

To Study the Relationship between the Gonado Somatic Index and the Gastro Somatic Index during Breeding Season of *Labeo bata* (Hamilton, 1822)

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Abstract

The investigation on the gastro-somatic index (G_aSI) and gonado somatic index (G_nSI) of *Labeo bata* was carried out in spawning season from July to December 2010. Length of fish ranged from 136.11 ± 2.00 to 145.44 ± 0.58 mm and while in average weight was 34.03 ± 1.00 to 44.11 ± 5.29 gm. G_aSI and G_nSI were determined at different length and weight ranges of different individual fishes. Significantly lowest G_aSI was 3.92 ± 0.38 in male specimens, where as 4.50 ± 0.10 in female specimens. G_aSI was also determined from wide highest peak ranges of *Labeo bata*, 8.02 ± 0.06 (November) in male specimens, 7.33 ± 0.10 (October) in female specimens. Ovary weight of the carp ranges from 0.39 ± 0.01 to 1.33 ± 0.58 gm with a mean value of 0.81 gm. Gonado somatic index varied in male from 0.73 ± 0.03 to 2.06 ± 0.05 while in female it was 0.91 ± 0.01 to 2.85 ± 0.07 . The Gonado-somatic Index (G_nSI) varied significantly (P is less than and equal to 0.01) in *L. bata* as between the sexes and among months. In the present study, it is found that irrespective of season the male *Labeo bata* is smaller in length and weight in comparison to female.

Key words: Gonado Somatic Index; Gastro Somatic Index; *Labeo bata*; Length; Weight

Introduction

India is the second largest producer of fish contributing 5.43% of the global fish production and also the second major producer of fish through aquaculture. The total fish production in India is 9.579 million a tonne of which nearly 6.136 million metric tonnes comes from Inland sector (DADF, 2014). Fisheries sector in India contribute significantly to food and nutritional security by providing livelihood to approximately 14.49 million people in the country and thus playing an important role in the national economy. It also plays an important role in improving the socio-economic condition of people by way of supplementing family income and generating gainful employment in the rural sector, particularly among the landless labourers, small and marginal farmers and women.

The existence of varied topography and different agro-climatic conditions in the state of West Bengal has bestowed upon a productive fishery resources. It is a unique state being gifted with diversified aquatic resources viz. freshwater, coldwater, brackish water and marine water. The total fish production of the state in 2013-14 was 15.81 lakh tonnes (DADF, 2014). Though the fish production is increasing steadily, there remains an annual deficit

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of 6 to 7% in this state. Since more than 90% of the population in West Bengal consumes fishes, the difference between the demand and supply always remains persistent. To fill the gap, West Bengal imports substantial amount of fishes from other states like Andhra Pradesh and Odisha every day.

Labeo bata (Hamilton, 1822) is considered as an important candidate species in aqua farming, it is herbivorous, adults are bottom dwellers and take rotten plants, algae and plankton; but is frequently moves all zone of water column for feeding and breeding purpose. It is being cultured widely because of high market demand, good growth rate, omnivorous feeding tendency, acceptability to artificial diet etc. Generally they are hardy and are capable of tolerating wide fluctuations of temperature, oxygen, turbidity etc. It has got

popularity due to its taste. It also provides a respected amount of fish protein. In West Bengal "Bata" consider as a lucrative fishery due to its high and regular demand (Roy, 1994).

This species is capable of attending maximum length of 61 cm (Fishbase 2009) whereas largest observed specimen was 290 mm in total length by Rahman (1989). It generally matures in two years. But under favourable condition this fish can mature in 9-10 months also. Spawning occurs during July and August. Each individual spawns only once with the onset of monsoon season. The average length of matured fishes in both sexes is matured around 20 cm in length and 100 to 125 gm in weight. *Labeo bata* breeds during monsoon and its spawning season is very short. In the nature it spawns once in a year but induced breeding technique it can be induced to breed two and more times in a year.

The Gonado Somatic Index (G_nSI) and Ovarian Index (OI), the peak value of which could observed certainly during the spawning period of the fish, are useful and sensitive parameters to monitor gonadal maturation. Das (2002) studied the testicular maturity of teleports and identified three phase of testes on the basis of GSI and Histological study.

Material and Methods

The present study on the Relationship between the Gonado Somatic Index and Gastro Somatic Index aspects of *Labeo bata* was conducted for a period of six month (July, 2010 to December, 2010) in the Department of Fisheries Resource Management, Faculty of Fishery Sciences, West Bengal University of Animal and Fishery Sciences, Chakgaria, Kolkata – 700 094.

The proper sequential steps of methodology are as follows:

Collection and sampling of fish species

In every fortnight period, sampling of live adults of *Labeo bata* was done randomly from a fresh water pond of Mallickpur, 24 parganas in West Bengal. In each sampling, 30 numbers (15 numbers of male and 15 numbers of female) of healthy and disease free fishes were selected for observation.

Morphological study of the specimen

Morphological observation of the specimen was done to identify and segregate the males and females.

Dissecting specimen

On a dissecting tray, each specimen was ventrally opened; the gut and gonad of each specimen was collected.

Collecting gut and gonad from each specimen

The entire gut and gonad were collected carefully from each specimen and cleaned in saline water to remove clots and other particles from them.

Length and weight measurement

The total length and the total weight of the sample fishes and gut and gonad weight were measured by using millimetre scale and monopan balance in gm unit.

Gonado Somatic Index (G_nSI)

Gonado somatic index values were used as indicator of degree of Gonadal development. It was found out by employing the following formula.

$$GnSI = \frac{\text{weight of the gonad}}{\text{total weight of the fish}} \times 100$$

Gastro Somatic Index (G_gSI)

It is the measure of the gastric weight in relation to total body weight of fish. The gastro somatic index was calculated following standard procedure as follows.

$$Gastro somatic index (GSI) = \frac{\text{weight of foregut}}{\text{weight of the body}} \times 100$$

Analysis of Data

All the collected data are plotted in the tabular form and then represented in the graphical form for better calculation and assessment.

Result and Discussion

Study was conducted during July 2010 to December 2010. Some remarkable change in the external morphology, morphometry and in some internal features of *Labeo bata* was found.

Morphology of body

Firstly, during the breeding season, the length and weight of the body of *Labeo bata* increased remarkably (Table I & II). Morphometrical study of *Labeo bata* showed that irrespective of season the male *Labeo*

bata is smaller in length and weight in comparison to female. From the study it can be concluded that the size of the fish is an important criteria for identification of sex. The standard length of *Bata* has varied from 136.11±2.00 to 145.44±0.58 mm and weight was 34.03±1.00 to 44.11±5.29 gm. while in

female average length was 139.66±2.65 to 144.11±4.36 mm. The average weight of female fish was 38.66±5.51 to 46.67±1.00 gm. For successful induced breeding the identification of sex external morphology, morphometry and gonadal morphology are very necessary (Roy, 1994).

Table 1: Monthly variation of Average Standard Length (mm±SD), Average Body Weight (gm±SD), Average Weight of Gut (gm±SD), Average Weight of Gonad (gm±SD), Gastro Somatic Index (±SD) and Ganado Somatic Index (±SD) male *Labeo bata*.

Month	Average Standard Length (mm)	Average Body Weight (gm)	Average Weight of Gut (gm)	Average Weight of Gonad (gm)	Gastro Somatic Index	Ganado Somatic Index
July	136.11±2.00	44.11±5.29	1.73±0.21	0.91±0.02	3.92±0.38	2.06±0.05
August	139.67±1.53	44.08±6.66	2.00±0.10	0.70±0.04	4.83±0.38	1.74±0.05
September	141.11±2.52	41.78±2.08	2.13±0.15	0.69±0.02	5.10±0.06	1.65±0.04
October	141.89±1.53	35.58±4.16	2.70±0.10	0.62±0.04	7.59±0.10	1.59±0.02
November	144.22±2.08	34.03±1.00	2.73±0.15	0.31±0.02	8.02±0.06	0.91±0.03
December	145.44±0.58	41.01±4.16	2.83±0.31	0.32±0.03	6.90±0.06	0.73±0.03

Table 2: Monthly variation of Average Standard Length (mm±SD), Average Body Weight (gm±SD), Average Weight of Gut (gm±SD), Average Weight of Gonad (gm±SD), Gastro Somatic Index (±SD) and Ganado Somatic Index (±SD) female *Labeo bata*.

Month	Average Standard Length (mm)	Average Body Weight (gm)	Average Weight of Gut (gm)	Average Weight of Gonad (gm)	Gastro Somatic Index	Ganado Somatic Index
July	139.66±2.65	46.67±1.00	2.10±0.26	1.33±0.58	4.50±0.10	2.85±0.07
August	140.11±3.21	44.14±1.53	2.13±0.32	1.09±0.11	5.01±0.44	2.47±0.10
September	141.33±3.21	44.91±1.53	2.70±0.10	0.92±0.02	6.01±0.21	2.04±0.10
October	142.22±5.51	39.55±2.08	2.90±0.10	0.72±0.01	7.33±0.10	1.82±0.07
November	143.77±4.36	38.66±5.51	2.87±0.25	0.41±0.03	7.16±0.10	1.06±0.06
December	144.11±4.36	42.77±1.53	2.93±0.15	0.39±0.01	6.85±0.17	0.91±0.01

Color of body

During the study of the colour pattern of the body in both male and female are more or less same during breeding season. The color was studied to identify the male and female externally. From the study it is found that on the basis of colour it is very difficult to identify male and female because they both exposed almost equal coloration. But in female fish the ventral portion of the belly becomes brownish-shivery and the dorsal portion becomes blackish-shivery. But in the same condition the dorsal and ventral portion of male becomes bright silvery. This color change is due to the action of secondary sexual characteristics of the fish (Lagler *et al.*, 1977). These color variations can be concluded as the criteria for identification of sexes.

Belly structure

The ranged of male gut from 1.73±0.21 to 2.83±0.31, while in female it varied from 2.10±0.26 to 2.93±0.15. The variations in the monthly average values of Gastro-somatic index (G_aSI) of *Labeo bata* are presented in Table 1 and 2. It was found to vary

according to the month and sex of the fish. The G_aSI of the male *bata* were highest in November (8.02±0.06) and lowest in the month of July (3.92±0.38). It was quite low in the month of August (4.83±0.38), September (5.10±0.06) and December (6.90±0.06). It was also moderately high during the month of November (7.59±0.10). The maximum value in female was found in the months of October (7.33±0.10) and November (7.16±0.10). The lower value of G_aSI was found in the months of July (4.50±0.10) and August (5.01±0.44). The values were moderately high in months of December (6.85±0.17) and September (6.01±0.21).

It was found that G_aSI was minimum during the months of July and August which might be due to advance stage of fish maturity. Other workers (Kiran *et al.* 1998; Basudha, 1999; Rajasree and Kurup, 2011) reported that gravid fish used to take less feed due to occupation of more space in the abdominal cavity. Subsequently it was found that G_aSI value was more during the months of September to November which could be due to higher feeding intensity of fish during post spawning stage. Feeding was low during the month December which might

be due to winter cold. The G_nSI varied significantly (P is less than equal to 0.01) during different months which can be attributed to varied feeding during different months owing to maturation and environmental factors.

During breeding season belly of the female showed more bulginess than the male because the gonad of female are expanded too much than the male. The gonad of the female occupies more space in the coelomic cavity than the male during same season. Therefore, the belly of female is more bulged than male. In the present study, it is concluded that the structure of belly can be used as a tool for identification of male and female during breeding season. With the onset of breeding season, both male and female exhibited an increase in belly size which was continued till peak breeding season. The fully rip female are found with prominent bulged belly and with more increased body structure in comparison to matured male. So, sex determination through observing external features could be possible during breeding season. But the weight of gut drops significantly in the matured female than a matured male.

Gonadal Morphology

The ranged of male gonad weight varied from 0.91 ± 0.02 to 0.32 ± 0.03 gm while the ovary weight of the bata ranges from 0.39 ± 0.01 to 1.33 ± 0.58 gm to with a mean value of 0.81 gm. The table 1 and 2 had shown the variations in Gonado-somatic index (G_nSI) of monthly samples of the *Labeo bata*. The average G_nSI of male *Labeo bata* varied from a minimum 0.73 ± 0.03 in the month of December to a maximum of 2.06 ± 0.05 in the month of July. The average value showed a decreasing trend from August (1.59 ± 0.02) to November (0.73 ± 0.03). While in case of female the average G_nSI value ranged from a minimum 0.91 ± 0.01 in December to a maximum of 2.85 ± 0.07 in the month of July. The average G_nSI values were relatively high in the female in comparison to male. The variations in the average G_nSI of the fish is presented in Table (1 and 2).

A thorough knowledge on maturation cycle and depletion of gonad is essential for the effective fishery management (Biswas *et al.*, 1984 and Cek *et al.*, 2001). De Vlaming *et al.* (1982) stated that gonadal development in fish is governed by a number of biotic and abiotic environment factors like water temperature, photoperiod, rainfall, etc. by playing significant role in gonadotrophics activity of pituitary gland, which have a triggering effect on the development of the gonad.

It was found that G_nSI of the fish was relatively higher during July and August indicating advance stage of maturation and breeding season. Subsequently it declined from the month of September which could be due to spent condition of fish. It exhibited an increasing trend of variation indicating gonadal development. The Gonado-somatic Index (G_nSI) varied significantly ($P < 0.01$) in *L. bata* between the sexes and among months.

There is a significant increment in weight and Gonado Somatic Index. But after breeding season, the weight of fish and Gonado Somatic Index were recorded reducing both in male and female *Labeo bata*. The relationship between length of body, weight of body and Gonado Somatic Index of matured fishes represented graphically during breeding season. For successful induced breeding the identification of sex external morphology, morphometry and gonadal morphology are very necessary (Roy, 1994). The study of sexual characteristics during breeding season is helpful for segregation of other biological studies. As the breeding season of bata is already been studies by Khan (2000) and mention that it is during pre monsoon period. A peculiarity observed during the period of study was that few numbers of matured male and female fishes were recorded during several sampling occasions. It indicated availability of matured fish during most of the months due to occurrence of few matured fishes in sampling.

Conclusion

In the present study, it is found that irrespective of season the male *Labeo bata* is smaller in length and weight in comparison to female. From the study it can be concluded that the size of the fish is an important criteria for identification of sex. Further, the secondary sexual characteristics like morphometry, colour of the body, belly structure are considered as key factors for the identification of sex during breeding season. A remarkable finding was also recorded that the breeding season the value of Ganado Somatic Index increases where as the Gastro Somatic Index decreases and vice versa. However, this knowledge of reproductive biology of bata during breeding will definitely become a tool for the fish farmers and hatchery entrepreneurs for successful induced breeding of bata.

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