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# RELATIONSHIP AMONG BODY WEIGHT, GONAD WEIGHT, FECUNDITY AND EGG SIZE OF AN ORNAMENTAL FIGHTING FISH, *BETTA SPLENDENS*

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## ABSTRACT

Study on natural breeding based on body weight, gonad weight, fecundity, gonado somatic index and egg size of *Betta splendens* were determined. Weight of the female varied from 0.811 gm to 1.452 gm and gonad weight varied from 0.040 gm to 0.101 gm with mean of 0.007 gm. The fecundity (number of eggs released/gm body weight of female) was calculated and it varied from 425 to 523 with mean value 71±35.51. It was found that hatching rate and survival of hatchlings were very low due to hardness of water. The Gonado somatic index (GnSI) varied from 4.93% to 7.65% and fluctuated up and down with respect to increase or decrease of fish weight. Thus, the relationship between weight of female fish and GnSI was not found significant. But the correlation co-efficient between weight of female fish and gonad weight was positively correlated at 5% level. The number of eggs released per female vary from 348 to 709 with egg diameter was varied from 0.76 mm to 1.04 mm. The relationship between fish weight and egg diameter was positively correlated and significant at 5% level. The correlation coefficient between fish weight and number of egg released and the relationship between fish weight and fecundity were positively significant at 5% level.

**KEYWORDS:** *Betta splendens*, cell division, embroyonic development, hatching, labyrinthine organ

**No: of Tables : 3** **No: of References: 14**

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## INTRODUCTION

Aquarium keeping of fish began in 1805 with the first public display aquarium opened at Regent's Park in England in 1853. The brilliant, flamboyant colour and exotic appearance of the fish appeal to one and all, children and aged alike. In India, the hobby of ornamental fish keeping is nearly 70 years old. It began with British period and is continuing till date. As the days passed, ornamental fish keeping became an interesting activity for many, in the process generating income for the unemployed youth and farmers (Ayyappan, 2006).

According to the Department of Fisheries, Thailand (2000 – 2005), *Bettas* ranked among the top two ornamentals in terms of number of fish and revenue. The latest official value (2005) for *Bettas* is about 25 million Thai baht (Monvises *et al*., 2009). On the global basis, India ranks one of the top few countries with maximum fresh water and marine ornamental fish reserves. India's share in global ornamental fish trade is 1.23 million US $ out of which west Bengal export US $ 0.56 million (MPEDA, 2008).

The feeding frequency significantly influenced growth, gonad weight and fecundity in the fighting fish, *B. splendens* (James and Sampath, 2004). The mean body length and weight generally increased with time and the increase in feeding frequency. James and Sampath (2003) observed that mean body length and weight of red swordtail *Xiphophorus helleri* were higher in fish receiving more frequent meals than in those receiving fewer meals. Hislop *et al.* (1978) reported that haddock, *Melanogrammus aeglefinus*, fed a low ration exhibited poor growth in terms of body length and weight. An increase in mean body length and weight was observed in juvenile dwarf gourami, *Colisa lalia*, as the protein level and rearing period increased (Shim *et al.*, 1989). The present investigation was conducted to study the relationship among body weight, gonad weight, fecundity and egg size of an ornamental fighting fish, *Betta splendens.*

## MATERIALS AND METHODS

The study was carried out in the Laboratory of Department of Fishery Biology and Resources Management, Faculty of Fishery Sciences, West Bengal University of Animal and Fishery Sciences, Kolkata, West Bengal from January to September 2010. In the present study of natural breeding, the following experiment was done.

**Spawning frequency with respect to water temperature**

The females were released into the male's chamber and spawning time was recorded from starting of egg laying to end of spawning.

**Calculation of hatching rate (%)**

After spawning the eggs were hatched and the hatching rate was calculated following the formula.

$$\%\ \textbf{Hatching rate} = \frac{\textbf{Number of hatched eggs}}{\textbf{Total number of eggs}} \times 100$$

**Egg size in different pairs**

After spawning, fully swollen eggs (5-10 nos.) were collected in 5 ml plastic test tube which contained Simpson solution (2 ml) for preservation. In this way eggs were collected from different pairs of *B.*

*splendens* and the eggs size were measured by ocular micrometry.

**Calculation and Comparisons of fecundity of females**

Fecundity was noted down for each female and a comparison was done to find out fecundity according to weight of the female fish.

**F = n× 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 sub sample.

**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.

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

**Statistical Analysis**

The Mean, Standard error, Correlation statistical methods were used in the present study. Pearson's correlation was used to denote the degree of association between variables.

**RESULTS AND DISCUSSION**

**Relationship between fish weight and gonad weight (Ovary) of female fish**

Weight of the female varied from 0.811 gm to 1.452 g with an average of 1.120 g in the present study (Table 2). The gonad weight varied from 0.040 g to 0.101 g with an average of 0.007 g (Table 2). The Gonado Somatic Index ($G_nSI$) varied from 4.93% to 7.65% and fluctuated up and down with respect to increase or decrease of fish weight. Thus the relationship between weight of female fish and $G_nSI$ was not found significant (Table 3). But the correlation co-efficient between weight of female fish and gonad weight was positively correlated at 5% level (Table 3). In the present study, it was found a direct relationship between fish weight and gonad weight of *B. splendens*. The correlation co-efficient between female weight and gonad weight was positively correlated at 5% level (Table 3). This indicates that the weight of gonad was found to be increased with the increase in female's weight. The development of gonad is influenced by the available energy derived from the food consumed by the fish. Growth and reproduction are influenced by numerous factors such as feed quality, quantity, composition and ration size and feeding frequency (Sampath and Pandian, 1984; James *et al*., 1993; Jobling, 1998). In the present study, gonad weight increases with increase fish weight. Similar result was observed by James and Sampath (2004) who reported that gonad weight was directly related to fish weight, which in turn depends on quality of food consumed and feeding frequency.

**Table 1:** Relationship between fish weight (female) and gonad weight (ovary)

| Sl. No | Weight of the female(g) | | Gonad Weight(g) | GnSI (%) |
|---|---|---|---|---|
| | Before Spawning | After Spawning | | |
| 1 | 1.315 | 1.050 | 0.091 | 6.92 |
| 2 | 1.242 | 1.035 | 0.084 | 6.76 |
| 3 | 1.042 | 0.837 | 0.073 | 7.00 |
| 4 | 0.915 | 0.766 | 0.070 | 7.65 |
| 5 | 0.914 | 0.766 | 0.061 | 6.67 |
| 6 | 0.811 | 0.734 0 | 0.040 | 4.93 |
| 7 | 1.315 | 1.046 | 0.086 | 6.53 |
| 8 | 0.984 | 0.873 | 0.072 | 7.31 |
| 9 | 1.452 | 1.306 | 0.101 | 6.95 |
| 10 | 1.093 | 0.921 | 0.076 | 6.95 |
| 11 | 1.126 | 0.945 | 0.079 | 7.01 |
| 12 | 1.254 | 1.091 | 0.085 | 6.77 |
| 13 | 1.136 | 0.898 | 0.082 | 7.21 |
| 14 | 1.090 | 0.850 | 0.076 | 6.97 |
| Average | 1.120 ± 0.180 | 0.937 ± 0.156 | 0.077 ± 0.014 | 6.83 ± 0.613 |

**Table 2:** Relation among fish weight, gonad weight (ovary), number of eggs released, fecundity and egg diameter.

| Sl. No. | Fish weight (gm) | Gonad weight (gm) | Number of eggs released | Fecundity | Egg diameter (mm) after water hardening |
|---|---|---|---|---|---|
| 1 | 1.315 | 0.091 | 689 | 523 | 1.01±0.01 |
| 2 | 1.242 | 0.084 | 597 | 480 | 0.97±0.01 |
| 3 | 1.042 | 0.073 | 459 | 440 | 0.86±0.01 |
| 4 | 0.915 | 0.070 | 401 | 438 | 0.79±0.02 |
| 5 | 0.914 | 0.061 | 389 | 425 | 0.79±0.01 |
| 6 | 0.811 | 0.040 | 348 | 429 | 0.76±0.01 |
| 7 | 1.315 | 0.086 | 658 | 523 | 1.00±0.01 |
| 8 | 0.984 | 0.072 | 434 | 441 | 0.82±0.02 |
| 9 | 0.984 | 0.101 | 709 | 488 | 1.04±0.02 |
| 10 | 1.452 | 0.076 | 512 | 487 | 0.89±0.01 |
| 11 | 1.093 | 0.079 | 561 | 498 | 0.90±0.01 |
| 12 | 1.126 | 0.085 | 650 | 518 | 0.99±0.02 |
| 13 | 1.254 | 0.082 | 570 | 501 | 0.92±0.01 |
| 14 | 1.136 | 0.076 | 533 | 469 | 0.86±0.02 |
| Average | 1.120 ±0.180 | 0.077 ± 0.014 | 536 ± 117 | 475.29 ± 35.51 | 0.90±0.091 |

**Table 3:** Correlation coefficient between different parameters of temperature and spawning, fish weight and gonad weight, fish weight and GnSI, gonad and no. of egg released, fish weight and fecundity and fish weight and egg diameter.

| Parameters | Degrees of Freedom (N) | Correlation value (r) | Table of critical value for Pearson correlation |
|---|---|---|---|
| Temperature × spawning | 7 | -0.965* | 0.875 |
| Fish weight × gonad weight | 12 | 0.932* | 0.576 |
| Fish weight × GnSI | 12 | 0.246 | 0.576 |
| Gonad × no. of egg released | 12 | 0.910* | 0.576 |
| Fish weight × fecundity | 12 | 0.829* | 0.576 |
| Fish weight × egg diameter | 12 | 0.987* | 0.576 |

*Significant at 5% level or P < 0.05

**Relationship between gonad weight (ovary) and spawning rate**

The gonad weight varied from 0.040 g to 0.101 g with an average of 0.007 g (Table 2). The number of eggs released per female varies from 348 to 709 with an average of 536 exhibited direct relationships between gonad weight and number of eggs released. Statistically, correlation between gonad weights and spawning was significant and positively correlated at 5% level (Table 3).

The number of eggs released was directly related to gonad weight and female body weight. It was observed that gonad weight and number of eggs released exhibited positive correlation, which is significant at 5% level (Table 3). This indicates that the number of eggs released by female was proportional to the gonad weight. Many authors (Sampath and Pandian, 1984; James *et al.*, 1993; Jobling, 1998) have also reported that feed quality, quantity, composition, ration size and feeding frequency are among the most important factor which influence growth and reproduction.

**Relationship between fish weight (female) and fecundity**

Fish weight and number of eggs released was tabulated in Table 2. The fecundity was calculated and it varied from 425 to 523 with an average of 475.71±35.51 (Table 3). The correlation coefficient between fish weight and number of egg released was positively significant at 5% level and relationship between fish weight and fecundity was also positively correlated at 5% level (Table 3).

*Betta splendens* attained first maturity after 110 days and mean absolute fecundity was 1023 and mean relative fecundity was 860 eggs/g fish weight. In the present study, fecundity varied from minimum 425 to maximum 523 with an average of 475. It was far below the recommended fecundity. This may be due to action of some other factors. The female body weight and

fecundity exhibit positive correlation which was significant at 5% level (Table 3). This shows that fecundity was directly related to fish weight and can be attributed to better food availability as reported by many authors (Donsakul, 1987; Chalokpunrat, 1982).

**Relationship between fish weight (female) and egg diameter**

Relation between fish weight and egg diameter is tabulated in Table 3. The egg diameter was varying from 0.76 mm to 1.04 mm. The relationship between fish weight and egg diameter was positively correlated and significant at 5% level (Table 3).

The egg diameter is closely related to the fish body weight. In the present study, it was observed that there was direct relationship between egg diameter and fish weight. Positive correlation was found between egg diameter and female weight at 5% level (Table 3). In the present study, the range of egg diameter was recorded to be minimum of 0.76 mm and maximum of 1.04 mm with an average of 0.90 mm. Choola (1930) and Donsakul (1987) have reported that the average diameter of the eggs laid by domesticated females is 0.89 mm (range 0.79 – 1.03) which is greater than that of the eggs laid by wild females. In case of wild female *Betta splendens*, it was found that the average diameter of the egg was found to be 0.79 mm (range 0.54-1.24) which is smaller than that of the eggs laid by domesticated fish. Gifford (2007) also reported that egg size depends on the availability and quality of food eaten by the parents.

## CONCLUSION

During the present study it was observed that gonad weight, fecundity and size of the egg increases as the female weight increases. There were positive correlations between these parameters.

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