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Fecundity and GSI of Mourala, *Amblypharyngodon mola* (Hamilton-Buchanan, 1822) from South Bengal district of West Bengal

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Abstract
Mature specimensof *Amblypharyngodon mola* ranging from 2.13 g to 4.46 g and 59 mm to 78 mm were analysed. Fecundity varies from 940 to 7210 and the fecundity factor ranged from 429.65 to 2281.65. The mathematical relationship of fecundity with fish length, fish weight, ovary weight and ovary length were calculated. The mathematical relationship of fish weight-ovary weight, fish length-ovary length and fish weight-ovary length was also carried out. The computed relationships were found to be highly significant especially between fecundity and ovary weight (r=0.890, p<0.01). The GSI of *A. mola* varies from 1.88 to 20.42, lowest value was recorded in January and maximum GSI was recorded in June and other in November *i.e.,* it breeds twice in a year.

Keywords: Mourala, *Amblypharyngodon mola,* fecundity, gonadosomatic index

1. Introduction
Fecundity literally means the potentiality of prolific breeding. But in the language of reproductive biology of animals, fecundity is used to describe the total number of eggs produced. Study on the reproductive biology of any species is very much essential for assessing commercial potentialities of its stock, life history, culture practice and actual management of its fishery [10]. Among the small indigenous fish species the Mola Carplet, *Amblypharyngodon mola*, locally known as mourala is very popular fish in West Bengal due to its good taste as well as high nutrient value including good amount of vitamin A, protein and mineral [26, 28]. This species provide not only nutrition but also livelihood opportunities and income to a large number of fishers. Earlier works on fecundity of *A. mola* were carried out by some workers in Bangladesh [2, 3, 5, 9, 13, 16, 20-22, 24] and India [7, 12, 16, 23] at different time period in different climatic condition from different habitat and location. The present study on fecundity and Gonadosomatic Index (GSI) of *A. mola* has been carried out to know whether any changes or differences of earlier studies were there in maturation, fecundity and GSI as the influence of habitat and climatic effects from South Bengal District of West Bengal, India.

2. Materials and Methods
Fecundity of *A. mola* was studied from different water body located in South Bengal district of West Bengal (Taldi, Behala, Garia, Thakurpukur). Fourty nos. *A. mola* females were collected during the breeding season for present studies. After measuring the body weight and length of the fishes, the ovary from each fish was removed carefully. The total length was recorded in millimeter and the weights were taken in gram. The moisture was thoroughly wiped out from the ovaries with a blotting paper. The length and weight of the ovaries were also recorded in millimeter and in gram respectively with complete care. The collected ovaries were then kept in Gilson's fluid [6] for fixation, softening of the ovarian tissue and hardening of the eggs. After about 6 weeks of fixation, ova were washed with tap water and left on a filter paper to dry. Four subsamples (air dried) were taken and counted separately for the number of ova present. The formula used for fecundity calculation is:

$$F = \frac{W}{W1 + W2 + W3 + W4} \times (N1 + N2 + N3 + N4)$$

Where F= Fecundity; W= total weight of the ovary; W1, W2, W3 and W4 = weight of the each subsample and N1, N2, N3 and N4 = ova number of each subsample. The relationships between fecundity and fish length, fecundity and fish weight, fecundity and ovary weight, body weight and ovary weight, fish length and ovary length, fecundity and ovary length and fish weight and ovary length were worked out. The relationships were determined by the method of least squares [27]. The fecundity factor (No. of ova per gram body weight of fish) were also calculated. All statistical relations were measured with the aid of computer using SPSS-16.0 and MS Excel.

In order to assess the gonadal development of fish the Gonadosomatic index of the fish was calculated as per formula:

Gonadosomatic Index (GSI)

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

3. Results

The ovaries of *A. mola* are paired and attached dorsally by the mesovarium. The hinder end of each ovary is continued posteriorly into a short oviduct. The shape and size of ovary shows morphological changes throughout the year. The ovary of *A. mola* was categorised into five maturity stages. During immature stage ovaries are colourless, thread like and translucent in appearance and during ripe stage, ovaries are deep yellow in colour. Ovaries were taken from individuals of known length and weight of *A. mola* which ranged from 59 to 78 mm and 2.13 to 4.46 g respectively. Fecundity has been observed to vary between 940 (for a fish of total length 65mm, body weight 2.15g, ovary weight 0.16g and ovary length 20mm) to 7210 (for a fish of total length 76mm, body weight 4.2g, ovary weight 0.70g and ovary length 25 mm). The number of mature eggs per gram of body weight (fecundity factor) ranged from 429.65 to 2281.65 with an average of 992.34 mature eggs.

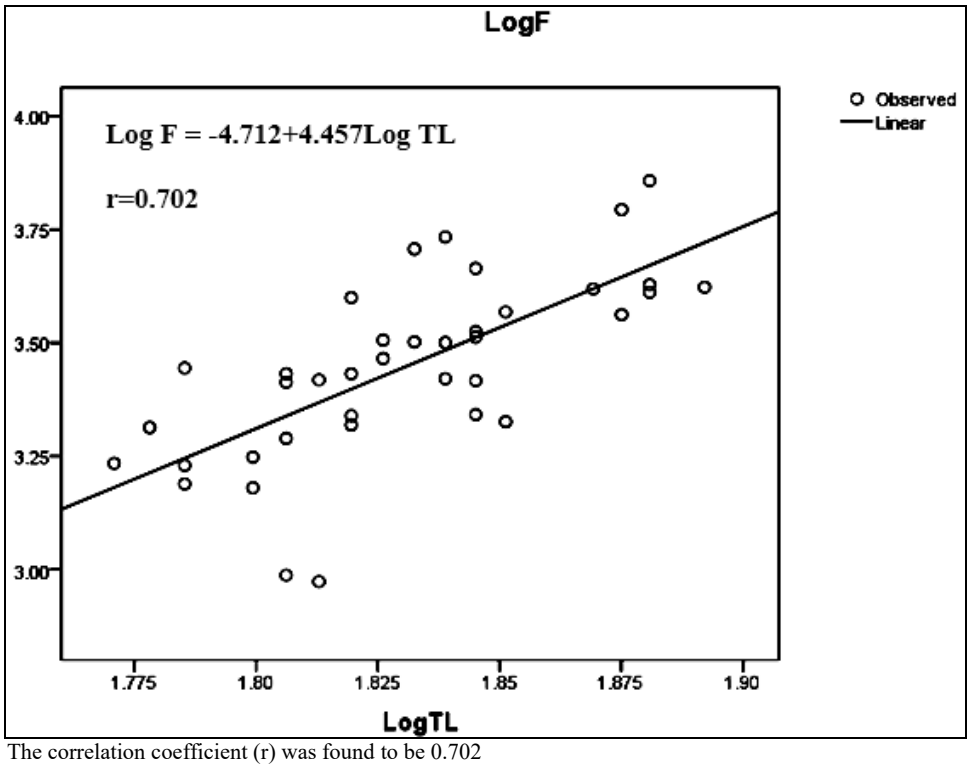
3.1 Relationship between fecundity (F) and fish length (TL) of *A. mola*

The scatter diagram revealed a linear (Fig 1) relationship between fecundity and fish length and the coefficient of correlation was significant at 1% level (p<0.01). The relationship between fecundity (F) and total length of the fish (TL) is expressed by the equation:

F = -10419.123 + 199.053 TL (r=0.708, p<0.01)

A logarithmic transformation gives the straight-line regression of log fecundity on Log length

Log F = -4.712+4.457 Log TL



The correlation coefficient (r) was found to be 0.702

Fig 1: Total length of the fish (TL) and Fecundity (F) - relationship in *A. mola*

3.2 Relationship between fecundity (F) and Fish weight (FW) of *A. mola*

The scatter diagram revealed a linear (Fig 2) relationship between fecundity and fish weight and the coefficient of correlation was significant at 1% level (p<0.01). The relationship between fecundity (F) and Fish weight (FW) is expressed by the equation:

F = -1771.598 + 1581.765 FW (r=0.754, p<0.01)

A logarithmic transformation gives the straight-line regression of log fecundity on log Fish weight

Log F = 2.655 + 1.657 Log FW

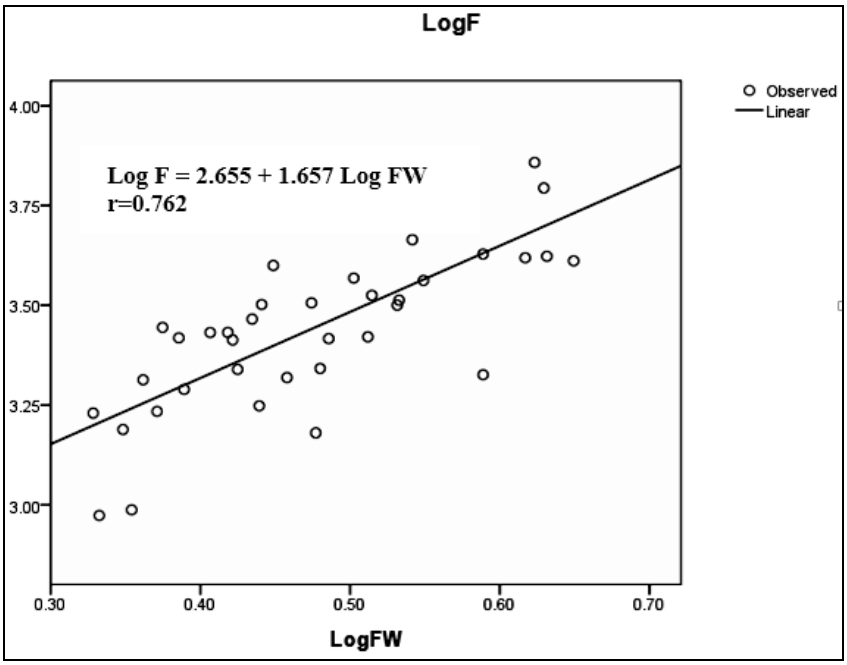


Fig 2: Weight of the fish and fecundity relationship in *A. mola*

3.3 Relationship between fecundity (F) and ovary weight (OW) of *A. mola*

The scatter diagram revealed a linear (Fig 3) relationship between fecundity and ovary weight and the coefficient of correlation was significant at 1% level (p<0.01). The relationship between fecundity (F) and ovary weight (OW) is expressed by the equation:

F = -10.281 + 8310.311 OW (r=0.890, p<0.01)

A logarithmic transformation gives the straight-line regression of Log fecundity on Log ovary weight

Log F = 3.916 + 1.016 Log OW

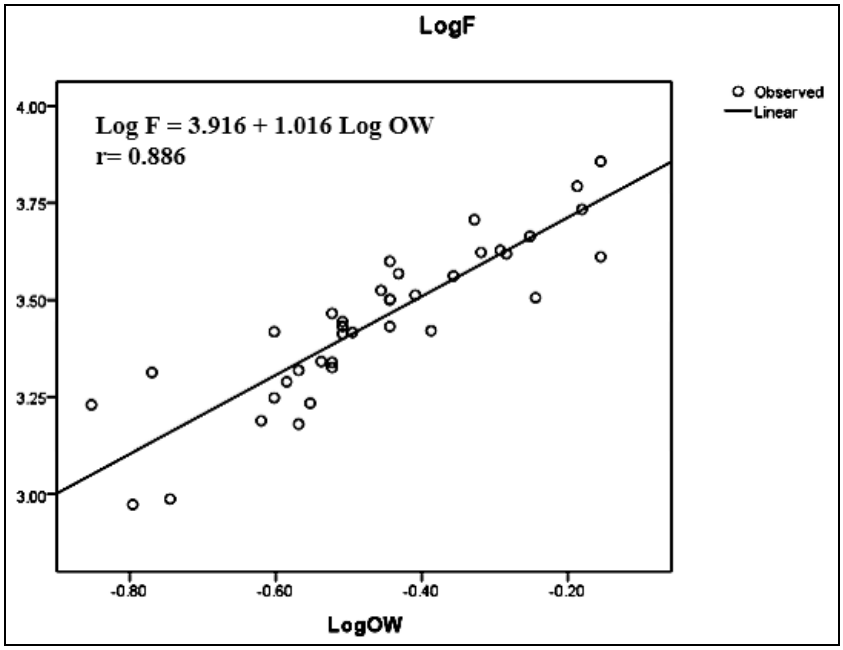


Fig 3: Fecundity- ovary weight relationship in *A. mola*

3.4 Relationship between fecundity (F) and ovary length (OL) of *A. mola*

The scatter diagram revealed a linear (Fig 4) relationship between fecundity and ovary length and the coefficient of correlation was significant at 1% level (p<0.01). The relationship between fecundity (F) and ovary length (OL) is expressed by the equation:

F = -4004.928 + 317.111 OL (r=0.628, p<0.01)

A logarithmic transformation gives the straight-line regression of log fecundity on Log ovary length

Log F = 0.246 + 2.377 Log OL

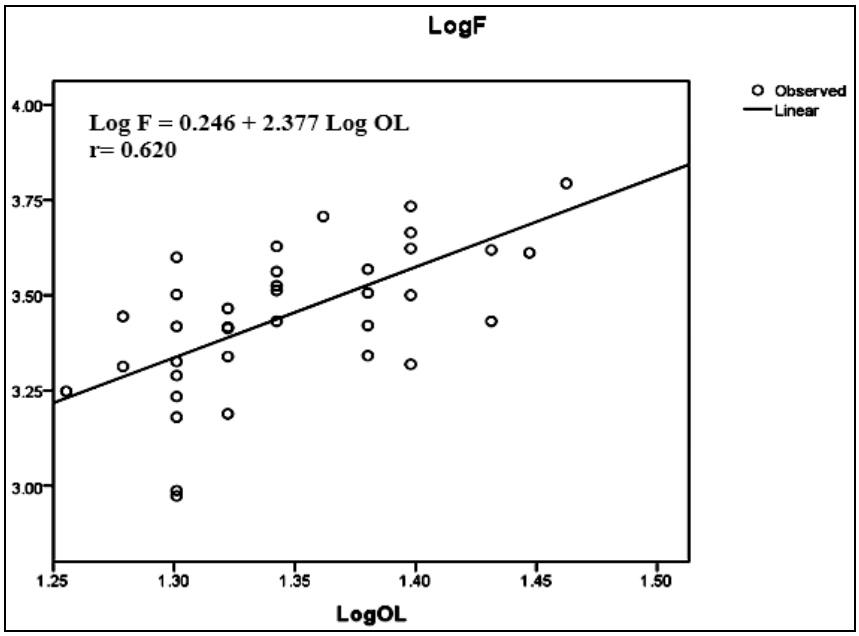


Fig 4: Fish length-ovary length relationship in *A. mola*

3.5 Relationship between Fish weight (FW) and ovary weight (OW) of *A. mola*

The scatter diagram revealed a linear (Fig 5) relationship between body weight and ovary weight and the coefficient of correlation was significant at 1% level (p<0.01). The relationship between body weight (FW) and ovary weight (OW)is expressed by the equation:

OW = -0.211 + 0.199 FW (r=0.787, p<0.01)

A logarithmic transformation gives the straight-line regression of log fish weight on Log ovary weight

Log OW = -1.193 + 1.580 Log FW

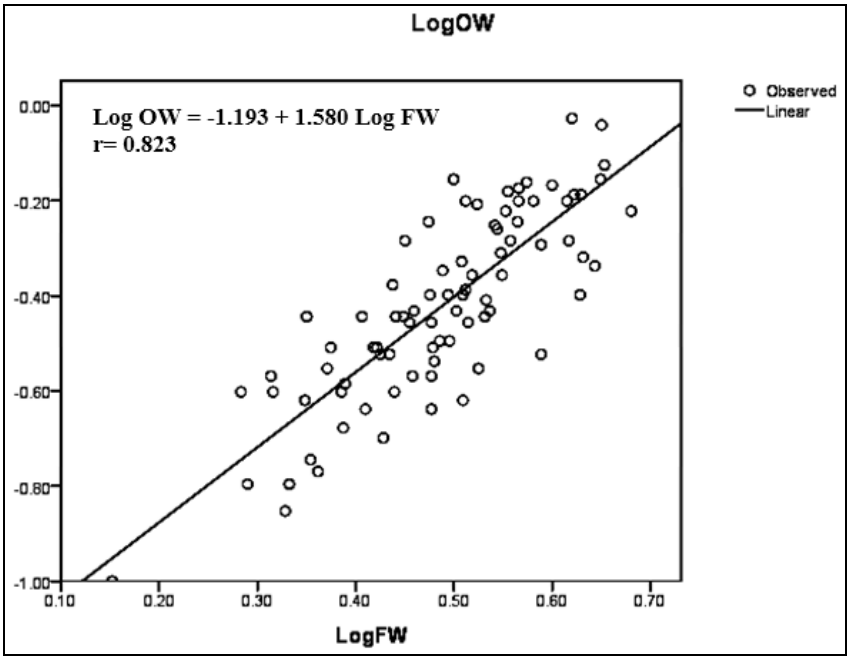


Fig 5: Fish weight- ovary weight relationship in *A. mola*

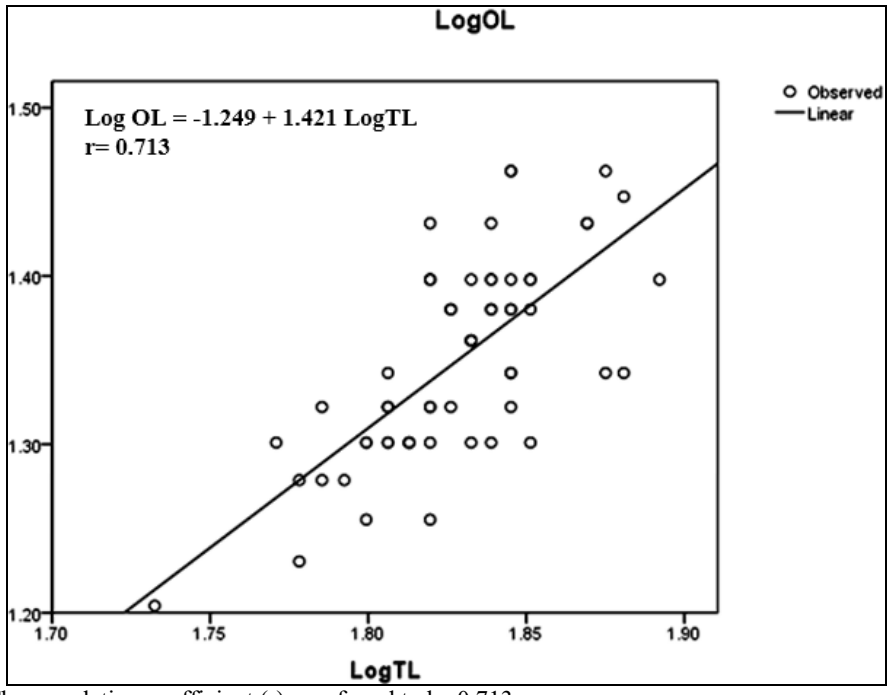
3.6 Relationship between Fish length (TL) and ovary length (OL) of *A. mola*

The scatter diagram revealed a linear (Fig 6) relationship between fish length and ovary length and the coefficient of correlation was significant at 1% level (p<0.01). The relationship between fish length (TL) and ovary length (OL) is expressed by the equation:

OL = -8.892 + 0.466TL (r=0.690, p<0.01)

A logarithmic transformation gives the straight-line regression of Log fish length on Log ovary length

Log OL = -1.249 + 1.421 Log TL



The correlation coefficient (r) was found to be 0.713.

Fig 6: Fish length-ovary length relationship in *A. mola*

3.7 Relationship between Fish weight (FW) and ovary length (OL) of *A. mola*

The scatter diagram revealed a linear (Fig 7) relationship between fish weight and ovary length and the coefficient of correlation was significant at 1% level (p<0.01). The relationship between fish weight (FW) and ovary length (OL) is expressed by the equation:

OL = 5.911 + 4.366 FW (r=0.344, p<0.01)

A logarithmic transformation gives the straight-line regression of log fish weight on Log ovary length

Log OL= 0.726 + 0.966 Log FW

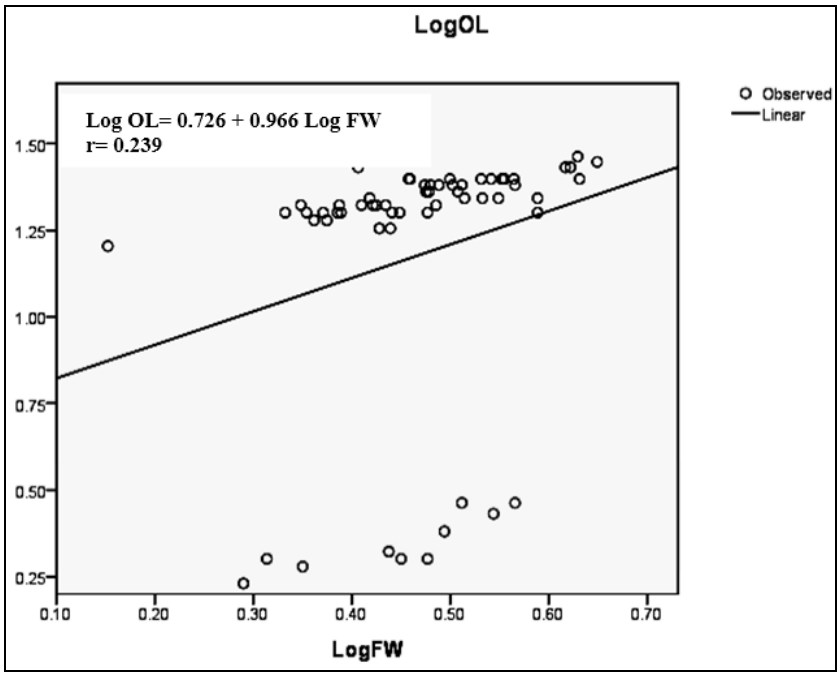


Fig 7: Fish weight-ovary length relationship in *A. mola*

3.8 Gonadosomatic Index

The GSI varies from 1.88 to 20.42. The breeding season of *A. mola* extend from April to December. Lowest value of GSI has been observed in the month of January (Fig 8); then it started to increase from February onwards and was maximum in June; then decreased in July and it again started to increase from October and reached the second peak in November; then also decreased in December to reach the lowest value again in

January. Seasonal changes of mean GSI of *A. mola* is given in Fig 9. In case of female GSI has shown significant positive relationship with total body weight, total gonad weight and gonadal length. In case of male GSI significant positive relationship only with gonad weight, no significant relationship has been observed with total body weight, total length and gonad length.

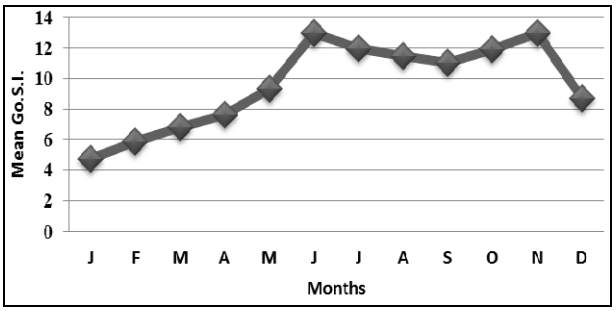


Fig 8: Monthwise trend in the Gonadosomatic index of *A. mola*

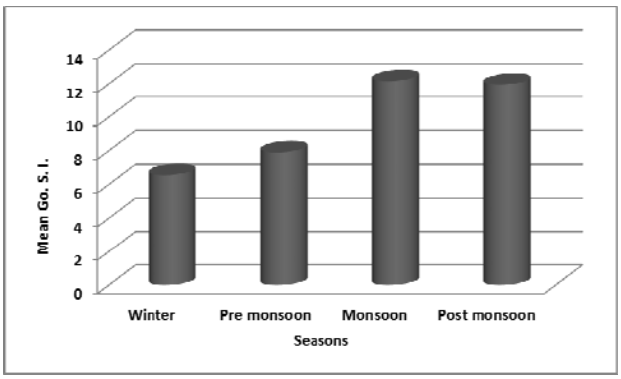


Fig 9: Seasonal changes of mean Gonadosomatic index of *A. mola*

4. Discussion

In the present investigation, the average fecundity of *A. mola* has been found varying between 940 (for a fish of total length 65mm, body weight 2.15g, ovary weight 0.16g and ovary length 20mm) to 7210 (for a fish of total length 76mm, body weight 4.2g, ovary weight 0.70g and ovary length 25 mm). Various researchers [1, 2, 5, 8, 9, 12, 13, 16-18, 20, 21, 26] worked on fecundity of *A. mola* and stated the various ranges of fecundity which varies between 400 to 16,072. The result of the present study closely agrees with the result of the above mentioned researchers and also depicts highly fecundity nature of *A. mola.* Variation in fecundity among the equal sized fish has been observed during this present study; fish measuring 70mm in total length (gonad weight 0.29gm) has been observed to produce 2,196 eggs; whereas another fish of the same length (gonad weight 0.56gm) has been observed to produce 4,617 eggs. The similar type of observation has also been reported by many researchers [2, 4, 12, 14, 19, 25] in different fishes and may be due to variation in age, condition factor, availability of space and food etc. [11, 15]. In the present study, the fecundity values suggested that the reproductive cycle of Mourala is from April to December with two peaks, one in June and other in November *i.e.,* it breeds twice in a year. Study also revealed that the average fecundity factor was 992.34 whereas at Assam the value of same was 646 [8]. The number of eggs produced by a female depends on various factors like size, age, condition and types of samples [15]. In the present study, fecundity was highly correlated (p<0.01) with body length, body weight, ovary weight and ovary length. Lowest value of GSI has been observed in the month of January (Fig 8); then it started to increase from February onwards and was maximum in June; then decreased in July and it again started to increase from October and reached the second peak in November; then also decreased in December to reach the lowest value again in January. On the other hand the earlier worker [24] reported the higher mean value of GSI of *A. mola* from March to August with a peak value in May.

5. Conclusion

A. mola is a highly fecund fish and reproductive cycle ranging from April to December with two peaks, one in June and other in November *i.e.,* it breeds twice in a year. Fecundity was highly correlated (p<0.01) with body length, body weight, ovary weight and ovary length. Lowest value of GSI has been observed in the month of January and reached the first peak in June and the second peak in November.

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