World Journal of Fish and Marine Sciences 6 (6): 537-543, 2014
ISSN 2078-4589

DOI: 10.5829/idosi.wjfms.2014.06.06.86210

# Reproductive Characteristics of Bele, *Glossogobius giuris* from Mithamoin *Haor*, Kissorgonj, Bangladesh

*Md. Shakhawate Hossain*

Department of Fisheries Biology and Aquatic Environment
Bangabandhu Sheikh Mujibur Rahman Agricultural University, Bangladesh

**Abstract:** The present investigation was conducted to assess the gonadosomatic index and fecundity of *Glossogobius giuris*. A total of 109 male and 77 female were collected from Kisshorgonj district of Bangladesh over the study period from January to December, 2013. For each individual total length were measured by cm scale board while body and gonad weight were taken by a digital balance. Mean total length and mean body weight of collected fish sample were 21.34 ± 5.57 cm, 91.08 ± 58.75 g, 21.67 ± 4.35 cm and 93.54 ± 43.7g for male and female fish respectively. The mean total fecundity was found 293115.12± 196479.47. Linear relationship were found when regression line for log body length (r = 0.88), log body weight (r = 0.85) and log gonad weight (r = 0.887) plotted against log fecundity. Variation in fecundity, GSI, total length, body weight and gonad weight of the studied species was found over the entire study period. The fish was found to spawn for several months with two spawing peaks. One in march and other one extended from June to October as indicated by the peaks of gonadosomtic index and fecundity study. The present study revealed that the *G. giuris* is high fecund fish compare to its size and weight and have a prolonged breeding season. Findings of this investigation highlighted the importance of this species in fisheries sector of Bangladesh and the information should be useful for sustainable fishery management in *haor* region and elsewhere in country.

**Key words:** Gonadosomatic Index · Fecundity · Bele · Glossogobius Giuris

## INTRODUCTION

*Glossogobius giuris* (Hamilton 1822) belongs to the family Gobiidae of order perciformes commonly known as Goby and locally known as Bele. People of South Asia have special preference for bele in their diet because of its exceptional taste, low fat and high protein content [1, 2]. This species is widely distributed in the freshwater and estuaries of Bangladesh, India, Pakistan, Myanmar and Fareast [3] and form an important capture fishery in our country [4]. A maximum length of 45cm has been observed in our country [5]. Recently popularity of *Glossogobius giuris* has increased several times than the previous in the domestic as well as international market like Italy, India, Burma, Nepal and France [6]. If the potential culture techniques as well as management system of these species can develop, it is possible to earn huge foreign currency in future. Now a day, Carps, tilapia and pangas are being now extensively used as commercially important aquaculture species in the country. However, these species are now genetically eroded due to inbreeding, introgressive hybridization as well as poor brood stock management. Therefore, farmers are now searching new potential aquaculture species. In this circumstances *G. guiris* may be a good candidate and play role for enhancement of fish production as well as upliftment of socioeconomic condition in the country. While 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 [7-10] have been made to popularize its commercial culture and mass production of fry and fingerlings [10]. Gonado-somatic index determines the state of maturity and onset of spawning season used to follow the reproductive cycle of a species over the year at monthly or less intervals. The size of ovary and eggs is used to characterize the relative sexual maturity of the fish [11]. Accurate fecundity estimates are also important for understanding the dynamics of fish populations,

**Corresponding Author:** Md. Shakhawate Hossain, Department of Fisheries Biology and Aquatic Environment Bangabandhu Sheikh Mujibur Rahman Agricultural University, Bangladesh.

predicting trends in population abundance and estimating spawning stock biomass [12]. Now a day, the Knowledge of fecundity has been applied for detecting the different population of the same species of fish in different locations [13]. A linear relationship between fecundity length and weight of ovary has been established by several authors [10, 14-17]. Islam and Mollah [18] and Islam *et al*. [9] have carried out research on the induced breeding of this species. As of late Roy *et al*. [10] studied GSI and fecundity of bele collected from Patuakhali region of Bangladesh. However, knowledge regarding GSI, fecundity and breeding of *G. giuris* is still fragmentary. Therefore, it is very important to know about gonadosomatic index and fecundity of this species to get more and more information about its reproduction potential and usefulness as a candidate for fish culture.

## MATERIALS AND METHODS

The experiment was carried out in the laboratory of Fisheries Faculty situated in the Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU) campus, Gazipur from January 2013 to January 2014. Samples of *Glossogobius giuris* (Hamilton, 1822) was collected monthly from the Chamra Ghat of Kissorgonj districts of Bangladesh. After collection fishes were carried immediately to the laboratory in ice box.

**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 (model PA 214) 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 number of eggs was counted for each sample and fecundity was determined by the following formula: $F = n \times G/ g$

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 gonadosomatic index was determined by the following formula

GSI= Gonad weight/ Body weight * 100

The linearity of the fecundity - weight relationships were determined using the following equation: Log Y = a + b Log x

Fig 1: Ovaries of G. giuris fish

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

**Data Analysis:** Micro Excel was used to determine linear relationship and correlation coefficient (r) between total length and fecundity, body weight and fecundity, gonad weight and fecundity.

## RESULTS AND DISCUSSION

**The Morphology of the Ovary:** The cystovarian ovaries of *G. giuris* were paired tubular organs lying dorsal to the alimentary canal and ventral to the swim bladder. They were attached to the body cavity by the mesovarium. The ripe ovaries were found to extend up to the end of the urinogenital pore. They were usually equal in size but occasionally one was larger than the other (Figure 1). The eggs were elongated in size. Alike phenomenon were also observed by Roy *et al*. [10].

**Sex Ratio and Gonado-somatic Index:** The sex ratio (Male: Female) of the examined fish were recorded 1:0.71. Rao and Rao [19] showed the male to female ratio as 1:0.59 over one year period examination in Gosthani Estuary which was statistically similar to those of this study. Begum *et al*. [20] observed 1:1.21 male-female sex ratio in *Liza parsia*. The gonado-somatic index, the indicator of the status of gonadal development and maturity of individuals of experimental species, was calculated for male and female *G. giuris* during January to December. The GSI value increases with the maturation of fish declining abruptly thereafter [21]. Month wise changes in mean GSI values of male and female of *G. giuris* are presented in Table 1 and Figure 2. Values of gonadosomatic index (GSI) ranged from 0.216 ± 0.11 to 9.62±2.21 in female and 0.04±0.01 to 0.358±0.04 in male

Table 1: Mean and standard error mean (± SEM) of total length, body weight, gonad weight, gonad length and GSI in male and female *G. giuris*

| | | Mean± SEM | | | | |
|---|---|---|---|---|---|---|
| Months | Sex | Total Length (cm) | Body Weight (g) | Gonad weight (g) | Gonad length (cm) | GSI |
| January | Male | 21.42±1.57 | 98.24±16.61 | 0.04±0.01 | 1.97±0.17 | 0.04±0.01 |
| | Female | 20.62±1.73 | 84.09±15.04 | 0.29±0.12 | 2.08±0.22 | 0.36±0.10 |
| February | Male | 12.68 ± 1.04 | 20.50 ± 3.97 | 0.01 ± 0.002 | 2.25 ± 0.28 | 0.063 ± 0.005 |
| | Female | 17.66 ± 1.55 | 42.60 ± 10.33 | 0.50 ± 0.06 | 2.66 ± 0.20 | 1.324 ± 0.217 |
| March | Male | 11.91± 0.16 | 15.20 ± 0.73 | 0.01 ± 0.002 | 1.59 ± 0.10 | 0.097 ± 0.006 |
| | Female | 12.53 ± 0.63 | 19.25 ± 3.47 | 0.96 ± 0.21 | 2.63 ± 0.31 | 5.265 ± 0.971 |
| April | Male | 13.92 ± 0.49 | 33.40 ± 2.62 | 0.04 ± 0.01 | 1.84 ± 0.19 | 0.120 ± 0.020 |
| | Female | 14.80 ± 0.80 | 37.00 ± 6.00 | 0.09 ± 0.05 | 2.15 ± 0.65 | 0.216 ± 0.110 |
| May | Male | 22.44 ± 1.02 | 105.43 ± 15.36 | 0.09 ± 0.02 | 3.86 ± 0.37 | 0.086 ± 0.022 |
| | Female | 23.4 ±0.75 | 113.21 ±10.77 | 3.88 ±1.34 | 5.20 ±0.60 | 2.93 ±0.882 |
| June | Male | 23.26 ± 0.50 | 89.00 ± 4.34 | 0.27 ± 0.01 | 3.90 ± 0.20 | 0.305 ± 0.018 |
| | Female | 23.72 ± 0.68 | 119.38 ± 10.48 | 9.25 ± 1.14 | 5.74 ± 0.19 | 7.774 ± 0.656 |
| July | Male | 27.02 ±1.71 | 172.17 ±29.22 | 0.43 ±0.06 | 4.83 ±0.43 | 0.258 ±0.034 |
| | Female | 23.77 ±0.93 | 117.00 ±11.22 | 6.35 ±1.57 | 5.72 ±0.27 | 5.631 ±1.146 |
| August | Male | 23.85 ± 0.41 | 94.83 ± 3.98 | 0.30 ± 0.02 | 3.88 ± 0.14 | 0.314 ± 0.020 |
| | Female | 24.00 ± 0.74 | 104.00 ± 8.80 | 7.76 ± 0.42 | 5.95 ± 0.13 | 7.558 ± 0.458 |
| September | Male | 20.10± 0.45 | 69.33± 4.95 | 0.15± 0.02 | 3.52± 0.12 | 0.23± 0.04 |
| | Female | 20.14±1.16 | 79.71±11.12 | 5.11±1.23 | 5.26± 0.34 | 6.04± 0.62 |
| October | Male | 20.2±0.98 | 57.8±7.24 | 0.196±0.02 | 3.22±0.15 | 0.358±0.04 |
| | Female | 19.00±0.58 | 45.67±1.86 | 4.34±0.95 | 4.47±0.27 | 9.62±2.21 |
| November | Male | 25.35±0.56 | 118.13±6.84 | 0.12±0.05 | 3.46±0.14 | 0.10±0.04 |
| | Female | 24.70±1.16 | 115.25±17.02 | 9.23±1.42 | 6.10±0.20 | 8.02±0.47 |
| December | Male | 21.32 ± 1.01 | 99.23 ± 12.34 | 0.08 ± 0.01 | 3.76 ± 0.39 | 0.045±0.01 |
| | Female | 23.4 ±0.65 | 105.42 ±9.58 | 3.79 ±1.46 | 5.40 ±0.70 | 2.15±0.73 |

The mean numbers were calculated as mean ± standard error of the mean.

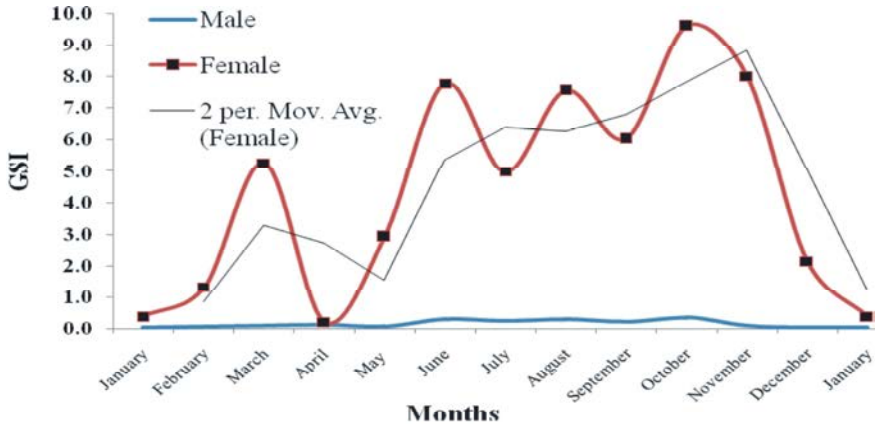


Fig 2: Monthly variation of gonadosomatic index (GSI) of male and female *G. giuris*

*G. giuris* during January to December. The GSI value of male *G. giuris* were found more or less similar during the study period except to some extent highest value observed in August (0.314) and October (0.358). In case of Female highest GSI value were observed in March (5.265), June (7.774), August (7.558), October (9.62) and in November (8.02) with two spawning peak one in March and other in Mid October (Figure 2). Therefore, the fish spawned for several months and this also indicate prolonged breeding season which was extend from March to November and was similar to Rao and Rao [19] observation where they found prolonged breeding season from August to January with its peak in the month of September. Islam [8] also stated that this species is a prolific breeder that breds throughout the year with a peak in August. On the other hand, Islam and Mollah [18] stated highest GSI value in April in captive condition. This slight variation may be due to the environmental

variation of the habitat. Miah and Dewan [22] stated three spawning peaks in case of *Sarotherodon nilotica*. However, Rheman *et al*. [23] found two spawning peaks in *Liza parsia* (Ham.).

**Fecundity:** The fecundity was estimated from 34 randomly collected fish samples ranging from 12.8 ± 0.8 to 25.5±1.041 cm in length, 20.5 ± 4.5 to 146 ± 10.693 g in weight and from 1.275 ± 0.25 to 10.073 ± 1.31g in ovary weight. In gravid female, fecundity was found variable over the spawning season. The average numbers of eggs was found 293115.12± 33695.95 (Table 2) in fish length from 12 cm to 2.8 cm and weight from 16-190 which indicates that the fish is highly fecund. The fecundity was found to vary from 17563.5 ± 2576.5 to 542875.8 ±72710.3 (Table 3). However, during the spawning season highest value was observed in August (542875.8 ±72710.3) in the fish having a mean length 24±0.74 cm with mean total body weight 104±8.80 g and the lowest in March (17563.5±2576.5) in the fish having a mean length 12.8 ±0.8 cm with mean total body weight 20.5±4.5 g. These results revealed that older fish were more fecund than the younger one. Begum *et al*. [20], Rheman *et al*. [23] and Dan [24] also observed same findings for *L. parsia* and *Tachysurus thalassius*. During the study, it was observed that the ovaries of same size of fishes contained different numbers of eggs. This may be due to the variations in environmental conditions and food intake by the individual. This variation is common in fish and has been reported by many researchers [26, 27]. So, variation in the fecundity during the study is not an exceptional case. Likewise, Roy *et al*. [10], Sulistiono [27] and Rao and Rao [19] reported the fecundity of *G. giuris* respectively range from 88495 to 264104, 9380 t0 293664 and 10640-150639 whereas Bhowmick [28] and Doha [3] 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. The mean value of fecundity in June was 416895.2±48951.44 (Table 3). There was no significant difference ($p$>0.05) between the fecundity of June and August. Similarly no differences were observed between June and May; May, July and September and March, July and September (Table 3). This indicates that *G. giuris* breeds several months in the year.

Table 2: Mean (± SEM) and Range value of fecundity and other parameters of *G. giuris*

| Parameters | Mean ± SEM | Range |
|---|---|---|
| Total Length (cm) | 22.01± 0.63 | 12.00-27.40 |
| Body Weight (g) | 99.32± 7.04 | 16.00-190.0 |
| Ovary Weight (g) | 7.43± 0.68 | 1.03-19.9 |
| Fecundity | 293115.12± 33695.95 | 14987-716400 |
| GSI | 7.15 ± 0.39 | 3.44-13.13 |

Table 3: Monthly variations of fecundity and other parameters of *G. giuris*

| Months | Statistics | Total Length (cm) | Body Weight (g) | Ovary Weight (g) | Fecundity |
|---|---|---|---|---|---|
| March | Mean ±SE | 12.8 ±0.8 | 20.5±4.5 | 1.275±0.25 | 17563.5±2576.5$^{c}$ |
| | Range | *12-13.6* | *16-25* | *1.03-1.52* | *14987-20140* |
| May | Mean ±SE | 25.5±1.041 | 146±10.693 | 7.47±1.60 | 281073.7±96014.28$^{ab}$ |
| | Range | *23.5-27* | *125-160* | *5-10.46* | *98036-422883* |
| June | Mean ±SE | 23.45±0.75 | 117.6±11.89 | 10.073±1.31 | 416895.2±48951.44$^{a}$ |
| | Range | *20.4-27.4* | *74-190* | *4.86-19.9* | *134136-716400* |
| July | Mean ±SE | 22.78±0.956 | 109.83±11.92 | 8.29±1.80 | 185354.3±35875.59$^{abc}$ |
| | Range | *21-27* | *88-157* | *3.03-14.58* | *88476-350000* |
| August | Mean ±SE | 24±0.74 | 104±8.80 | 7.7575±0.42 | 542875.8 ±72710.3$^{a}$ |
| | Range | *21.9-25.2* | *80-121* | *6.95-8.84* | *350730-694624* |
| September | Mean ±SE | 20.14±1.16 | 79.71±11.12 | 5.11±1.23 | 184740.71±62295.44$^{abc}$ |
| | Range | *18.00-24.90* | *55.00-123.00* | *2.79-11.11* | *63522-514170* |
| October | Mean ±SE | 18.00±1.0 | 44.5±2.5 | 5.3±0.37 | 170900±23617$^{bc}$ |
| | Range | *18.00-20.00* | *42.0-47.0* | *5.63-4.9* | *147283.0-194517.0* |

$^{a,b,c}$ Mean values having different superscripts differ significantly (P<0.05)

Table 4: Average of fecundity counts at various lengths ranges and number of ova per g body weight of *G. giuris*

| | | Mean ± SEM | | | | |
|---|---|---|---|---|---|---|
| Frequency | Length Range (cm) | Total Length (cm) | Body Weight (g) | Ovary Weight (g) | Fecundity | No. of ova / g body weight |
| 2 | 12-17 | 12.80±0.80 | 20.50±4.50 | 1.28±0.25 | 17563.50±2576.50 | 857 |
| 15 | 17-22 | 19.94±0.38 | 72.4±4.33 | 5.33±0.58 | 193393.7±32476.4 | 2522 |
| 17 | 22-29 | 24.92±0.34 | 132.35±6.00 | 10.02±0.86 | 413522.41±43086.24 | 3124 |

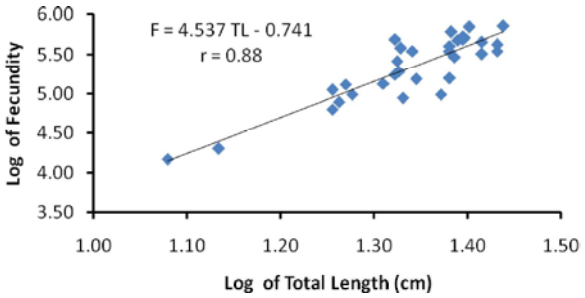


Fig 3: Relationship between log of fecundity and log of total length of female *G. giuris*

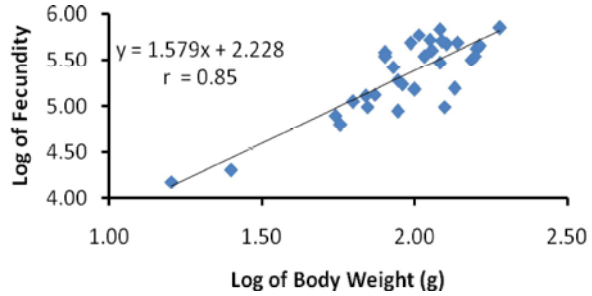


Fig 4: Relation between log of fecundity and log of body weight of female *G. giuris*

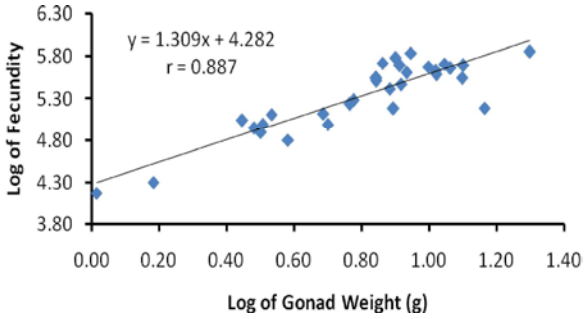


Fig 5: Relationship between log of fecundity and log of ovary weight of *G. giuris*

The fecundity of *G. giuris* also varies according to length. Average highest fecundity 413522.41±43086.24 was found in the length range of 22-29 and lowest 17563.50±2576.50 was in 12-17 length ranges (Table 4) and here also found that ova count per g body weight of fish increasing with the increase of length. These results revealed that older fish were more fecund than the younger one. Similar results also found in *L. parsia* (20).

**Relationship Between Fecundity and Other Parameter**

**Fecundity (F) and Total Length (Tl) Relationship:** The scattered diagram obtained from the fecundity and total length relationship showed a nearly perfect correlation. The logarithmic relationship of fecundity on total length (Figure 3) gave a regression coefficient 4.537; intercept - 0.741 and correlation coefficient of 0.88. Therefore, the regression equation of fecundity with total length of fish could be expressed as: $Log_{10}F = - 0.741 + 4.537 Log_{10}TL$

**Fecundity (F) and Body Weight (bw) Relationship:** The logarithmic relationship of fecundity against body weight (Figure 4) produced a regression coefficient of 1.579, intercept 2.228 and correlation coefficient of 0.85 in *G. giuris*. The equation can be stated as:

$$Log_{10}F = 2.228 + 1.579\ Log_{10}BW$$

It could be seen from the figure that a straight line through the origin would fit the points well, showing that number of egg were directly proportional to the weight of the fish.

**Relationship Between Fecundity (f) and Gonad Weight (gw):** The fecundity increased progressively with ovary weight of the fishes. For the regression of log fecundity on log ovary weight the following equation was obtained:

$$Log_{10}F = 4.282 + 1.309 Log_{10}GW$$

The above equation and the estimated regression line (Figure 5) showed that the relationship between fecundity and gonadal weight was linear.

The relationship with fecundity and total length, body weight and gonad weight have been established and found linear. The similar findings were also observed by Roy *et al*. [10], Begum *et al*. [19], Khan *et al*. [29], Kabir *et al*.[30] and Islam and Hossain [31] in case of *G. giuris*, *Liza parsia*, *Plotosus canius*, *Gadusia chapra* and *Puntius stigma* respectively. It has also been noted that the fecundity is more related to the ovary weight (r=0.887) than the fish length (r=0.88) and fish weight (r=0.85).

This finding agrees with the conclusion reached for *G. giuris* by Roy *et al*. [10] and Nabi *et al*. [32] and for *Sillaginopsis panijus* by Islam *et al*. [33].

## CONCLUSION

It is clear from the results that *G. giuris* is a highly fecund fish and fecundity is linear type with different body parameter. The fish spawned for several months in the year with highest peak spawning season in June to October. This basic information will be helpful to evaluate reproductive potential of individual fish species in similar studies. Similarly, it will be useful for fishery biologist or manager to enforce adequate regulation for sustainable fishery management to control over exploitation. Additionally, information also aids in evaluation and prediction of fish stock in the different water bodies of Bangladesh. However, further investigation on breeding behavior and artificial breeding feasibility also necessary to introduce the species in commercial aquaculture.

## ACKNOWLEDGEMENT

The authors would like to thank Research Management Committee (RMC) of Bangabandhu Sheikh Mujibur Rahaman Agricultural University for funding the research.

## REFERENCES

1. Islam, M.N. and M.A.R. Joadder, 2005. Seasonal variation of the proximate composition of freshwater gobi, *G. giuris* (Hamilton) from the river Padma. Pakistan J. of Biological Sci., 8(4): 532-536.
2. Ahmed, A.T.A., G. Mustafa and M.Z. Alam, 1984. Biochemical composition of seven species of Gobi fish. J. Asiatic Soc. Bangladesh, 10: 107-111.
3. Doha, S., 1974. Investigation into the biology of the gobi, Glossogobius giuris (Hamilton -Buchanan). Bangladesh J. Zool., 2: 95-106.
4. Costa, T., A. Begum and S.M.N. Alam, 1999. From exclusion to collective ownership: A case study of user-group representatives in fisheries management in Bangladesh. Caritas and Department of Fisheries (DoF), Bangladesh.
5. Rahman, A.K.A., 1989. Freshwater Fishes of Bangladesh. Zoological Society of Bangladesh, Dhaka, pp: 364.
6. Pillay, T.V.R., 1990. Aquaculture: Principal and practices. Blackwell Science Ltd., UK., pp: 575.2.
7. Hossain, M.R., K. Afsana and A.K.M. Azad, Shah, 1999. Nutritional value of some small indigenous fish species (SIS) of Bangladesh. Journal of Fisheries Research, 3: 77-85.
8. Islam, M.N., 2004. Eco-biology of freshwater gobi, Glossogobius guiris (Hamilton) of the river of Padma in relation to its fishery. Journal of Biological Sciences, 6: 780-793.
9. Islam, M.S., D.M. Tuly, M. Hasnahena, P. Bahadur and M.R. Hasan, 2014. Induced Breeding of Freshwater Goby, Glossogobius giuris (Hamilton, 1822) in the Captivity: A preliminary Study. Journal of Fisheries and Aquatic Science, 9(1): 24-32.
10. Roy, A., M.S. Hossain, M.L. Rahman, M.A. Salam and M.M. Ali, 2014. Fecundity and gonadosomatic index of Glossogobius giuris (Hamilton, 1822) from the Payra River, Patuakhali, Bangladesh. Journal of Fisheries, 2(2): 141-147.
11. Islam, M.K. and M. Das, 2006. Fecundity of gulsa Mystus cavasius (Hamilton) from the Bramaputra and Kongsa Rivers. Journal of Bangladesh Agricultural University, 4(2): 347-355.
12. Eldridge, M.B. and B.M. Jarvis, 1995. Temporal and spatial variation in fecundity of yellow tail rockfish. Trans. Amer. Fish. Soc., 124(1): 16-25.
13. Mishra, S. and D.N. Saksena, 2012. Gonadosomatic Index and Fecundity of an Indian Major Carp Labeo Calbasu in Gohad Reservoir. The Bioscan, 7(1): 43-46.
14. Khan, H., 1939. Study on the sex organ of Mahaseer (Barbus tor). J. Nat. Hist. Soc., 40: 653-656.
15. Alikunhi, K.H. and S. Parmeswaran, 1963. Induced spawning of Chinese carp Ctenopharyngodon idellus (C.V.) and Hypophthalmichthys molitrix (C.V.) in ponds at Cuttack India. Proc. Indo-Pac. Fish Counc., 10(2): 181-204.
16. Desai, V.R., 1973. Studies on fisheries and biology of Tor tor (Ham.) from river Narbada. Pro. Indian Nat. Sci. Acad., 39: 228-248.
17. Pathani, S.S., 1981. Fecundity of Mahseer Tor putitora (Ham.). Proc. Indian Acad. Sci., 9: 253-260.
18. Islam, M.R. and M.F.A. Mollah, 2013. Morphological observation and PG-induced breeding of glossogobius giuris (hamilton 1822). Journal of Science and Technology, 11: 171-180.
19. Rao, S. and L.M. Rao, 2007.Sex Ratio, Fecundity, Maturity and Spawning Details of Glossogobius giuris (Hamilton) from Gosthani Estuary near Visakhapatnam. Journal of Life Science, 1: 16-29.

20. Begum, M., M.A. Islam, H.K. Pal and M.J. Alam, 2010. Reproductive characteristics of Liza parsia (Ham.) inhabiting southwest coast of Bangladesh. J. Bangladesh Agril. Univ., 8(1): 173-178.
21. Parameswarn, S., C. Sevaraj and S. Radhakrishnan, 1974. Observation on the biology of Labeo gonius (Hamilton). Indian J. Fish., 21: 54-75.
22. Miah, A.M. and S. Dewan, 1984. Studies on the fecundity of Sarotherodon nilotica (Linnaeus) in a fish pond. Bangladesh J. Zool., 12: 99-103.
23. Rheman, S., M.L. Islam, M.M.R. Shah, S. Mondol and M.J. Alam, 2002. Observation on the fecundity and gonadosomatic index (GSI) of grey mullet Liza parsia (Ham.) Online J. Biol. Sci., 2(10): 690-693. Science Publishers, Ann Arbor, MI, pp: 161.
24. Dan, S.S., 1977. Maturity, spawning and fecundity of catfish Tachysurus thalassinus (Day). Indian J. Fish., 24: 96-106.
25. Akter, H., M.R. Islam and M. Belal Hossain, 2012. Fecundity and Gonadosomatic Index (GSI) of Corsula, Rhinomugil corsula Hamilton, 1822 (Family: Mugilidae) from the Lower Meghna River Estuary, Bangladesh. Gloval Veterinaria, 9(2): 129-132.
26. Bhuiyan, A.S., K. Islam and T. Zaman, 2006. Fecundity and ovarian characteristics of Puntius (Bloch/Bleeker) Cyprinidae: Cypriniformes). J. Bio. Sci., 14: 99-102.
27. Sulistiono, 2012. Reproduction of tank goby (Glossogobius giuris) in Ujung Pangkah waters, East Java. Jurnal Akuakultur Indonesia, 11(1): 64-75.
28. Bhowmick, R.M., 1965. Studies on some aspects of the biology of Glossogobius giuris (Hamilton) with notes on its fishery in the Hoogly estuary. Proc. Indo-Pacific Fish Coun., 11: 99-115.
29. Khan, M.S.A., M.J. Alam, S. Rheman, S. Mondol and M.M. Rahman, 2002. Study on the fecundity and GSI of brackishwater catfish Plotosus canius (Hamilton-Buchanon). Online J. Biol. Sci., 2(4): 232-234.
30. Kabir, A.K.M.A., M.A. Hossain, S.M. Rahmatullah, S. Dewan and M.S. Islam, 1998. Studies on the gonadosomatic index and fecundity of chapila (Gadusia chapra Ham.). Banladesh J. Fish. Res., 2(2): 195-200.
31. Islam, M.S. and M.A. Hossain, 1990. The fecundity and sex-ratio of the common punti, Puntius stigma (Cuvier and Valenciennes) (Cypriniforms: Cyprinidae) from the river Padma near Rajshahi [in Bangladesh]. University J. Zool. Bangladesh, 6: 69-74.
32. Nabi, M.R., H.A. Rahman, S. Mustafa and M.A. Kader, 2007. Population dynamics of estuarine set bag net fishery of Bangladesh. Chiang Mai Journal of Science, 34(3): 355-365.
33. Islam, M.R., N. Sultana, M.B. Hossain and S. Mondal, 2012. Estimation of Fecundity and Gonadosomatic Index (GSI) of Gangetic Whiting, Sillaginopsis panijus (Hamilton, 1822) from the Meghna River Estuary, Bangladesh. World Applied Sciences Journal, 17(10): 1253-1260.