

REPRODUCTIVE BIOLOGY OF FEATHER BACK, CHITAL (*Notopterus chitala*, Ham.) CULTURED IN A POND OF BANGLADESH

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Abstract

Studies on Gonadosomatic index (GSI), ova diameter and histology of the gonad were performed to understand reproductive biology of Feather back, Chital (*Notopterus chitala*) for a period of 6 months from January to June 2010. Thirty live chital fish were used in this study. The mean GSI values for female chital were found to range between 0.20 ± 0.013 and 4.63 ± 0.50 . The highest GSI value was found in June. The smallest diameter of ovum was recorded 0.04 mm (January) and the largest was 4.00 mm (June). During the experimental period, the fecundity was ranged from 8,238 to 18,569 (mean $13,052 \pm 4607$) in fish samples with body weight range from 1,296 to 2,360 (mean $1,742.50 \pm 474.44$ g) while the relative fecundity was 5.65 to 14.33. Histological study revealed that the percentage of late perinucleolus (LPN) stage was highest in April and Cortical alveoli (CA) stage appeared from April and reached to maximum in May. Vitellogenic stage (VG) appeared in the month of May and chronologically increased through June. Vitellogenic stage (VG) of oocyte as well as highest ova diameter reached to the peak in June. The variations in the gonad weight and GSI of the female fish reached to the peak during June indicating maturity of ovary and definite spawning season.

Keywords: Reproductive biology, feather back, chital

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Introduction

Feather back, Chital (*Notopterus chitala*) is a rheophilic important freshwater fish found widely in lentic waters. This species is widely distributed in deep and clear waters in the rivers, beels, reservoirs, haors, baors and ponds in Bangladesh (Azadi *et al.*, 1994). In recent years, the catch of this species has been declining fast due to environmental degradation (Hossain *et al.*, 2006). This fish is rich in nutritive value and commands high market price despite of the presence of a large number of intramuscular bones. In addition to the above qualities, Chital plays a significant role in regulating the population imbalance that may be caused by wild breeding of common carp, abundance of other minnows and insects in ponds under composite carp culture where strict control on the population size of the stocked fish is essential to obtain optimum production (Chaudhuri *et al.*, 1975). Some progressive farmers are thinking to culture this species in pond with carps using

polyculture technique. The fry of chital is not available throughout the year for growing out in the farms for producing marketable size fish, which indicates significance for developing seed production technology of this species. Although literature is available, on the morphometry, food and feeding habits, natural breeding (Singh *et al.*, 1980; Hossain, 1999) of this fish, very scanty systematic attempts have been made to study the reproductive biology and breeding technique in captivity of this fish. This paper reports a detailed account of the reproductive biology of chital.

Materials and Methods

The study was carried out for the period of six months from January to June 2010 in the Freshwater Station, Bangladesh Fisheries Research Institute, Mymensingh, Bangladesh. Fifty brood fish of chital were stocked in a rearing pond with an area of 400 m² between August and September. After stocking,

the brood fishes were fed with live food such as small fish, tilapia fry, small prawn etc. @ 2% of estimated body weight.

Fish Sample collection

Five female live fish samples were collected by seine net once in a month from January to June 2010 from the experimental pond. After collection, live fish were transported to the laboratory and the gonads were removed by opening the peritoneal cavity and were used for the study.

Determination of the reproductive periodicity

The methods were used to determine the reproductive periodicities of the fish are as follows:

Gonadosomatic Index (GSI)

Total body weight of selected fishes in each month was considered to calculate the mean Gonadosomatic Index (GSI). Gonadosomatic Index (GSI) was calculated according to the formula:

$$\text{GSI} = \frac{\text{Weight of gonad}}{\text{Weight of fish}} \times 100$$

Diameter of ova

After dissecting the ovary, small representative part from the anterior, posterior and middle portion of the ovary was removed separately. The ova of the samples were separated using physiological saline solution (0.65% NaCl) with a petridish and spread on a glass slide to measure the diameter under a microscope with an ocular micrometer. The units of the ocular micrometer that visible in the microscope were standardized with a stage micrometer for measurement of ova diameter in micrometer (μm). Approximately 300 ova from each sample were measured and ova diameters were determined and were expressed in unit value of the ocular micrometer.

Histology of Gonad

To study the sequential histological changes, the

ovaries tissues were fixed in aqueous Bouin's fluid and then routine histological process was followed for slide preparation. The gonadal tissues were serially sectioned at a thickness of 4μ and stained with haematoxylin-eosin. From the histological preparation of the gonadal tissues, the cells and nuclear diameters of cells and various oocytes were measured by ocular micrometer.

Results and Discussion

The different development stages of gonad are presented below:

Gonad observation

The oval shaped chital ovary was single lobed lying in the body cavity. The size and extent of occupancy of the body cavity were found to vary with size and maturity of the females. Ovary showed the highest weight in June indicating the mature stage. During this time, the colour of the ovary was yellowish. The immature ovary was compact but the matured one was filament like structure (Plate 1).



Plate 1. Physical appearance of Chital ovary

Gonadosomatic index (GSI)

Monthly variations in GSI values of chital are presented in Table 1 and Fig. 1. The mean GSI values of female chital were found to range between 0.20 ± 0.013 to 4.63 ± 0.50 . The greatest GSI value was found in June, which indicates peak period of ovarian growth. It is evident from the results that the GSI values increased slowly from January to March and then sharply increased in June. Thomas *et al.* (2003) described that gonadosomatic index (GSI) found lowest in early stage and highest in later stage in fin fish and shell fish.

Table 1. Mean and standard deviation (\pm SD) of total body weight, total length, gonad weight and GSI (%) at successive months of female *N. Chitala*

Month	No. of fish examined	Total length (cm)	Body weight (g)	Gonad weight (g)	GSI (%)
January	4	53.90 \pm 5.90	1178 \pm 131.45	2.34 \pm 0.36	0.20 \pm 0.01
February	4	60.88 \pm 1.40	1605 \pm 114.65	3.78 \pm 0.40	0.24 \pm 0.02
March	4	65.85 \pm 0.95	2101 \pm 357.84	11.2 \pm 2.73	0.53 \pm 0.04
April	4	65.58 \pm 4.98	1855 \pm 463.41	34.52 \pm 14.28	1.80 \pm 0.45
May	4	66.7 \pm 2.66	2019.75 \pm 206.0	165.55 \pm 23.79	3.21 \pm 0.98
June	4	67.65 \pm 4.64	2041 \pm 518.19	95.50 \pm 29.86	4.63 \pm 0.50

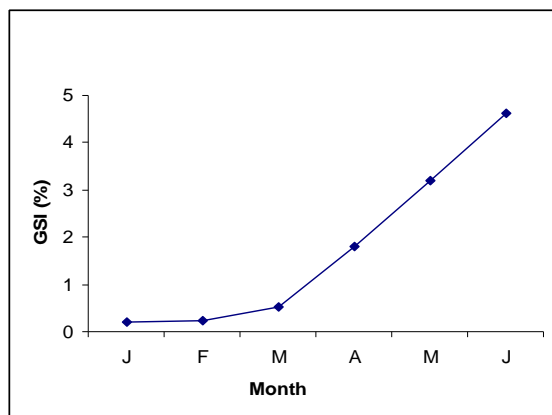


Fig. 1. Monthly trend of changes in Gonadosomatic Index (GSI) of female *N. chitala*

Diameter of ova

Increasing diameter of ova indicates the development of eggs which is related to approaching the breeding season of fish. The observed ova size at different months indicated that the chital fish become sexually matured between May and June.

For easy interpretation, the ova were grouped into two categories on the basis of size of diameter i.e. category I (0.04-0.168 mm) and category-II (1.00-4.00 mm). The smallest diameter of ovum was recorded 0.04 mm and the largest was 4.00 mm during the study period. During January to March, only category-I oocytes were found and this category was also

widely distributed up to June. But in June it was comparatively lower percentage (66.04 ± 4.73) than other months. During the observation period, mean ova diameter was 0.117 ± 0.02 mm and 0.120 ± 0.03 mm in February and March, respectively (Table 2).

Table-2 also showed that two categories of ova were observed from April. The ova belonging to category II was found in April with a rapid increase in diameter in May. It was observed that the abundance of category II oocytes were highest in June ($34.21 \pm 6.54\%$) and lowest in April ($8.86 \pm 3.38\%$). The mean ova diameter of Category I and II, were 0.122 ± 0.02 mm and 2.51 ± 0.54 ; 0.124 ± 0.021 and 3.16 ± 0.89 mm; 0.129 ± 0.02 mm and 3.21 ± 0.47 mm in the month of April, May and June, respectively (Table 2).

It is mentioned by Rahman (1989) that chital breeds in June and having an egg size of 3.0 to 4.5 mm in diameter. While, Radheyshyam and Sarangi (2004) studied the breeding activity and egg incubation of the same species in captivity and observed the diameter of fertilized eggs ranges were 4.8-8.2 mm. Hossain *et al.*, (2006) cultured chital in ponds and found the fertilized eggs having average diameter of 4.5 mm. The results obtained in the present study are consistent with the study mentioned above.

Table 2. Category wise distribution of oocytes during observation period

Groups	Months				
	February	March	April	May	June
Category-I (mm)	0.117 ± 0.02	0.120 ± 0.03	0.122 ± 0.02	0.124 ± 0.021	0.129 ± 0.02
Category-II (mm)	-	-	2.51 ± 0.54	3.16 ± 0.89	3.21 ± 0.47

Fecundity

Breeding performance of a fish species depends on different parameters like fecundity, spawning response, fertilization rate, hatching rate, hatching time, size of spawn, yolk sac absorption time period, larval survival rate etc. Therefore, to understand fecundity of this species a study was

carried out. In this study fecundity was found to ranged from 8,238 to 18,569 (mean $13,052 \pm 4607$), in fish samples with body weight from 1296 to 2360 g (mean 1742.50 ± 474.44 g) while the relative fecundity were 5.65 to 14.33 (mean 7.99 ± 4.24 g). Details of results are given in Table 3.

Table 3. Mean gonad weight and fecundity of *N. chitala*

Mean. body wt. (g)	Mean gonad wt. (g)	Mean relative fecundity (No. of eggs/g B. Wt.)	Mean fecundity
1742.50 ± 474.44	66.25 ± 6.80 g	7.99 ± 4.24 g	13052 ± 4607
(1296 to 2360)	(59.00 to 73.00)	(5.65 to 14.33)	8238 to 18,569

The results analysis shows a nearly perfect positive linear relationship between fecundity and body weight, where the calculated values of regression coefficient, intercept and coefficient of correlation were 0.1021, + 409.69 and 0.9834, respectively (Fig. 2). Shing *et al.* (1980) observed natural spawning of chital in pond ecology and estimated the fecundity of the fish to be around 400 eggs kg⁻¹ body weight. In another study, Hossain *et al.* (2006) reported that fecundity was 5761 eggs of a 4200 g female weight.

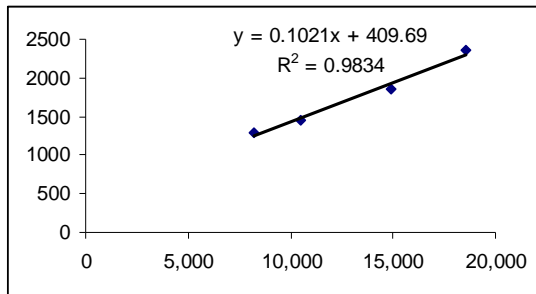


Fig. 2. Relationship between body weight and fecundity of *N. chitala*

Histology of gonad

Histological structure of gonad was examined and different stages of oocytes indicated that the oocytes did not develop synchronously. In gonad,

Table 4. Month wise per cent distribution of different development stage of oocytes in sample of ovarian tissue of Chital

Months	Oogonia	EPN	LPN	CA	VG
January	100	-	-	-	-
February	100	-	-	-	-
March	92.67±1.53	5.33±1.53	2.00±0.98	-	-
April	76.33±4.51	14.67±2.52	7.67±1.53	1.33±0.58	-
May	25.33±2.52	31.00±2.65	6.67±2.08	10.67±2.08	26.33±1.15
June	23.67±3.51	30.33±2.52	5.00±1.13	7.33±0.58	33.67±3.51

In the present study, five stages of oocyte were identified that were: (a) oogonia, (b) early perinucleolus stage, (c) pre-vitellogenesis, (d) vitellogenesis and (e) maturation stage. These stages of oocyte development in Chital are similar to that of *Ompok pabda*, *Amblypharyngodon mola*, *Puntius sophor*, *Puntius gonionotus* and *Chela cachius* (Zakia, 1996; Begum, 1997 and Kohinoor 2000). These developmental stages are seemed to be fairly similar to that of *Pleuronectes flesus* described by Janseen *et al.* (1995) who described eight stages of oocyte development in their study. On the other hand, Mollah (1986) observed the oocyte maturation in catfish, *Clarias macrocephalus*, and identified seven stages: oogonia, chromatin nucleus, early perinucleolus, late perinucleolus, yolk vesicle, early yolk-granule and late yolk-granule stage. In another histological study, the stage of oogonia of *L. rohita* and *C. cirrhossus* were found from the month of

different developmental stages of oocyte viz. oogonia (OG), early perinucleolus stage (EPN), late perinucleolus stage (LPN), cortical alveoli stage (CA), vitellogenic stage (VG) were distinguished on the basis of size appearance of nucleolus and cytoplasm. It was found that at the earlier stages of the study period (January/February), all oocytes were found in oogonial stage. Later on, the percentage of oogonia showed a decreasing trend in the successive months.

The highest percentage early perinucleolus stage (EPN) was found in May (31.00±2.65 %) with a decreasing trend in the following months. As a result, the percentage of late perinucleolus (LPN) stage was highest in April (7.67±1.53%) and then their appearance was found to decrease gradually. But the oogonia stage, early and late perinucleolus stage showed a decreasing trend from February to June. Cortical alveoli stage (CA) appeared from April and turned greatest in May (10.67±2.08%). Vitellogenic stage (VG) appeared in the month of May and chronologically increased up to June (33.67±3.51%). Atretic oocytes (AO) were not found during the study period. Month wise per cent distribution of different development stage of oocytes is shown in Table 4. No literature is available on histology of gonad of this species for comparison.

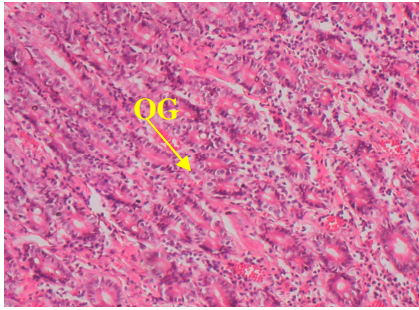
February while, it was fully absent in June. Jahan, (2008) observed that the EPN and LPN stages appeared from April and the vitellogenic stage (VG) in May.

Conclusion

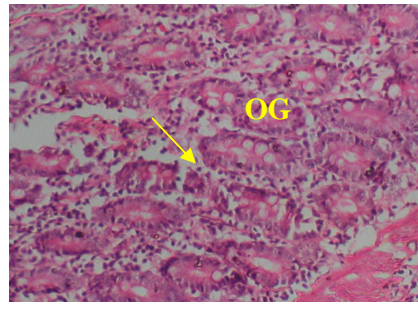
The variations in the gonad weight and gonado somatic index (GSI) of the female chital fish reached to the peak during June indicating maturity of ovary and definite spawning season. While Vitellogenic stage (VG) of oocyte as well as highest ova diameter was observed in June also. The present study on reproductive biology of chital may contribute to the seed production technology of this fish species in captivity, which may prelude to their introduction as a potential candidate for aquaculture and paves the way to conserve this endangered native fish species.

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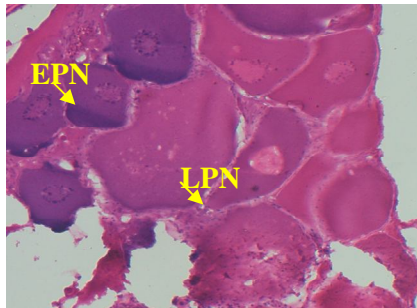
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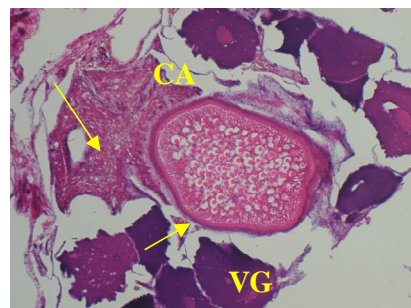
January



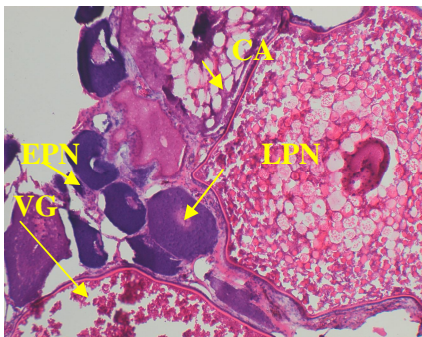
February



March



April



May



June

Plate 2. Developmental stage of Oocytes in different months