World Academy of Science, Engineering and Technology
International Journal of Nutrition and Food Engineering
Vol:8, No:1, 2014

Estimation of Fecundity and Gonadosomatic Index of *Terapon jarbua* from Pondicherry Coast, India

R. Nandikeswari, M. Sambasivam, V. Anandan

***Abstract*—**In the present study fecundity of *Terapon jarbua* was estimated for 41 matured females from the Bay of Bengal, Pondicherry. The fecundity (F) was found to range from 13,475 to 115,920 in fishes between 173-278mm Total length (TL) and 65- 298 gm weight respectively. The co-efficient of correlation for F/TL (log F = - 4.821 + 4.146 log TL), F/SL (log F = -3.936 + 3.867 log SL), F/WF (log F = 1.229 + 0.730 log TW) and F/GW (log F = 0.724 + 1.113 log GW) were obtained as 0.474, 0.537, 0.641 and 0.908 respectively. The regression line for the TL, SL, WF and GW of the fishes were found to be linear when they were plotted against their fecundity on logarithmic scales. Highly significant ($P<0.01$) relationship was obtained for all the variables. Hence Total Length, Standard Length, Weight of Fish and Gonad Weight were found to be the best indicators of the fecundity of *Terapon jarbua*. Gonadosomatic indices of *Terapon jarbua* showed that the spawning took place in February to July. The overall sex ratio of male to female is 1.28:1 with chi-square value 5.719, significant at 5% level.

***Keywords*—**Fecundity, Gonadosomatic index, Reproductive biology, spawning, *Terapon jarbua.*

I. Introduction

TERAPON *jarbua* belong to the family teraponidae is a medium size food fish which inhabits the sea, backwater and estuaries in Pondicherry coast. Being commercially important, this species constitute a regular fishery throughout the year. No information is available regarding the fecundity study of *Terapon jarbua.* With the view of supplementing this, the present study was undertaken along the Pondicherry coast.

The number of eggs contained in ovary of a fish is termed as fecundity. The term fecundity denotes the egg laying capacity of a fish or it refers to the number of ripe eggs produced by a fish in one spawning season. 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. Relative fecundity is the number of eggs per unit of weight is commonly used as an index of fecundity. The fecundity of an individual female also varies according to many factors including age, size, types of species, food availability and season. Many works had been done on the fecundity of different fishes [2], [4], [5], [7].

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II. Materials and Methods

A total of 41 matured females of *Terapon jarbua* were collected from Bay of Bengal, Pondicherry from July 2008 to June 2010 for the determination of fecundity and gonadal weight in relationship to other the parameters. Enlarged abdomen of the female fish was easily distinguished as gravid one. For detail study of fecundity the collected fishes were carried immediately to the laboratory. After thorough wash with tap water the total length of each fish was measured with a measuring scale to the nearest millimeter and the body weight in gram by an electronic balance. Excess water from the fishes was removed with blotting paper before measuring the weight of the fishes. The gonads were dissected out and weighted.

Two lobes of the ovary from each sample fish were removed carefully by dissecting out the abdomen and placed in modified Gilson's fluid. It helped to preserve the ovary as well as made it much easier to separate the eggs from the ovarian wall. Gravimetric method was used to determine the fecundity of fish [3].

The two lobs of each ovary were dried off removing of excess moisture with blotting paper. Then 0.01g of each ovary was taken separately from anterior, middle and posterior portions of each lobe. The number of eggs in 0.01g was determined and then multiplied by the total weight of the ovary, which gave the total number of eggs i.e. the fecundity of respective fish.

Gonadosomatic index (GSI) of the male and female fishes of the collected samples was determined separately by the following method:

$$\text{GSI} = \frac{wt.of\ the\ gonad}{wt.of\ the\ fish} \times 100$$

The relationship between fecundity and total length, standard length, weight of fish, and gonad weight were determined with the help of a computer software viz SPSS.

III. Results and Discussion

The relationship between total length (TL) and fecundity (F), standard length (SL) and fecundity (F), total weight of fish (WF) and fecundity (F), gonad weight (GW) and fecundity (F) were estimated by least square method. The fecundity varied from 13,475 to 115,920 based on 41 ovaries of fishes ranging in total length from 173–278mm and weight 65-298gm.

A. Relationship between Total Length (TL) and Fecundity (F)

The relationship between Total length and Fecundity of *Terapon jarbua* showed a linear relationship, expressed by the equation,

$$F = - 279132+17566*TL \text{ (or)}$$

$$\text{Log } F = - 4.821+4.146*\log (TL)$$

Based on this formula, the fecundity values were calculated for different lengths showed a linear relationship. Hence the present study suggests that the fecundity increase with the increasing length of the fish**.** The correlation co-efficient (r = 0.474) between total length and fecundity was found to be significant at 0.01 level.

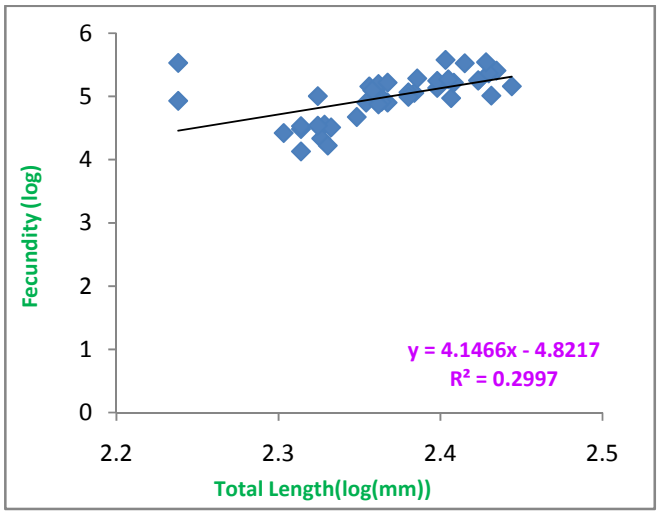

Fig. 1 Relationship between Total Length and Fecundity of *Terapon jarbua*

B. Figures Relationship between Standard Length (SL) and Fecundity (F)

The relationship between standard length and fecundity of *Terapon jarbua* was found to be linear, expressed by the equation,

$$F = - 26145+19171*SL \text{ (or)}$$

$$\text{Log } F = -3.936+3.867*\log (SL)$$

The correlation co-efficient (r = 0 .537) between standard length and fecundity was found to be significant at 0.01 level.

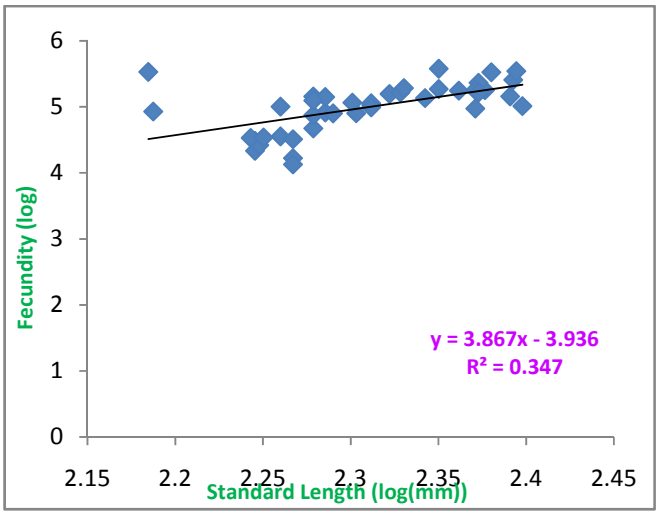

Fig. 2 Relationship between Standard Length and Fecundity of *Terapon jarbua*

C. Relationship between Weight of Fish (WF) and Fecundity (F)

The relationship between total weight of the fish and fecundity showed a linear relationship, expressed by the equation,

$$F = -2593+833.5*WF \text{ (or)}$$

$$\text{Log } F = 1.229+0.730*\log (WF)$$

The correlation co-efficient (r = 0.641) between total weight and fecundity was found to be significant at 0.01 level. Hence it was concluded that fecundity increases as weight of the fish increases.

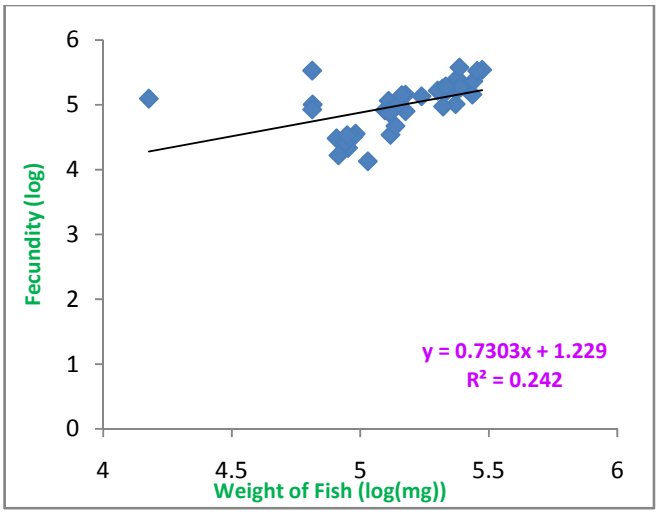

Fig. 3 Relationship between Weight of Fish and fecundity of *Terapon jarbua*

D. Relationship between Weight of Gonad (GW) and Fecundity (F)

The relationship between gonad weight and fecundity showed a linear relationship, expressed by the regression

equation,

$$F = -8109+16618*GW \text{ (or)}$$

$$\text{Log } F = 0.7248+1.113*\log (GW)$$

The correlation co-efficient (r = 0.908) between gonad weight and fecundity was found to be significant at 0.01 level indicating a high degree of relationship between these two variables. Hence Gonad weight was found to be the better index of fecundity in *Terapon jarbua.*

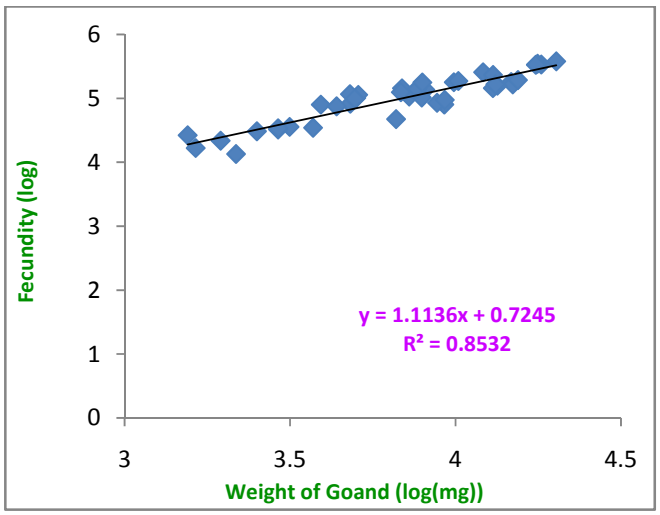

Fig. 4 Relationship between Weight of Gonad and Fecundity of *Terapon jarbua*

IV. Gonadosomatic Index of *Terapon jarbua*

The reproductive cycle in fishes involves large changes in the weight of gonads which are usually reported in terms of the gonadosomatic index (GSI) expressed in terms of the gonadal weight as a percentage of the whole body weight. There have been numerous studies in which GSI has been used as an indicator of gonad development, i.e. ovary and testis in terms of maturity and denotes the phase of the reproductive cycle. Gonadosomatic index is generally used for the study of maturation and spawning biology. It is also used to assess the degree of ripeness of the ovary.

During the year 2008-2009, the Gonadosomatic index of *Terapon jarbua* showed two peaks one during the month of February and other during the month of April. Significant rise in Gonadosomatic index was observed in the month of February (8.65) and declined in March which indicates the onset of spawning. The higher peak in April (5.04) indicates maturation of another small fraction of population. From the present study it has been observed that the spawning period of *Terapon jarbua* starts from February and extended to July. The highest peak in February coincides with warm temperature. The commencement of spawning in April coincides with the rising temperature and its accompanied longer photoperiod may play a role on gonad maturation [8]. In case of male, Gonadosomatic index showed peak in March-April coinciding with that of female.

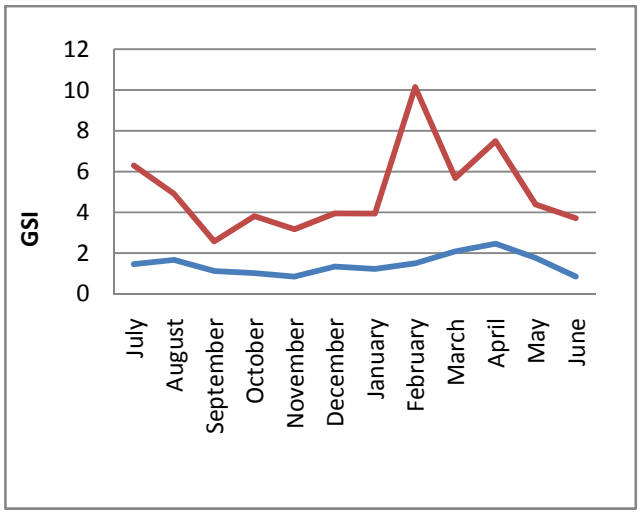

Fig. 5 Gonadosomatic index of *Terapon jarbua* during 2008-2009

During the year 2009-2010, the Gonadosomatic index of *Terapon jarbua* increased in February (7.69) and significantly increased in March (18.27) and slightly declined in April. During April, June and July there is a slight fall in Gonadosomatic index which indicates the spawning activity during these months. From August onwards the Gonadosomatic index began to decline. From the observation it is concluded that temperature and longer photoperiod play important role in spawning activity. The male showed increased peak in April-May indicating the spawning activity.

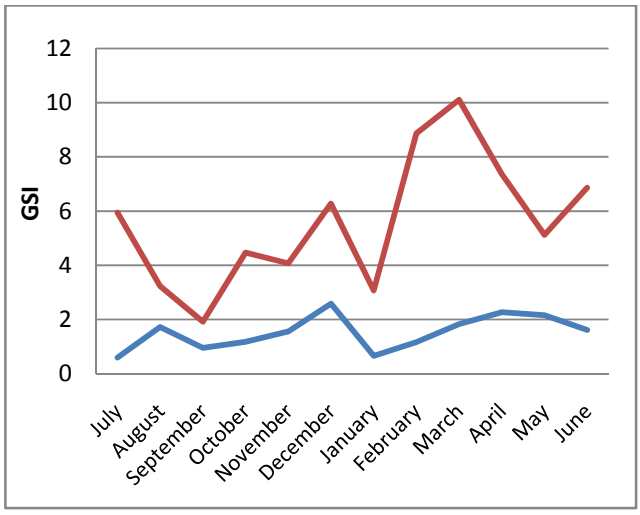

Fig. 6 Gonadosomatic index of *Terapon jarbua* during 2009-2010

Gonadosomatic index has been considered as reliable estimate for gonad maturity and spawning of any species. The gonadosomatic index increased with the maturation of fish and reaches to its maximum at the peak period of maturity. Its abrupt decrease indicates beginning of spawning. Similar observation was made by Golikatte and Bhat [6] in Gerres filamentosus.

V. Sex Ratio

Sex ratio indicates the proportion of male to female in a population. In nature, the ratio is expected to be 1:1. The study on sex ratio throws light on aspects such as sex viability and segregation or aggregation of sexes according to breeding behavior. A knowledge of sex ratio in population of fishes is essential in the derive means of ensuring a proportional fishing of two sexes.

This study is based on random samples of species *Terapon jarbua* collected at Pondicherry by trawl nets operated from mechanized boats and bag nets. Sex ratio was determined from the number of specimens of each sex sampled every month (Table I). The sex ratio values obtained every month were subjected to chi-square (χ^2) analysis to test the significant deviations from an expected 1:1 sex ratio for male and female fishes employing the formula $\chi^2 = \sum\left[\frac{(o-e)^2}{e}\right]$ where o is the observed frequency and e is the expected frequency.

During the period 2008-2010, a total of 208 males and 162 females were recorded. The data of sex ratio for each month showed that in many months, the number of males exceeded the number of females. The chi-square value calculated for each month showed that the sex ratio was conformed to the expected ratio 1:1 except during July and October, March, June. The chi-square values vary significantly with the expected 1:1 ratio with lesser females in July and October, March but lesser males in June.

Significant variation occurred during the peak spawning season i.e. March, June and July. In the month of October, March and July (2010) the proportion of males was highest. The observation could be attributed due to active movement of males for spawning. The proportion of females was higher during June (2010) which could be due to possibility that spent males must have left the spawning ground before the females. Similar observation was reported earlier by Shendge et al. [1] in *Oreochromis mossambicus*.

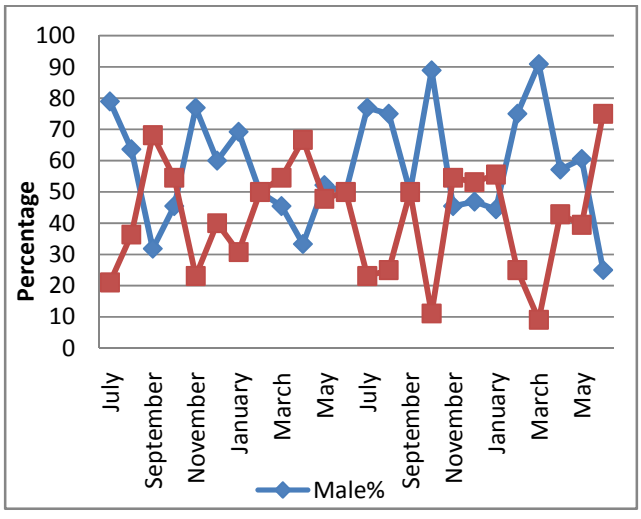

Fig. 7 Month wise sex ratio of *Terapon jarbua* during 2008-2010

TABLE I
Month Wise Sex Ratio of *Terapon jarbua* During 2008-2010

Month	M	F	Total	%(M)	%(F)	M:F	χ^2
July	15	4	19	78.95	21.05	3.75:1	6.37*
August	7	4	11	63.64	36.36	1.75:1	0.82
September	7	15	22	31.82	68.18	1:2.14	2.91
October	5	6	11	45.45	54.55	1:1.2	0.09
November	10	3	13	76.92	23.08	3.3:1	3.77
December	9	6	15	60	40	1.5:1	0.6
January	9	4	13	69.23	30.77	2.25:1	1.92
February	5	5	10	50	50	1:1	0
March	5	6	11	45.45	54.55	1:1.2	0.09
April	5	10	15	33.33	66.67	1:2	1.67
May	12	11	23	52.17	47.83	1.09:1	0.04
June	9	9	18	50	50	1:1	0
July	10	3	13	76.92	23.08	3.33:1	3.77
August	9	3	12	75	25	3:1	3
September	8	8	16	50	50	1:1	0
October	8	1	9	88.89	11.11	8:1	5.44*
November	5	6	11	45.45	54.55	1:1.2	0.09
December	15	17	32	46.88	53.13	1:1.13	0.13
January	4	5	9	44.44	55.56	1:1.25	0.11
February	6	2	8	75	25	3:1	2
March	10	1	11	90.91	9.09	10:1	7.36*
April	8	6	14	57.14	42.86	1.33:1	0.29
May	23	15	38	60.53	39.47	1.53:1	1.68
June	4	12	16	25	75	1:31:3	4*
Total	**208**	**162**	**370**	**56.22**	**43.78**	**1.28:1**	**5.72***

*significant, M: Male, F: Female

The spawning season of *Terapon jarbua* commences in the month of February and extends up to July. It is interesting to note that in the month of February, July and September the sex ratio was found to be 1:1 which ensures the success of spawning. The males in monthly samples ranged between 25% and 90.91% while the females ranged between 9.09% and 75%. The overall sex ratio of males to females is 1.28:1 with chi-square value 5.719 (Fig. 7, Table I).

Acknowledgment

We would like to thank Dr. V. Anandan, Professor and Head Kanchi Mamunivar Centre for Post Graduate Studies, Pondicherry, Pondicherry University for motivating to do research in this filed. We also thank Dr. P. M. Mohan, Professor and Head, Department of Ocean Studies and Marine Biology, Pondicherry University, India, for his continuous support, valuable suggestions and encouragement.

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