REPRODUCTIVE ASPECTS OF A CICHLID FISH *TILAPIA ZILLII* (GERVAIS) (PISCES: CICHLIDAE) IN OPA RESERVOIR, ILE-IFE, NIGERIA

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Abstract

A total of 1486 specimen of the fish *Tilapia zillii* was collected by gillnetting and analysed for aspect of its reproductive biology in Opa reservoir, between October 1991 and February 1994. Sex ratio was approximately 1:1 (male: female). Fish total length at maturity was 15.1 cm (males) and 13.2 cm (females). The fecundity was 4329±1153.9 eggs, n = 685 with an egg diameter of 1.06 ±0.67 mm, n = 619. The mean gonado-somatic index was 0.39±0.234.1, n = 865 (males) and 1.05±1.011.2, n = 619 (females). The relationship between fish length and fecundity relationship gave a statistically significant correlation ($r = 0.5722$, $P < 0.001$, $n = 619$). The mean relative fecundity was 29.6 eggs per body weight (g). The species was a substratum brooder and it bred throughout the study period.

Keywords: Fecundity, sex ratio, gonado-somatic index, substratum brooder.

1. Introduction

The family Cichlidae is one of the most commercially important fish families found in Tropical African freshwaters (Fryer and Iles, 1972). The inland water bodies of West Africa alone support more than 200 species of the family (Harbott, 1975 and Holden and Reed, 1978). Although breeding behaviour of members of this family differs the care of the eggs and larvae is a common feature to them (Trewavas, 1983). *Tilapia zillii* (Gervais) is one of the dominant cichlids of Nigerian water bodies (Turner, 1970) and the species is commercially important (Arawomo, 1993). Various aspects of the reproductive biology of *T.* zillii have been reported by El-Zarka (1956), El-Bolock and Koura (1960), Fryer and Iles (1972), Spataru (1978) and Buddington (1979). Fish information on reproduction is needed in establishing fish reproductive potential and consequently for its exploitation and management. This study aims at providing further information on aspects of the reproduction of *T. zillii* a species which is economically important in Opa reservoir.

2. Materials and Methods

The investigated water body is Opa Reservoir an impoundment of Opa River created in 1978 on the Campus of Obafemi Awolowo University, Ile-Ife, Nigeria. The major inflow of rivers into the reservoir are Obudu, Opa and Esinmirin. The reservoir has a catchment area of about 116 km^2 of land and located within Longitudes 04°31'E - 04°32'E and Latitudes 07° 29'N - 07°30'N. The reservoir has a surface area of about 0.95 square kilometre and maximum capacity of 675 cubic metres. The minimum and maximum depths are 0.95 m and 6.4 m respectively while the substratum of the reservoir is mainly mud and sand with submerged logs of wood. The catchment area is characterized by wet and dry seasons (Ekanade, 1980). The reservoir water becomes turbid as a result of high discharge of water from the catchment area in the rainy seasons and heavy particles from the atmosphere during the harmattan seasons. Sampling for the study of the biology of *T. zillii* began in October 1991 and extended to February 1994. The fishing method employed was gillnetting.

Each specimen of fish was measured for total length, standard length and weighed. It was slit open ventrally from the anus to the pectoral fin and examined. The sex and the stage of development of the gonad were determined by visual inspection (Roberts, 1989). Sex ratios were subjected to chi-square (χ^2) analysis. All mature gonads were removed, weighed and gonadal stages noted according to Hyndes *et al.* (1992). The gonad weight was expressed as a percentage of the fish somatic

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weight (Sturm, 1978) to obtain the gonado-somatic index (GSI). The mean seasonal values of GSI was used to express the seasonal changes in the gonads of *T. zillii* in the reservoir. The ovaries were preserved in Gilson's fluid (Barbieri, 1989) and agitated at intervals to ensure the separation of the eggs from the ovarian tissues. The numbers of eggs in each pair of ovaries was determined by direct enumeration. The diameter of each egg was measured using a calibrated ocular micrometer in a binocular microscope.

3. Results

Out of a total catch of 1486 fish specimens examined, 865 were males while 619 were females giving and overall mean sex ratio of 1:0.8 (male: female).

The sex ratios of the 1991/1992; 1992/1993 and 1993/1994 populations, 1:0.8, 1:0.7 and 1:0.9 (male: female) were similar and they follow the same pattern. The deviation of each of the values of from the expected 1:1 ratio was not statistically significant using chisquare (χ^2) analysis (P>0.05; df. 1484). Similarly, the offshore and inshore catches followed the same pattern with deviations not statistically significant ($P>0.05$; *df.* 1484).

The smallest male with a mature gonad had a total length of 15.1 cm, a standard length of 13.3 cm and a weight of 47 g while the smallest female with a mature gonad had a total length of 13.2 cm a standard length of 10.8 cm and a weight of 38 g.

Only the mature eggs for each specimen were used in estimating the fecundity of the species (Bagenal and Braum, 1978). The total lengths of the specimens examined ranged from 13.2 cm to 23.7 cm, the standard lengths ranged from 10.8 cm to 18.4 cm while the weights ranged from 38 g to 224 g. The range of fecundity values in the ovary varied from 2820 eggs in a fish of total length of 14.7 cm, standard length 10.8 cm and a weight of 102 g to 6473 eggs in a fish of total length 23.7 cm, standard length 18.4 cm and a weight of 224 g. The mean fecundity was 4329 eggs. The highest fecundity was observed in the biggest specimen while lowest fecundity of 2820 was not in the smallest specimen. The smallest specimen had a fecundity of 2910 eggs. The equation describing the relationship between fecundity and standard length of fish is given as (Bagenal, 1967):

$$F = a\, l^{\,b}$$

where,
F = Fecundity
l = Standard length (cm)
b = Slope of the regression line (regression constant)
a = Intercept of the regression line on the y-axis (regression coefficient)

Through a logarithm transformation, the resulting regression line takes the form:

$$log\,(F) = b\, log\,(l) + a$$

Hence, the relationship between fecundity and standard length for *T. zillii* in this study be described by the following regression equation.

$$log\,(F) = 14.718 + 1.181\ log\,(l)$$

The correlation coefficient of the regression analysis ($r = 0.5722$; $P < 0.001$, $n = 619$) observed indicated a high correlation between fecundity and standard length (Fig. 1). The mean relative fecundity was 29.6 eggs per gram body weight and this ranged from

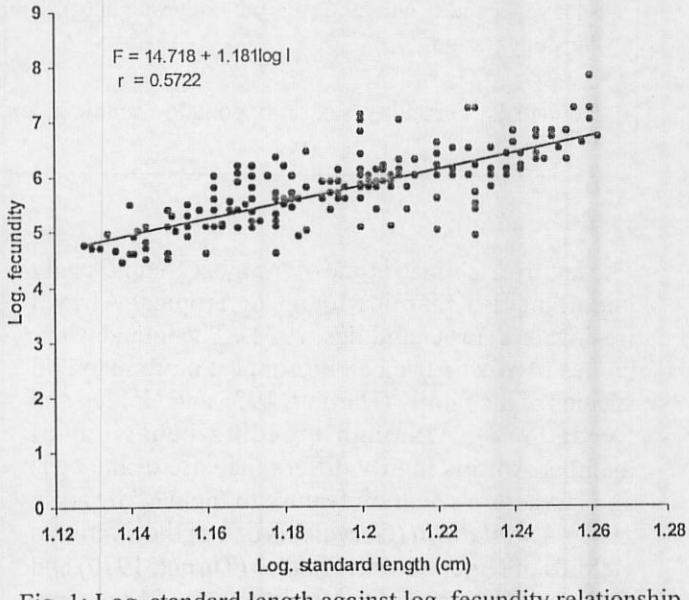

Fig. 1: Log. standard length against log. fecundity relationship

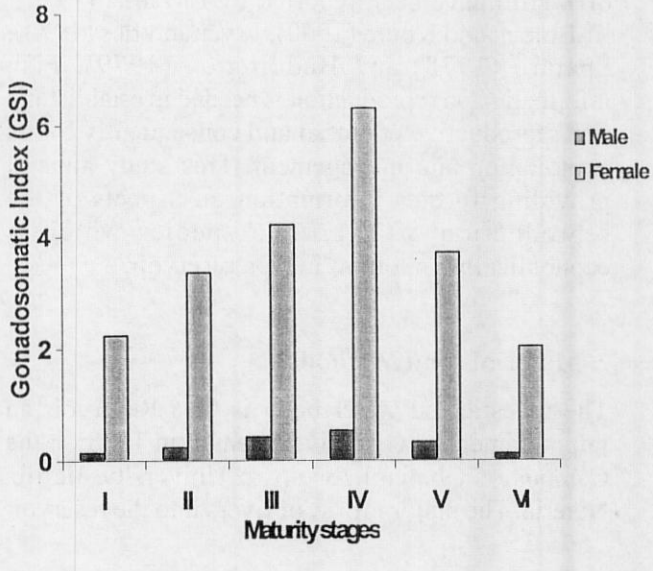

Fig. 2: Variation of GSI with stages of maturation

14.50 eggs to 45.2 eggs per gram body weight. A fairly high correlation ($r = 0.670$, $P < 0.001$, $n = 619$) was recorded between fecundity and fish weight.

In each mature ovary, the eggs were of varying sizes i.e. the egg, sizes were not uniform. Mature eggs were ovoid and yellowish in colour. The diameter of the eggs which varied in fish of the same length or weight ranged from 0.18 mm to 2.1 mm. The mean weight of mature female ovary was 3.07 g while individual values were within the range of 2.26 g to 8.04 g. The mean weight of testes was 0.70 g while individual values were all within 0.40 g and 1.21 g. The gonado-somatic indices ranged from 0.13% to 2.51% in males and 2.02% to 6.28% in the females. The GSI increased both in male and female fish from the first stage up to the fourth stage of gonadal development and decreased in spawning and spent fish specimens (Fig. 2).

During the study period, the species showed associated characteristics of a substratum spawner. Male and female specimens were seen in pairs guarding dug-up nests in the substratum along the shores of the reservoir. Some male specimens had reddish brown ventral surfaces which is a characteristic 'breeding dress' exhibited by the species. The fry of the species was observed throughout the period of study along the shoreline of the reservoir indicating that the fish did not have a definite breeding period.

4. Discussion

In Opa reservoir, the sex ratio in *T. zillii* is approximately one male to one female as the deviation from the expected 1:1 (male: female) ratio was not statistically significant. In the same habitat, Komolafe (1995) and Fawole (1985) at Asejire lake recorded a sex ratio of 1:1 (male to female) for *Oreochromis niloticus* and *Sarotherodon galilaeus*. The result obtained in this study indicates that the species is growing towards a stable population in the habitat.

The smallest mature male of *T. zillii* had a total length of 15.1 cm while the smallest mature female had a total length of 13.2 cm. In River Niger, the total length of the smallest mature male of *T. zillii* was 19.0 cm with no record for the female (Fryer and Iles, 1972). Fawole (1996) reported that the smallest mature male and female specimens of *S. galilaeus* in Opa reservoir measured 12.5 cm and 11.7 cm total length respectively. In the same environment *O. niloticus* male specimens matured at 19.0 cm while the female specimens matures at 18.0 cm (Komolafe, 1995). This size at maturity which is at per with other cichlids in the reservoir might be attributed to numerous food items and good condition of the species in the habitat (Komolafe, 2004).

The species is a substratum brooder and the average number of eggs obtained for the female was 4329±1153.9 eggs, while the number of eggs in mature ovary varied from 2820 eggs to 6472 eggs. The number of eggs obtained in this study is slightly higher than 3849 eggs observed for the species by Akintunde and Imevbore (1979) in Kainji Lake. This is probably because *T. zillii* like some fish species had a selective advantage of delaying sexual maturation until they grow larger because fecundity in fish increases with size and age (Robert and Thomas, 1998). The wide variation in the fecundity of *T. zillii* in this study was also reported for *O. niloticus* by Komolafe (1995) in the same habitat. Bagenal and Braum (1978) also reported that fish exhibit wide fluctuations in fecundity even among fish of the same species, size and age. Fagade *et al.* (1984) also suggested that variation in fecundity may be due to differential abundance of food. The occurrence of eggs of varying sizes in *T. zillii* is also an indication of multiple spawning by the species. According to Fryer and Iles (1972), *T. zillii* had a maximum egg diameter of 2.2 mm. The mean egg diameter of 1.56 mm obtained in this study is an indication that *T. zillii* produces smaller eggs when compared to mouth brooders like *S. galilaeus* 2.49 mm (Fawole, 1996) and *O. niloticus* 2.47 mm (Komolafe, 1995) in the same environment. The species is a substratum brooder which accounted for high number of eggs produced and the ovaries containing large number of eggs. *T. zillii* with mature ovaries were available all the year round, indicating that the fish breeds throughout the year. The gonado somatic indices for the males were always lower than those of the females. This is associated with the relatively heavier female gonads. However the indices declined sharply in spawning and spent fish specimens. This is an indication that the gonads were shed during copulation and the development of gonads had begun.

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