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GONAD HISTOLOGY AND BIOLOGICAL ASPECTS OF FRESHWATER GOBI, *GLOSSOGOBIUS GIURIS* (HAMILTON 1822)

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ABSTRACT
In this study, it was aimed at investigating the reproductive biology and histologically determining the developmental stages of oocytes of bele, *Glossogobius giuris.* Based on the weight of the gonad, presence or absence of ripe oocytes, diameter of oocytes in the ovary and histological observations: five typical gonad maturation stages were described for female using microscopic criteria. During observation period the mean fecundity was obtained 13909.57 ± 3574 and ovum length 0.032 mm to 0.054 mm. Based on the percentage of vitellogenic (VG) stages of oocytes and developmental pattern of gonadosomatic index (GSI) value, it was concluded that their breeding season restricted from April to June.

KEY WORDS: freshwater, fecundity, Gobi, gonad histology, GSI.

INTRODUCTION

Bangladesh is highly rich in fishery potentialities. There are thousands of ponds, tanks, beels, haors, baors, canals and rivers all over the country. Fishery contributes 3.74% in its GDP and ensures 60% of animal protein to the people. Nearly 10% of country labor force engaged in fishery sector and contribute 3% in its export earnings. Gobi or goby, *Glossogobius giuris* is commonly known as bele or bailla in Bengali. About 80% population is poor in the country and they depend on small size fish for their daily supply of animal protein as they are available at reasonable price (Siddique, 1985). Bele is a small size of fish but not an important fish in Bangladesh. It is a source of protein to the common people of Bangladesh. *G. giuris* is a low fat and high protein fish (Islam and Joadder, 2005 and Ahmed *et al*., 1984). Recently the commercial value of gobi is increasingly recognized in many parts of Bangladesh due to its high nutrition and palatability.

Great ecological diversity is seen in gobies and distributed naturally in estuaries, haors, boars, beels, streams, rivers, lakes or reservoirs and old mining pools. Talwar and Jhingran (1991) reported that *G. giuris* is found mainly in freshwater and estuaries, but also enter the sea. *G. giuris* are found 24 species in fresh, brackish and marine (Coad, 2009). It is a carnivore and feeding on a wide variety of prey items. Bhuiyan (1964) reported that *G. giuris* is a bottom dweller fish and taken small fish and crustaceans, insects and rotten plants and plays an important role in our ecology. Now-a-days its abundance in nature is decreasing day by day due to various human interferences. According to IUCN (2000), bele is considered as rare or very rare species. The number of eggs contained in the ovary of a fish is term the fecundity (Nikolsky, 1963). 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 (Doha and Hye, 1970). It is most important to know the number of eggs, fry and young that could be produced from an individual brood fish for the purpose of better management and production. Fecundity varies from one species to another, depending on the environmental conditions, length, age, etc. Many workers have worked on the fecundity of different fish, viz, Alam *et al*. (1994), Bhuiyan *et al.* (2000), Dobriyal *et al*. (2000), Kiran and Puttaiah (2003). But very little information is available on the fecundity and basic genetics of gobi fish. So an attempt was made on to evaluate the GSI value based on reproductive biology and proper breeding of bele.

MATERIALS AND METHODS

A total number of 200 live samples of gobi were obtained from Bramaputra river during November to December, 2009 and were temporarily stored at the indoor tanks of Bangladesh Fisheries Research Institute Hatchery Complex at Mymensingh and then kept in a pond. The fishes were fed with supplementary feed consisted with 35% protein and also live feed with small fish mola and prawn. Only gravid females /sexually mature fishes were used to study the fecundity, GSI and gonad development. To estimate GSI value and observation on gonad development was made on

January to July, 2010. In each month ten fish samples were sacrificed. Prior to sacrifice the fish the total length were measured in the nearest mm and their weights were recorded in the nearest gram be a sensitive balance in the laboratory. All the samples were killed by over anaesthetized in ice water. After sacrificing the fish gonad were removed and then the length and weight of the ovaries were taken. Excess of water was removed from the surface of the fish as well as the ovaries with blotting paper before their weights were taken. To estimate the fecundity, gravimetric method (Hunter *et al.*, 1989) was used and a portion of mature ovaries was wet weighed and the ripe oocytes were counted. For histological study the target organs (gonads) was sampled and preserve in Bouins fixative and then dehydrated by different grades of alcohol (70, 85, 96 and 99%). Samples were cleared by xylene and embedded in paraffin wax and then the wax blocks were sectioned. The sections were stained by hematoxyline and eosin and then subjected to a histological examination according to Roberts (2004). The histological characteristics of *G. giuris* ovarian tissues were investigated. Gonads were classified according to the development with a four points of maturity: i).immature stage ii) maturing stage iii) mature stage iv) ripe stage. To estimate ova diameter 300 oocytes were measured from each sample in ripe stage. The oocyte was measured as maximum diameter using oculometer under a stage microscope.

RESULTS AND DISCUSSION

Physical appearance of gonad

The gobi ovary was double lobes lying in the body cavity and usually are of same size which are connected along their dorsal surface by a thin mesentery. It was almost cylindrical shaped. In mature stage the colour of female gonads was yellowish (Plate 1).

Plate 1. Physical features of *G. giuris* gonad.

Gonadosomatic index (GSI)

The Gonadosomatic Index (GSI) value and ova diameter showed the maturation stage of the fish. DeVlaming (1972) reported that GSI has been used as indicator of the spawning period in teleosts and considered as the reproductive biology when associated with other indications of the reproduction (DeMartini and Lau, 1999). In the present study the GSI value was low during January to March. The GSI increased monthly and attained its maximum level in April which was later on declined to minimum value. Details data on body weight, gonad weight and GSI value at successive month are shown in Table 1.

Table 1. Mean body weight, gonad weight and GSI value at successive months of *G. giuris*

Body weight (g)	Gonad weight (g)	GSI (%)
14.38 ± 6.32	0.39 ± 0.06	2.71 ± 1.01
18.59 ± 12.64	0.76 ± 0.63	3.96 ± 1.08
23.70 ± 5.48	0.99 ± 0.24	4.26 ± 1.13
22.77 ± 6.32	1.10 ± 0.06	5.02 ± 1.03
30.78 ± 5.09	1.59 ± 0.07	5.24 ± 0.58
28.07 ± 14.05	1.53 ± 1.01	5.07 ± 1.60

Fecundity

In the present study, fecundity of the studied fish individual varied from 9,085 to 17,886 eggs/fish with an average 13,909.57 ± 3,574. It is mentioned by Islam and Mollah (2013) fecundity of *G. giuris* was 3,339.89 ± 261.53 to 15,012 ± 4,862.41 while Kovacic (2007) estimate total fecundity ranged from 560 - 3,045, with an average 1,426 ± 89 ripe eggs of the striped goby, *Gobius vittatus*. During observation period, it was observed that same size of *G. giuris* carried different number of eggs in their ovaries. Variation in fecundity of fish species may be due to different environment factors such as water, temperature, food and feeding ground, species variation etc. Bagenal (1957) opined that environmental factors and food supply might affect the fecundity of fish. On the other hand, Lagler *et al*. (1967) also opined that fecundity appears to bear some broad relationship to the care of environment accorded to the eggs. Details data are shown in Table 2.

Table 2. Mean body weight, gonad weight and fecundity of *G. giuris*

Body weight (g)	Gonad weight (g)	Relative Fecundity (No. /g gonad weight)	Fecundity
33.52 ± 8.55	2.08 ± 1.30	224.15	13,909±7,373

Description and diameter of ova

In immature stage the ovam was almost oval shape but in mature stage the ovum was elongated. In mature condition the physical feature of the ovum was like jack fruit seed. But histologically the ovum shows leg foot like. In mature condition the smallest ovum length was recorded 0.032 mm and largest size was 0.054 mm while Kovacic (2007) obtained the oocyte diameters in a ripe ovary of striped goby contained 0.44-0.60 mm (fully ripe oocytes), 0.16-0.24 mm (early ripening oocytes) and <0.08 mm (numerous, very small ones). The author also reported that the presence of three sizes of oocytes in ripe ovaries indicated that the striped gobi could spawn at least twice during the breeding season and further mentioned among gobius species fecundity and egg size generally depended on species size.

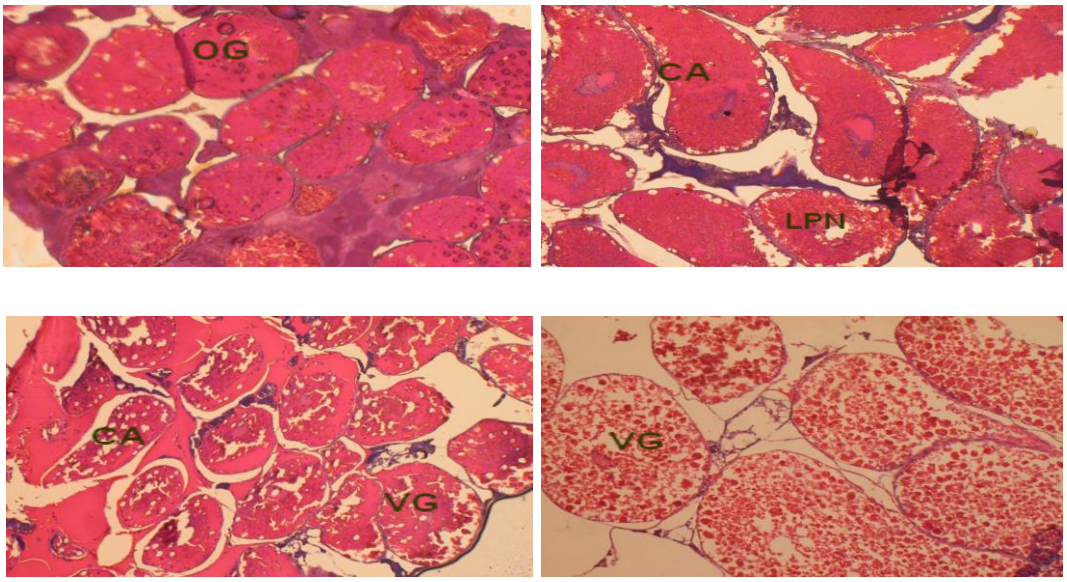
Maturity stage of the gonads

The phase of gonad development is important for understanding the dynamics of the gonads and to asses' reproductive performance of a species. The maturity stage in the female of *G. giuris* exhibited that most of the oogonia was found in immature condition during January and then gradually decreased. Oogonia were small round cells characterized by a single conspicuous nucleolus in the nucleus. At the same time the early perinucleolus (EPN) oocytes appeared and continued up to February. Simultaneously late perinucleolus (LPN) oocytes first time appeared in the month February and the declined. Concomitant with oocyte growth, the nucleus increased in size and multiple nucleoli became located around the periphery of the nucleus. The follicular layer was not visible in this stage. The LPN was distinguished from the EPN by an enlargement of the oocyte. Nucleus with a large number of nucleoli was clearly visible. The follicular cells started to develop in this stage around the oocyte. In mature female gonad, cortical alveoli (CA) oocytes were found to be appeared during March to May and then declined and zona radiate has become visible in this time. Looking into sexual maturity of *G. giuris* reveals that during ripe stage vitellogenic (VG) was noticed during April and continued till June and highest percentage was found in this month. VG can be distinguished by enlargement of oocyte, attributable mainly to the accumulation of yolk, is very considerable.

Table 3. Month wise percent distribution of different developmental stage of oocytes in ovarian tissues of G. giuris.

Months	Oogonia	EPN	LPN	CA	VG
January	100	-	-	-	-
February	48.30 ± 8.23	29.30 ± 6.62	18.60 ± 5.40		
March	17.50 ± 5.38	14.30 ± 5.61	47.20 ± 9.71	16.50 ± 5.70	-
April	-	9.10 ± 4.01	37.50 ± 9.31	33.40 ± 5.19	17.10 ± 4.91
May	-	2.00 ± 1.25	11.00 ± 3.74	36.00 ± 8.76	48.00 ± 10.04
June	-	-	-	15.50 ± 3.24	84.10 ± 11.09

The histological characteristics of *G. giuris* ovarian tissues were investigated and shown in Plate 2 and the percent distributions of different developmental stage of oocytes in gonads are depicted in Table 3. In the present observations ovaries carried immature eggs during January to mid March and mature eggs in April to mid June indicated that the species has a long spawning period. Literature is not available on gonadal histology of *G. giuris* for comparison. But the developmental stages of oocytes seemed to be fairly similar to that of *L. rohita* and *C. cirrhossus* (Jahan, 2008) and *Puntius sophore* (Kohinoor, 2000).



Mature stage **Ripe stage**

Plate 2. Photograph of developmental stage of oocytes (H & N x 220); OG: Oogonia, EPN: Early Perinucleolus, LPN: Late Perinucleolus, CA: Cortical alveoli & VG: Vitellogenic oocyte.

CONCLUSION

Gobi, *G. giuris* is a semi-commercially important fish in Bangladesh. It is one of the sources of protein to the common people of Bangladesh. The outcome of the present study has provided some new and updated information on *G. giuris*. Knowledge about fecundity evaluates the commercial production and management of bele. A successful breeding programme as well as mass seed production of gobi, *G. giuris* in captive condition may save gobi from extinction. So, development of breeding programme of *G. giuris* is essential to ensure its availability in nature. The highest GSI value, beginning and peak period of vitellogenic stage of oocytes revealed the breeding period as well as spawning period of *G. giuris* lies between April and June.

REFERENCES

Ahmed A.T.A., Mustafa G. and Alam M.Z. (1984). Biochemical composition of seven species of gobi fis. *J. Asiatic Soc. Bangladesh*. 10:107-111.

Alam M.R., Mortuza M.G., Islam M.S. and Hossain M.A. (1994). The fecundity of *Ailia coila* (Hamilton-Buchannan) (Siluriformies: Schilbeidae) from the river Padma near Rajshahi city. *J. Biol. Sci.* 2:113-116.

Bagenal T.B. (1957). The breeding and fecundity of the long roughdab, *Hippoglossoides platessoides* (Fabr.) and the associated cycle in condition. *J. Mar. Biol. Ass. UK*. 36: 339-375.

Bhuiyan A.S., Nessa Q. and Begum M. (2000). Fecundity and sex-ratio of Thai silver barb *Barbodes gonionotus* (Bleeker). *Bangladesh J. Fish. Res*. 4(1): 97-99.

Bhuiyan A.L. (1964). Fishes of Dacca. *Asiatic Soc., Pakistan*, Publ. No. 13, Dacca, pp. 113-114.

Coad B.W. (2009). Freahwater Fishes of Iran, http://www.briancoad.com/main.asp.

DeMartini E.E and Lau B.B (1999). Morphometric criteria for estimating sexual maturity in two snappers *Elelis carbunculus* and *Pristipomoides sieboldii*, U.S. Fish. Bull. 97:449-458.
DeVlaming V.L. (1972). Environmental control of teleost reproductive cycles: A brief review, *J. Fish. Biol*. 4:131-140.
Dobriyal A.K., Kumar N., Bahuguna A.K. and Singh H.R. (2000). Breeding ecology of some cold water minor carps from Garhwal Himalayas, In: Coldwater Fish and Fisheries: 177-186 (eds. H.R. Singh and W.S. Lakra). Narendra Publishing House, New Delhi. 337 p.
Doha S. and Hye M.A. (1970). Fecundity of the Padma river *Hilsa ilisha* (Ham.). *Pak. J. Sci*. 22:176-183.
Hunter J.R., Macewicz B.J. and Kimbrell C.A. (1989). Fecundity and other aspects of the reproduction of sablefish, *Amploporna fibria*, in Central California waters CalCOFI, Report, 30:61-72.
Islam M.N. and Joadder M.A.R. (2005). Seasonal variation of the proximate composition of freshwater Gobi, *Glossogobius giuris* (Hamilton) from the river Padma. *J. Biol. Sci*. 8 (4): 532-536.
Islam M.R. and Mollah M.F.A. (2013). Morphological observation and PG–induced breeding of *Glossogobius giuris* (Hamilton 1822). *J. Sci. Technol.* 11:171-180.
IUCN (International Union for Conservation of Nature) (2000). Red Book of Threatened Fishes of Bangladesh.
Jahan D.A. (2008). Substitution of Fishmeal Protein by Soybean Meal Protein in the Diet of Two Indian major carps. Ph.D. Dissertation, Department of Fisheries Biology & Genetics, Bangladesh Agricultural University, Mymensingh, p. 222
Kiran B.R. and Puttaiah E.T. (2003). Fecundity studies on *Chela untrahi* (Day) from Bhadra reservoir, Karnataka. *India Inland Fish. Soc.* 35(2):41-44.
Kohinoor A.H.M. (2000). Development of culture technologies of three small indigenous fish mola (*Amblypharyngodon mola*), punti (*Puntius sophore*) and chela (*Chela cachius*) with notes on some aspects of their biology. Ph.D. Dissertation, Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh, p. 366.
Kovacic M. (2007). Reproductive biology of the striped goby, *Gobius vittatus* (Gobiidae) in the northern Adriatic Sea. *SCI. MAR*. 71(1):145-151.
Lagler K.F., Bardach T.E. and Miller R.R., Ichthyology, John Willey and Sons (1967). Inc. New York, London, Sydney. pp. 271-274.
Nikolsky G.V. (1963). The Ecology of Fishes, Academic press London, London 1963, p. 352.
Roberts R.J. (2004). Fish Pathology, 3rd Edn, W.B. Saunders.
Siddique K. (1985). Bangladesh Grameen Dharidrer Sarup-o-Samadhan (in Bengali). Dana prokasoni. Dhaka. p. 152.
Talwar P.K. and Jhingran A.G. (1991). Inland Fishes of India and Adjacent Countries, Vol 2, Oxford and IBH Publishing, Co. Pvt. Ltd., New Delhi, India.

