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Study of sex ratio and fecundity of fresh water mouth brooding fish Oreochromis mossambicus (Peters)

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ABSTRACT

The mouth breeding fish *Oreochromis mossambicus* is belongs to family, Cichilidae introduced in Indian water in 1952. *Oreochromis mossambicus* is found to be omnivorous and prolific breeder. It is extremely used as a food. For the study of its reproductive characters the fish is collected from the Daroji water tank with the help of local fisher man. The study is carried out for determination of sex ratio, fecundity. The male and female sex ratio was found 1:1.03 to 1: 2.7, the number of females is more than males were observed during the study period except February and November months of 2017. The average fecundity range found between 356 to 1350 during study period. The studies show that females dominate males throughout the study period and shows linear relationship between fecundity with ovary weight and bodyWeight.

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INTRODUCTION

Sex Ratio

The determination of the sex ratio and of the sequence of changes in maturity stage during the year is of considerable importance in building a thorough knowledge of the general biology of an exploited stock. These form part of the basis of stock assessment. For some species it may be necessary to maintain routine programmes of sex ratio and maturity stage analyses. Mortality rates may also differ between sexes. Moreover, where the catch of a species contains a mixture of stocks, maturity data may provide the best guide to the relative proportions of the stocks in the catches and to changes in these proportions.

However, the determinations of sex and sexual maturity stages find their primary application in providing basic knowledge of the reproductive biology of a stock. The information derived from these analyses can be used in ascertaining the age and size at which fish attain sexual maturity, the time and place of spawning and the duration of the cycle from the beginning of the development of the ovary to the final release of eggs. Together with fecundity estimates this information can be used to calculate the size of a stock and its reproductive potential. The data have several practical uses. The age and size at sexual maturity may be important in assessing the optimum age of first capture of a species and the time and place of spawning can be used to plan fishing tactics because many species of fish are easiest to catch when they congregate to spawn.

Sex ratio of any species affords necessary information on the representation of male and female fish present in a population. It statuses the proportion of male to female fish in a population and indicates the dominance of sex of fish species in a given population. Sex ratio also constitutes basic information indispensable for the assessment of the potential of fish reproduction and stock size estimation in fish population (Adebiye, 2013; Vicentini, Araujo, 2003). Furthermore, gonadosomatic index is one of the important parameter of fish biology, which gives the detail idea regarding fish reproduction and reproductive status of the species and help in ascertaining breeding period of fish

Fecundity

The fecundity of a fish is defined as the number of eggs that are likely to be laid during a spawning season (Bagenal 1957). 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). The reproductive potential, i.e., fecundity is an important biological parameter that plays a significant role in evaluating the commercial potentials of fish stocks (Gomez-Marquez 2003). 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 Siddique1986). Successful fisheries management including practical aquaculture relies on having an accurate assessment of fecundity to understand the recovery ability of fish populations (Lagler 1956; Nikolskii 1969; Tracey *et al.*,2007). The fecundity and its relation to female size make it possible to estimate the potential of egg output Chondar(1977) and the potential number of offspring in a season and reproductive capacity of fish stocks

(Qasim&Qayyum 1963). Descriptions of reproductive strategies and the assessment of fecundity are fundamental topics in the study of biology and population dynamics of fish species (Hunter et.al., 1985). Studies on reproduction including the assessment of size at amturity, fecundity, duration of reproductive season, daily spawning behaviour and spawning behaviour and spawning fraction, permit the quantification of the reproductive capacity of individual fish. This information in combination with estimates of egg production enable estimation of spawning stock biomass (Saville, 1964; Parker, 1980; Lagler K F (1956). Even within a stock, fecundity is known to vary annually, undergo long-term changes (Horwood et.al., 1986; Rijnsdorp 1991; Kjesbu et.al., 1998) and has been shown to be proportional to fish size and condition. Larger fish produce more eggs, both in absolute and in relative terms to body mass. For a given size, female in better condition exhibit higher fecundity (Kjesbo*et. al.*, 1991). Fish size and condition are thus key parameters to properly assess fecundity at the population level. As the weight of a fish is normally closely proportional to the cube of the length the fecundity-weight relationship is linear for those species for which b approximates to 3 and is of the form F = aW + b, where W is the weight of the fish. Another way of expressing such differences is by using a 'fecundity index' expressed as either fecundity/weight or fecundity/length. The latter is the better expression because it avoids the variance in weight within a stock during a season caused by growth of the gonads.

Materials and Methods:

Fecundity:

To estimate the fecundity, three sub-samples of ovaries weighing 0.1 g to 0.2 g were obtained from the anterior, posterior and the middle of gonad. The eggs were placed into a dish and counted under stereo light microscope (olympus). The mean from the three sub-samples were used to calculate absolute and relative fecundity using gravimetric method. Fecundity was calculated by the following formula:

$$F = \frac{n X G}{g}$$

Where "F" is fecundity, "n" is the average number of eggs in sub-sample, "G" is weight of the gonads and "g" is the weight of the sub-sample.

Fecundity in fish was estimated by using the gravimetric method (Hunter et al. 1992). For each ovary, 0.1g of each sample was taken separately from the anterior, posterior and middle region of each lobe. The eggs were counted from 0.1g of each sample and mean number of eggs was calculated and then multiplied by total ovarian weight which gives the absolute fecundity.

b. Relative fecundity:

Number of mature oocytes in a female divided by the total weight of that female.

d. Sex ratio

Each specimen was dissected and the gonads were removed. The sex of each specimen was identified by examination of the gonads. The proportion of the two sexes relative to one another was used to calculate the sex ratio.

I. Results

Sex Ratio

The observed sex ratio of *O. mossambicus* in the sampled population was regrouped according to the seasons and the data is given in the Table-1. During the year of study there were more females than males in all seasons. The differences were found to be statistically insignificant.

Table-1: Sex ratio in *Oreochromismossambicus* during the year 2017.

Month	Male	Female	Sex ratio	X^2
January	22	44	1:2.1	7.55*
February	33	34	1:1.05	0.02
March	17	45	1:2.7	13.51**
April	35	33	1.03:1	0.01
May	29	32	1:1.1	0.15
June	29	35	1:1.3	0.58
July	29	32	1:1.2	0.16
August	26	42	1:1.6	3.86*
September	23	38	1:1.7	3.82*
October	34	36	1:1.03	0.01
November	38	35	1.09:1	0.12
December	29	38	1:1.5	1.53

Table -3: Seasonal changes in sex ratio during 2017

Season	Male	Female	Sex ratio	X^2
Summer season	79	112	1:1.6	5.4*
Rainy season	73	71	1.03:1	0.02
Winter season	81	116	1:1.6	5.8*

Significant at **P < 0.05

Table-3: Variation of Fecundity with length and weight during the year 2017

Total length (cm) range		Frequency	Total body Weight (g)		Average weight(g)	Fecundity range	Mean Fecundity	Relative fecundity
10	11.9	08	30.32	40.28	34.6	281-389	356	10.29
12	13.9	10	38.20	54.25	49.2	326-480	453	9.21
14	15.9	12	50.25	80.40	70.12	360-552	542	7.73
16	17.9	17	82.40	130.20	110.2	548-823	721	6.54
18	19.9	18	120.36	190.10	148.0	742-844	818	5.53
20	21.9	15	167.42	210.30	190.1	860-1302	1187	6.24
22	23.9	9	190.70	261.25	216.2	1218-1386	1281	5.93
24	25.9	5	272.50	310.20	290.1	1115-1390	1314	4.53
26	27.9	4	316.45	345.30	325.4	1142-1492	1350	4.15

During the study period year 2017, the mean fecundity is varied from 356 (for a mean body weight of female of 34.6 g) to 1350 (for a mean body weight of female of 325.4g). The mean fecundity in the year 2017 is 862.56. Absolute fecundity of *O. mossambicus* in Water body during the study not only varied between different sizes but also within individuals of the same size. On the whole, the average fecundity of *O. mossambicus* was found to be862.56. the study revealed very significant in total body wight and absolute fecundity showed less significant difference.

The above mentioned details the mean body weight, absolute fecundity and relative fecundity of different size classes of *O. mossambicus*of fieldpopulation. Absolute fecundity was found to increase with increase in Total length and Body Weight, while relative fecundity decreased indicating that older fish were more fecund, it is the younger individuals that produced more ova/g weight of the body.

DISCUSSION

SEX RATIO

The operational sex ratio (ratio of fertilizable females to sexually active males at a given time) is a principal factor influencing the intensity of sexual selection and if the adult sex ratio is biased, potential rates of reproduction are not sufficient to predict the direction of sexual competition (Khalfalla et al., 2008). The distribution of individuals in time and space, water temperature and precopulatory guarding of multiple mates can also influence the sex ratio (Debuse et al., 1999). *Oreochromismossambicus* has an XX female/XY male sex determination (Rafael Campos-Ramos et al., 2003). Tables 1 and 2 detail the observed sex ratio of *O. mossambicus* during 2017 in the water body. In the sampled population during 2015, females were more than males in all the months. On the whole male to female sex ratio ranged from 1: 1.5 to 1: 3.1. Chi–square test revealed significant differences between male to female ratio. During the study year predominance of females over males was not constant in all the months. During April 2017 (49.25%) males outnumbered the females. In the remaining months females were more than males and the maximum ratio (M. 1: F. 2.7) was observed in March 2017. Chi-square test revealed significant differences between male to female ratio only in January and March 2017.

From the study it is apparent that in Water body preponderance of females over males was evident. This means male to female ratio has a deviation from the expected ratio 1: 1. Nijaguna (1989) has observed a sex ratio of 1 male: 1.48 female for this *O. mossambicus* in the Nelliguda reservoir, Bangalore District. Jayaraj (2000) has also reported a sex ratio of 1:1.16 for this species in the same reservoir. A high female to male ratio of 2: 1 has been recorded for *O. mossambicus*in habiting a man-made lake in Sri Lanka (De Silva, 1986). The present observations agree with the observation of Gomez-Marquez et al. (2003), Pena-Mendoza et al. (2005) and Ibrahim et al. (2008) on *O. niloticus*. Fryer and Iles (1972) have pointed out that, in cichlid populations of the African Lakes, dominance of males over females is common or they generally exhibit more growth than females. Ramozs-Cruz (1995) has observed a sex ratio of 2.6 male: 1 female in *O. aureus*. Nikolsky (1963) stated that the sex ratio varies considerably from species to species, but in the majority of cases it is close to one, and may vary from year to year in the same population. The observed variation in sex ratio could be due to the fact that once the fertilization of eggs is completed, males continued to attract other females which are ready to spawn or in the absence of breeding females males probably emigrate from the areas of spawning towards the feeding areas in shallow part of the lake, while females migrate from spawning ground and freely swim with other fishes.

Fecundity

Fecundity in *O. mossambicus*ismuch variable as reported by other investigators.According to Hora and Pillay (1962), the female tilapia lays 75-250 eggs at a time.Mironova (1969) reported that the fecundity of tilapia ranged from 80 to 1000 eggs perfemale. De Silva (1980) found that thefecundity of *O. mossambicus*varied from 360 to 1,775 eggs per female for fish with lengththat ranges from 20 to 31.9cm and weight ranging from 145 to 538g. Whereas Riedel (1965) observed that the fecundity of the speciesranged from 660 to 1,754 eggs/100g body weight. In this study, theabsolute fecundity and the relative fecundity was studied. Itwas reported that fecundity of *O. mossambicus*varied from 287 to 1445.Indicating that the fecundityrecorded in the present investigation was similar to those recorded elsewhere. The low124fecundity could well be attributed to the parental care (Anon., 2000). Furthermore, the lowfecundity of *O. mossambicus*also might be due to prolonged breeding season.

CONCLUSION

A brief account is given on the mouth-breeding Cichlid flsh, *Oriochromismossambicus* on its breeding activity. It can be concluded from the present study that the spawning period of the fish is throughout the year and the condition of Female fish improves as the length and body weight increases.The increase in absolute fecundity with increase in body weight confirmed the correlation between the body weight and fecundity. The results indicate that the Female fish is thriving well in the aquatic body with proper feeding, growth and breeding activities.

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