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Study on gonadosomatic index and sex ratio of *Terapon jarbua* (Forsskal, 1775) from Pondicherry coast, India

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Abstract

The Gonadosomatic index and Sex ratio of *Terapon jarbua* from Pondicherry coast has been studied. The Gonadosomatic index of *Terapon jarbua* based on different size groups showed a gradual increase varied from 0.48283 to 2.48615 for male and 0.31981 to 5.28722 for female. The data on sex ratio of *Terapon jarbua* in relation to various length groups showed that 75% of female were recorded in lowest length group (12-14cm). The highest length groups (28-30cm and 30-32cm) were recorded only in female.

Keywords: Gonadosomatic index, *Terapon jarbua*, Sex ratio, Spawning, Pondicherry coast.

1. Introduction

Terapon jarbua belongs 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 constitutes a regular fishery throughout the year. 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 denotes the phase of the reproductive cycle. Gonadosomatic index is generally used for the study of maturation and spawning biology. The most suitable method of determining the reproductive cycle of fishes is to observe seasonal developmental changes in gonads [1-3]. The maturation cycle has been described as morphological changes that gonads undergo to attain full growth and ripeness [4]. 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 [5]. No information is available regarding the GSI and Sex ratio study of *Terapon jarbua*. With the view of supplementing this, the present study was undertaken along the Pondicherry coast.

2. Materials and Methods

2.1. Gonadosomatic index (GSI)

The collected specimens from landing centers were brought to the laboratory. The gonads were collected for reproductive analysis and also to determine the sex. Every specimen was measured to determine the total length in mm and total weight in gm. The male and female perches were differentiated and data were recorded after dissecting out the gonad. Gonads were carefully removed, washed, cleaned with distilled water, dried with the help of blotting paper and then weighed. The gonads were preserved in a well labeled vial containing 10% buffered formalin for subsequent studies. The ovarian membrane becomes transparent and mature eggs were observed by naked eyes.

General feature and structure as well as size, shape and colour of male and female gonads of the experimental fish were considered after sample collection and preservation. The gonadal weight was noted and the gonadosomatic index (GSI) was calculated for each specimen following the method of Render [6].

$$GSI = \frac{WG}{WB} \times 100$$

by the formula

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Where WG is the weight of gonad and WF is the weight of fish.

2.2 Sex ratio

This study is based on random samples of *Terapon jarbua* collected at Pondicherry by trawl nets operated from mechanized boats and bag nets. During the period 2008-2010, a total of 208 male and 162 female of *Terapon jarbua* were recorded. Sex ratio was determined from the number of specimens of each sex sampled every month. The sex ratio values obtained every month were subjected to chi-square 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.

3. Results

3.1. Gonadosomatic index (GSI)

Gonadosomatic index has been considered as reliable estimate for gonadal 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. During the study period, it was noted that the gonadosomatic index of male and female *Terapon jarbua* based on the different size groups showed a gradual increase in relation to increase in the size groups of male and female (Table 1 & Fig. 1, 2).

Table 1: Mean GSI of male and Female *Terapon jarbua* in different size group during 2008-2010

Length (cm)	Mean GSI(M)	Cum. GSI (M)	Mean GSI(F)	Cum. GSI (F)
12_14	0.48283	0.482833	0.31981	0.31981
14_16	2.20528	2.688111	0.59292	0.912729
16_18	0.82616	3.514274	4.51578	5.428505
18_20	1.40055	4.914822	2.53705	7.96555
20_22	1.74115	6.655972	2.72275	10.6883
22_24	2.13199	8.787957	4.58444	15.27274
24_26	1.99049	10.77845	4.38464	19.65738
26_28	2.48615	13.26459	4.62574	24.28312
28_30	0	13.26459	5.28722	29.57034
30_32	0	13.26459	2.64423	32.21457

cm: Centimeter Cum: cumulative, M: Male, F: Female

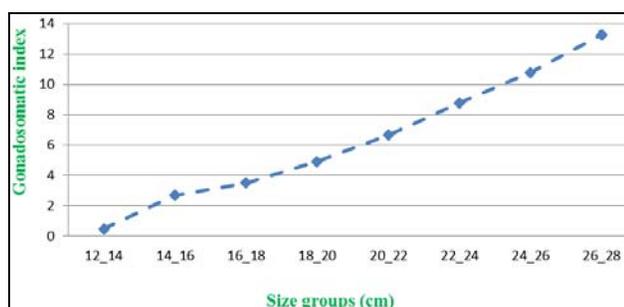


Fig 1: GSI of male *Terapon jarbua* in different size group during 2008-2010

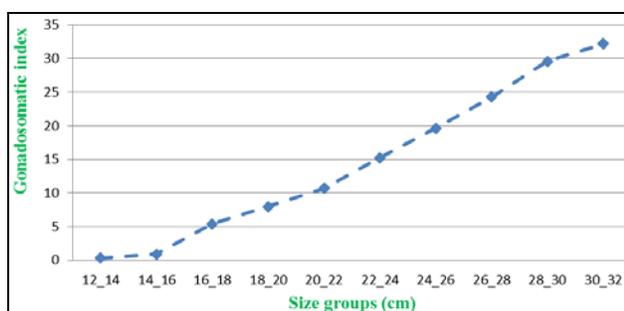


Fig 2: GSI of female *Terapon jarbua* in different size group during 2008-2010

3.2. Sex Ratio

The data on sex ratio in relation to various length groups showed that in lowest length group (12-14cm) 75% of female was recorded. In the highest length groups (28-30 and 30-32cm) only female were recorded, which could be due to

possibility that the spent male must have left spawning ground before the female (Table 2 & Fig. 3).

Table 2: Sex ratio of *Terapon jarbua* in relation to various length groups during 2008-2010

Length (cm)	Male	Female	Total	%M	%F	M:F	χ^2
12_14	1	3	4	25	75	1:3	1
14_16	10	11	21	47.62	52.38	1:1.1	0.05
16_18	40	17	57	70.18	29.82	2.35:1	9.28*
18_20	74	30	104	71.15	28.85	2.47:1	18.62*
20_22	50	33	83	60.24	39.76	1.52:1	3.48
22_24	19	16	35	54.29	45.71	1.19:1	0.26
24_26	8	27	35	22.86	77.14	1:3.8	10.31*
26_28	6	15	21	28.57	71.43	1:2.5	3.86
28_30	0	9	9	0	100	0:1	9*
30_32	0	1	1	0	100	0:1	1
Total	208	162	370	56.22	43.78	1.28:1	5.72*

*significant, M: Male, F: Female, T: Total

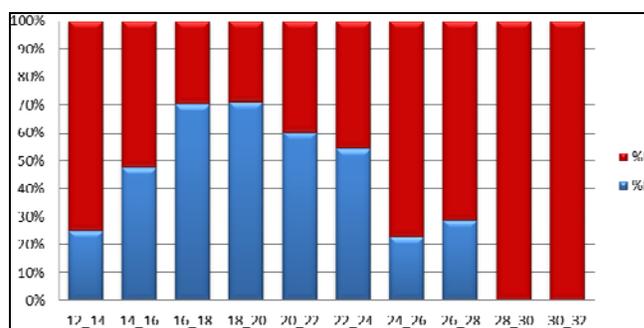


Fig 3: Sex ratio of *Terapon jarbua* in relation to various Length groups during 2008-2010

4. Discussion

Gonadosomatic index (GSI) is one of the important parameters of the fish biology, which gives the detailed idea regarding the fish reproduction and reproductive status of the species and helps in ascertaining breeding period of fishes [7-13]. The analysis of gonadosomatic index values provides an important information regarding to the measure of gonad size relative to body weight [14]. And also the studying of the spawning season [15]. Gonads undergo regular seasonal cyclic changes in weight; particularly in female indicate the spawning season [16]. The maximum values of the gonadosomatic index of Haddock (*Mellanogrammus aeglefinus*) (GSI) were found in pre-spawning female in March–April. During spawning, GSI of female gradually decreased in May when the last batch of eggs was spawned. The minimum values of GSI were observed during the post-spawning season from August to September [17]. It can provide a quantitative assessment of the degree of gonadal development, breeding season and reproductive cycles of fishes [18]. Meanwhile the development and growth of gonad take place in the fish simultaneously. As Fish grows, the GSI increases [19]. When the direct inspection of gonadal maturation is not available, the reproductive studies are frequently based on quantitative indices, as gonadosomatic index values (GSI) and condition factor (K), which help to define the reproductive cycles and possible variation in the physiological condition of the species during the course of its lifespan [20,21]. Knowledge of gonadal development, spawning season and spawning frequency of a population, which is very important studies with management practices.

As the fish grows older the ovary weight increase faster with fish length than does somatic weight and therefore the GSI values tend to be higher in the fully matured fishes about to spawn. Another reason for this phenomenon is that the weights of hydrated ovaries have two or more that of other maturity stages which lead to GSI values higher just before spawning [22]. The gonadosomatic index of *Terapon jarbua* was found to coincide with the above said report.

According to Nikolsky [23]. The optimum sex ratio may vary drastically as a result of being affected by numerous factors. Nikolsky [24]. Reported the predominance of female in fishes, especially where the male produce several batches of sperms but female produce only one batch of ova.

Different populations inhabiting in different regions show different sex ratios. Higher sex ratio has been reported during the first breeding season and a lower sex ratio in second breeding season when the water parameters are at their peak [25]. A rising temperature and moderate water velocity, vulnerability of female to their predators and other natural hazards, migratory phase in brooder population are some of the reasons for the change in the sex ratio in fishes [26].

The data on sex ratio of *Terapon jarbua* in relation to various length groups showed that in lowest length group (12-14) 75% of female were recorded. In the highest length groups (28-30 and 30-32) only female were recorded, which could be due to possibility that the spent male must have left spawning ground before the female.

5. Conclusion

This is the first and foremost report on Gonadosomatic index and sex ratio of *Terapon jarbua*. The present study indicates that the Gonadosomatic index increases with the increase in length group of this species. The data on sex ratio of *Terapon jarbua* in relation to various length groups showed only female were recorded in the highest length group. A thorough

knowledge of maturation cycle and depletion of gonads, sex ratio will help to understand and predict the annual changes that a population undergoes and also important for proper management and conservation of that fish species.

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