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STUDY OF GONADOSOMATIC INDEX AND FECUNDITY OF FISH *CIRRHINUS MRIGALA* (HAMILTON)

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ABSTRACT
The major Indian carp *Cirrhinus mrigala* from Kalambe reservoir near Kolhapur (Maharashtra) was studied from a period of June 2012 to May 2013 to evaluate the gonadosomatic index (GSI). Fecundity of the fish was studied for a period of three months (June to August 2012). The minimum GSI values in both male and female were observed in winter (0.0812 and 0.0857) while maximum of it was estimated in mansoon (1.7200 and 20.5700). It has been observed that fecundity increases with increase in length, body weight and gonad weight of the fish. The species is a moderately fecund, total spawner and having a restricted breeding season.

INTRODUCTION

Human population of India continues to grow. Finding means of food for the growing population is one of the most important challenges faced in India. A healthy diet high in protein is necessary to ensure that growing population does not fall victim to sickness and disease. Fish is an excellent source of protein. Since time immemorial, fish has been regarded as easily accessible and digestible animal food. *Cirrhinus mrigala* (Hamilton) is a major riverine carp. It is commonly known as mrigala, a popular food fish and is cultured extensively in different parts of India. However, high yield of fish production depends on the scientific knowledge of fish breeding and proper management. Fecundity estimates are important for understanding the dynamics of fish population, predicting trends in population abundance and estimating spawning stock biomass (Eldridge and Jarvis, 1995). Reproductive biology i.e. fecundity, spawning etc. are important aspects of fish biology which must be understood to explain the variations in the population and to make efforts to increase amount of yield (Azadi and Siddique 1986). The commercial potential of a species is predicted by its stock, life history, culture practice and management (Doha and Hye, 1970). Gonadosomatic index and fecundity is useful for making total population estimates. It is useful in studies of population dynamics or productivity. Fecundity expresses the number of eggs laid by a fish in single season. While gonadosomatic index is the ratio of fish gonad weight to body weight. It measures reproductive strain of fishes by measuring general body weight ratios. It is one of the important parameter of fish biology, which gives the detail idea regarding the fish reproduction and reproductive status of the species particularly in indentifying seasons of spawning. The spawning potential and its success is determined by fecundity of a fish (Qasim, 1973). However, the egg production varies not only among different species but also within the same species depending upon length and weight of gonad, influenced by the environment (Kulshrestha *et al.*,1990; Barmanh and Saikia, 1995). Fecundity also helps in determining fluctuations in the egg production, potential of individual stock related to life processes such as age and growth (Ludwig and Lange, 1975), effects of environmental factors (Devlaming, 1971). It helps in formulating the commercial management of fishery. Reddy (1979) reported that the determination of breeding season is an essential part of biological investigation of fishes. Saksena (1987) identified the use of gonadosomatic index and volume of gonad as indicators of gonadal state. Fecundity in different species of fish was studied by Khan (1986) in *Cirrhinus reba*, Alam and Pathak (2010) in *Labeo rohita,* Narejo *et al.*, (2002) in *Mastacembelus armatus*, Mishra and Saksena (2012) in *Labeo calbasu*.

The present work was undertaken in order to determine the spawning season and study reproductive biology based on fecundity and gonadosomatic index.

MATERIALS AND METHODS

A reasonable number (60) of mature and immature fishes were collected from reservoirs near Kolhapur every fortnight. The study was carried out for a period of one year during June 2012 to May 2013. For GSI study the collected fishes were weighed. The gonads were dissected and weighed by digital electronic weight balance nearest to 0.01mg. The GSI was calculated by following formula given by Parmeshwaran *et al.*, (1974) for both male and female fishes.

$$\text{Gonadosomatic index} = \frac{\text{Weight of gonads}}{\text{Weight of fish}} \times 100$$

For fecundity estimation fishes were studied from June 2012 to September 2012 (N = 26). Every fish was weighed and length was measured. The gonads were dissected out and weighed. Samples were taken from anterior, middle and posterior portions of ovary. The number of eggs from each sample was counted. Fecundity was calculated by Le Cren (1951) formula.

$$F = \frac{N \times \text{Gonad weight}}{\text{Sample weight}}$$

Where F is fecundity and N is number of eggs in sample.

RESULTS AND DISCUSSION

Gonadosomatic index

In the present work the cyclic changes in gonadosomatic index of *C. mrigala* with an average weight of 0.500kg + 0.100kg collected from Kalambe were studied to determine GSI and fecundity. GSI values were estimated monthly for both males and females. GSI values ranged from 0.06 to 2.0 in males and 0.08 to 24.00 in females. The GSI showed one peak in July. The values are expressed in Table1. Higher values of GSI were observed during June to August indicating the period of maturity, spawning and its extension. The GSI declines suddenly in September indicating reduction in size and weight of gonads i.e. post spawning period. The decline in GSI values in *C. mrigala* during October to December 2012 indicated that during these months the weight of gonad was minimum probably due to dormancy of gonads in post breeding season. From the above studies it is inferred that *C. mrigala* spawns once in a year with spawning peak in July as indicated by GSI.

Table 1: Month wise variations of Gonnadosomatic Index between male and female of *Cirrhinus mrigala*

Month	Gonnadosomatic Index	
	Male	Female
June	1.4667 ± 0.1764	6.8955 ± 1.7182
July	1.7238 ± 0.1602	20.5780 ± 1.7984
August	0.2734 ± 0.0111	18.6442 ± 2.3715
September	0.3569 ± 0.1866	1.1046 ± 0.0721
October	0.1315 ± 0.0152	0.2381 ± 0.0337
November	0.1044 ± 0.0220	0.0792 ± 0.0011
December	0.0813 ±0.0265	0.0857 ± 0.0080
January	0.1176 ± 0.0213	0.1175 ± 0.0098
February	0.1389 ±0.0550	0.1389 ± 0.0268
March	0.3111 ± 0.1682	0.2883 ± 0.0024
April	0.9401 ± 0.1495	0.9171 ± 0.0772
May	1.1998 ± 0.1057	3.1346 ± 0.1608

Table 2: Total length, body weight, gonad weight and fecundity of *Cirrhinus mrigala*

Parameters	Mean ± S. D.
Total Length	29.114 ± 6.137
Body Weight	413.938 ± 155.853
Gonad weight	65.614 ± 35.080
Fecundity	120480.250 ± 47409.386

Fecundity

The fecundity estimation in the present study is based on 26 females of *C. mrigala* sampled during June to August 2012. The individuals ranged in size from 240 to 360 mm in total length. The individual fecundity ranged from 38250 to 187302. It was observed that female fish with greater length and weight had higher fecundity. Maximum fecundity was observed in a fish with length 350 mm and body weight 550g while the minimum was observed in fish with 250 mm length and body weight 300g. The number of ova/g body weight (fecundity factor) was 302.97 and number of ova per gram ovary weight 1924.17. There was only one size group of ova.

DISCUSSION

The gonadosomatic index is particularly helpful in identifying gonadal maturity and spawning season of any fish species. The GSI increases with fish maturity and reaches to its maximum at the peak of maturity. The lowering of GSI (in winter) indicates depletion of gonadal activity due to spawning. A single peak in GSI during July (1.33 to 2.00 and 14.00 to 24.00) for males and females respectively indicates spawning. The moderate increase in GSI in summer indicates preparatory and pre spawning phase. Our study confirms the fact that *C. mrigala* has only one breeding season of short duration running from June to August with a peak in July. The present study confirms the findings of earlier workers in various species of fish including Rao *et al.*, (1972), Qazi (2001), Shendage and Mane (2006) in *Cirrhinus reba*, Hassanin *et al.*, (2002) in *Cyprinus carpio*, Brewer *et al.*, (2008) in small bodied riverine fish and Ozcan and Balik (2009) in *Acanthobrama mirabilis*. Peak value of GSI in *C. mrigala* of Hatnoor reservoir were observed in June and lowest values during October to January (Shaikh and Lohar, 2011). In the present study the peak value of GSI was observed in July while a decline in GSI was initiated in September and reached to its maximum in December. Tropical fish that spawned throughout year generally show smaller variations in GSI than those spawn in short season (Wootton, 1979). *C. mrigala* spawns for a short period hence showed great variations in GSI. Increase in the GSI in *C. mrigala* was also noted with the advancement of ovary and testes development. Similar results were earlier reported by Joshi and Joshi, (1989), Manna *et al.*, (2010) in species of *Puntius* and Kapil *et al.*, (2011) in *Channa punctatus*.

Knowledge of fecundity of cultivable fishes becomes very useful in culture fishery for assessing the targets of spawn production. Fecundity has a significance in population and production studies of a species. Estimated fecundity of *C.mrigala* ranges from 100000 to 200000 eggs/kg body weight (Khan and Jhingran 1979). Fecundity of *Cirrhinus reba* from Cauvery and Bharni river was studied by Rao *et al.,* (1972) and it was reported to be maximum in July. In the present studies the individual fecundity was relatively higher than observed by Jhingran. The highest number of eggs (187302) was carried by female with a body weight 550g and the lowest number of eggs (38250) were observed in *C.mrigala* with a body weight 300g. The change in fecundity may be due to the environmental factors in which these populations live. In the present studies fecundity increased with increase in body

length, body weight and gonad weight. Similar observations were reported in *Cirrhinus reba* by Mathialagan and Sivakumar (2012). Fecundity of an individual female varies according to many factors including age, size, species, environmental conditions (such as food availability, water temperature and salinity)(Simpson, 1957). Fecundity variation may be due to differential abundance of food. (Fagade *et al.*, 1984). Even the geographical distribution is also known to influence the fecundity (Somvanshi, 1985; Shinde *et al.*, 2000). The fecundity factor of *C. mrigala* in the present study was 302.97 for the size range 240 to 345mm.

The present studies, concluded that *C. mrigala* is a total spawner, its spawning takes place during mansoon months and its absolute fecundity is related with total length, body weight and gonad weight.

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