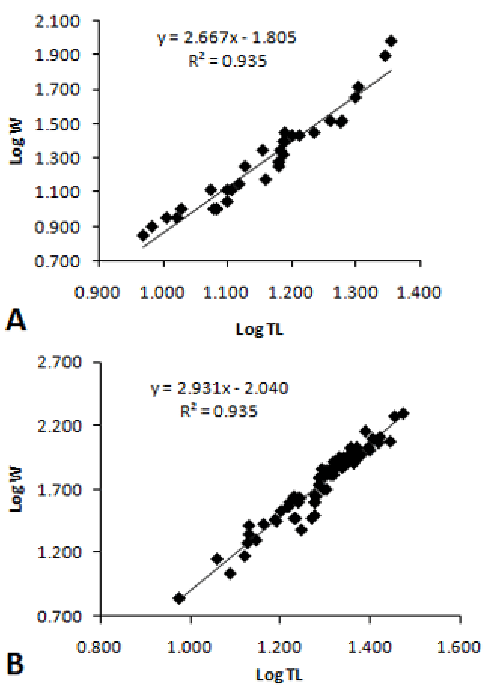

Figure 2: Logarithmic relationship between total length and body weight of *Glossogobius giuris*; (A) male and (B) female

The correlation coefficient '*r*' between log length and log weight was found to be 0.966 in case of both males and females. The results of ANOVA on the length-weight regressions were found to be highly significant ($P<0.001$) in both the sexes based on the coefficient of determination (r^2) (Croxton 1953). The 't' test on 'b' values showed the existence of good relationship between length and weight ($P<0.01$) measurement of males and females.

The significance of the variation in the estimate of '*b*' for females and males of this species from the expected value 3.0 for ideal fish was tested by "t" test. The results of Student's 't' test revealed significant departure of 'b' value from the hypothetical value of '3' in males. While no significant difference could be noticed in females. The 't' test arrived at, 2.31 in males manifested the significant departure of 'b' value from 3 ($P<0.05$). In females value was 0.61 which was non-significant. In the present study the exponential value (*b*) in the length-weight equation was found to be 2.667 for male, shows slight variation and indicate negative allometric growth and in female 2.931 shows isometric growth based on Hossain (2010).

The K_n for all fish samples was determined monthly and individually and presented as 3 cm interval of total size group (Table 1 and 2). The values of K_n shows fluctuation in all size groups of both for males and females. Though, monthly variation of K_n value was not so significant. But, sex wise observation showed contrast figure. In case of female K_n value increase with increasing size. However, when t-test applied on data of K_n for males and females was found that the values are statistically non-significant (p>0.005). In the present study sex-wise analysis of K_n values revealed that the mean K_n value in females (1.02) was to some extent lower than that of males (0.97).

Table 1: Descriptive statistics and estimated parameters of length-weight relationships and condition factor for *Glossogobius giuris* from the river Payra of Patuakhali, Bangladesh

Month	*No. of fish*	*Length range (cm)*	R^2	*b*	*95% CL of b*	$K_n \pm SD$	*a*
Mar	18	9-23	0.992	2.987	2.847-3.128	1.001±0.072	-2.060
April	22	10-23	0.974	3.184	2.950-3.419	1.008±0.121	-2.392
May	29	12-28	0.946	3.314	3.00-3.628	1.009±0.150	-2.623
Jun	14	11-30	0.961	2.873	2.508-3.238	1.012±0.143	-1.934
Jul	18	15-29	0.907	3.276	2.719-3.834	1.009±0.131	-2.497
Aug	8	17-24	0.936	2.542	1.946-3.136	1.003±0.065	-1.484
Sep	6	19-27	0.919	2.524	1.484-3.563	1.004±0.072	-1.483
Oct	20	12-27	0.906	3.276	2.719-3.833	0.929±0.183	-2.498

Gonadosomatic index: *G. giuris* ovaries were paired and in sac which continuous to oviduct lying dorsal to the alimentary canal and ventral to the swim bladder. They were usually equal in size but occasionally one was larger than the other.

Table 2: Mean relative condition factor (K_n) for different size groups of *Glossogobius giuris* from the river Payra of Patuakhali, Bangladesh

Size group (cm)	No. of fish		Observed weight (g)		Calculated weight (g)		K_n	
	M	F	M	F	M	F	M	F
9-12	7	5	9.4	10.5	8.6	17.1	1.11	0.60
12-14	7	7	12.7	18.6	13.7	26.1	0.92	0.70
14-16	11	6	21.9	27.8	22.2	34.1	0.99	0.81
16-18	7	11	27.5	36.2	28.8	42.8	0.96	0.85
18-20	8	14	35.8	51.5	40.4	53.7	0.88	0.95
20-23	6	27	75.3	79.2	57.3	65.5	1.30	1.20
23-25		11		97.9		78.6		1.24
25-30		8		139.9		101.1		1.37

Month wise changes in mean GSI values of male and female of *G. giuris* are presented in Figure 3. Values of gonadosomatic index (GSI) ranged from 0.04 to 10.33 in female and from 0.064 to 1.697 in male during study period. The GSI value of male *G. giuris* were found to be increased during breeding season and gave rise to peak in August (1.23) and after that it declined. In female, alike male average GSI value over months showed similar trend and the highest GSI value observed in August (8.26) and September (9.34).

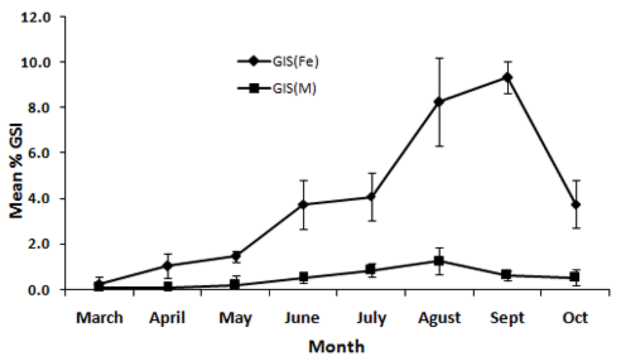

Figure 3: Monthly variation of gonadosomatic index of male and female *Glossogobius giuris*

Fecundity: The fecundity was estimated from gravid randomly collected fish samples ranging from 9.5 cm to 30.5 cm in length, 7.0-197.0 g in weight and from 0.01 to 13.12 g in ovary weight. In gravid female, fecundity was found variable across the spawning season. The fecundity was found to vary from 88495 to 264104 with mean value of 171581±17855 (Table 3).

Table 3: Mean fecundity and other parameters of female *Glossogobius giuris* from the Payra River of Patuakhali District, Bangladesh

Parameters	Min	Max	Mean±SEM
Total length (cm)	9.5	30.5	21.21±0.44
Body weight (g)	7.0	197.0	70.22±4.62
Ovary weight (g)	0.01	13.12	2.74±0.31
Fecundity (No.)	88495	264104	171581.23 ±17855.68
GSI	0.04	10.33	3.42±0.33

Relationship between fecundity and total length: The linear relationship between log of fecundity and total length showed a positive correlation (*r*=0.95) (Figure 4). The regression equation of fecundity with total length of fish was found as follows:

$$\text{Log}_{10}\text{ F} = 2.132 + 1.59\ \text{Log}_{10}\text{ TL}$$

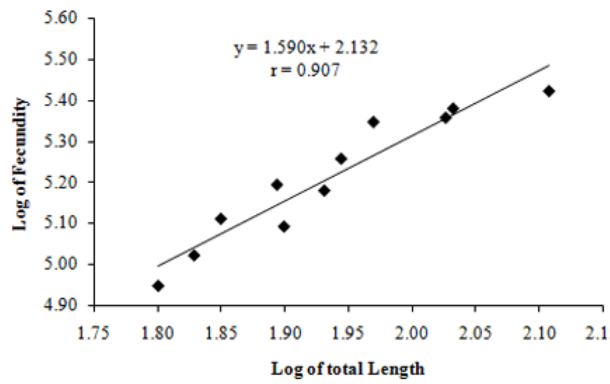

Figure 4: Relationship between log of fecundity and log of total length of female *Glossogobius giuris*

Relationship between fecundity and body weight: The logarithmic relationship of fecundity against body weight (Figure 5) provided a positive linear correlation (*r*=0.818). The equation can be stated as:

$$\text{Log}_{10}\text{ F} = 1.312 + 2.915\text{Log}_{10}\text{ BW}$$

A straight line through the origin would fit the points well, showing that the number of egg were directly proportional to the weight of the fish.

Relationship between fecundity and ovary weight: The fecundity increased progressively with ovary weight of the fishes (Figure 6). The linear relationship between log fecundity and log ovary weight was positively correlated (*r*=0.905):

$$\text{Log}_{10}\text{ F} = 4.147 + 1.173\text{Log}_{10}\text{ OW}$$

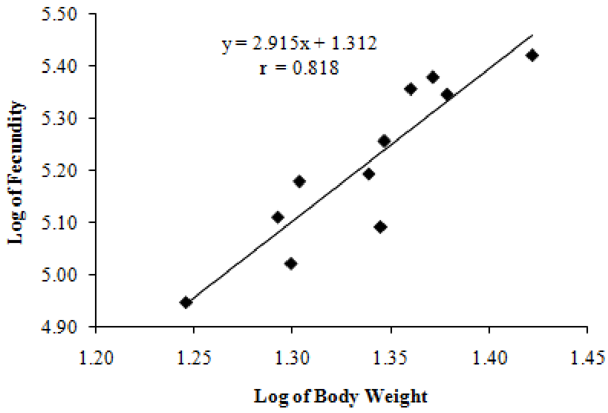

Figure 5: Relation between log of fecundity and log of body weight of female *Glossogobius giuris*

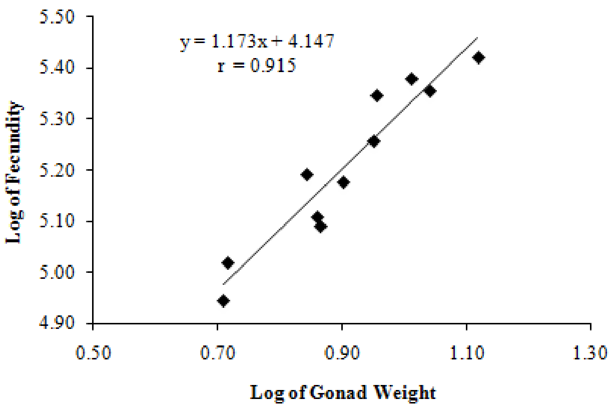

Figure 6: Relationship between log of fecundity and log of ovary weight of *Glossogobius giuris*

DISCUSSIONS

Length-weight relationship: We have observed that a and b value of the present study is 2.667 in case of male and 2.931 in case of female. 95% confidence limit shows that b value were 2.414 to 2.919 in case of male and 2.761 to 3.109 in case of female. The student's t-test was conducted to in case of male. Similar result were obtained by Zoadder (2009), working on the same species from the Northern part of Bangladesh. These findings also supported by Mia (1984) for male *Heteropneustes fossilis*. In case of female t-test showed insignificant difference between *b* value (2.931) and the value of isometric growth (*b*=3). Moreover, b value was slightly lower from the result of the *Oreochromis mossumbicus* female (*b*=3.0577) obtained by Achakzai *et al.* (2013), Al-Baz and Grove (1995) for *Tenualosa ilisha* (3.0345 for female). However, the result obtained from the research on the same species conducted by Zoadder (2009) was quite lower than the present study (*b*=2.657 for female). The Variation may be due to factors like number of specimens examined, habitat, seasonal variations, health condition and differences in the observed length ranges of specimens examined (Bagenal and Tesch 1978, Wooten 1998).

Relative condition factor: The condition factor (K) reflects its variations, information on the physiological state of the fish in relation to its welfare. Furthermore, from a nutritional point of view, there is the accumulation of fat and gonad development (Lalèyè 2000). In the present study the mean K_n was 1.02±0.155 for male and 0.97±0.276 for female. The range of the condition factor for male was from 0.88 to 1.11 and from 0.60 to 1.37 for female. There was no significant difference between different fluctuation levels and indicating a satisfactory condition of the fishes. The mean condition factor of male and female was nearly similar to that of Zoadder (2009) worked with the same species (1.055 for males and 1.0046 for females). In the present study the K_n is higher in the larger sized group. A number of factors (e.g. sex, seasons, environmental conditions, stress and availability of food) are also affecting the condition of fish.

Gonadosomatic index: The mean GSI values during the study period showed the existence of one breeding season in *G. giuris*. The GSI was calculated from March to October and other months were negligible. There was a gradual rise in the values from March to July in case of both male and female. The highest GSI of *G. giuris* was 9.34±0.713 in September and the second highest was 8.26±1.933 in August for female and for male the highest GSI was 1.23±0.593 in August, indicating that *G. giuris* may breed in August and September. Similar trends of the peak value of GSI in the month of August (9.95) and September (8.67) was reported by Islam *et al.* (2012) in *Sillaginopsis panijus* from Meghan river. Alam and Pathak (2010) reported that the peak season of *Labeo rohita* is the month of August.

Fecundity: The number of eggs contained in ovary of a fish is termed as fecundity. Knowledge about fecundity of a fish is essential for evaluating the commercial potentialities of its stock, life history, practical culture and actual management of the fishery (Lagler 1956). In the present study the fecundity was found to vary from 88495 to 264104 with mean value of 171581.23±17855.68 for the fish length from 9.5 cm to 30.5 cm and weight from 7-197 g which indicates that the fish is highly fecund. The variation in fecundity is very common in fish. Numerous factors like stock of fish, nutritional status (Gupta 1967), time of sampling and maturation stage and changes in environmental parameters (Bhuiyan *et al.* 2006) have reported to affect the fecundity. So variation in the fecundity during the study is not an exceptional case. Likewise, Sulistiono (2012) reported the fecundity of *G. giuris* range from 10640-150639 whereas Bhowmick (1965) and Doha

(1974) observed very few eggs ranged from 10760-29580. The present study also indicates that *G. giuris* belonging to the same size group had varying number of eggs in their ovaries.

Relationship between Fecundity and others parameter: Rao and Karamchandani (1986) reported a linear relationship between fecundity-body length, fecundity-body weight, fecundity-standard length and fecundity-ovary weight for *Mystus gulio* which is consistence with the present study. The relation between fecundity and ovary weight were found to be the most prominent among all the relationships and the correlation coefficient, *r* (0.915) between fecundity and ovary weight was highly significant. These findings also agree with the findings of Mishra (1991) for *Channa gachua,* Islam *et al*. (2012) *for Sillaginopsis panijus* and Sharma (1987) for *Mystus cavasius.*

CONCLUSION

Finally, it can be concluded that the result of length-weight relation and condition factor of the *Glossogobius giuris* population from the Payra River is satisfactory. Peak breeding season of this species is August and September. The fecundity of this species is very high. This work would also contribute to the existing knowledge by acting as a baseline data for carrying out future research especially on taxonomy, racial study, morphology, genetic diversity and breeding parameter of other fish species in Bangladesh.

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