THE BREEDING BIOLOGY OF *Oreochromis niloticus* LINNAEUS (PISCES: CICHLIDAE) IN OPA RESERVIOR ILE-IFE, NIGERIA

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ABSTRACT

Sampling for the fish Oreochromis niloticus in Opa reservoir started in October 1997 until February 2000. The fishing methods employed for collecting the 1430 specimens were cast netting and gillnetting. Egg diameter varied between 2.12mm and 2.69mm with a mean of 2.47±0.02. Female gonadosomatic index was 1.05±0.01 (0.12 - 4.06, n = 637). The male gonadosomatic index was 0.39±0.02 (0.03 - 1.67, n = 789). O. niloticus bred throughout the period of study. The species was a material mouth brooder with the female fish carrying eggs and alevins in the buccal cavities. The sex ratio of O. niloticus was approximately 1:1 in the reservoir. The fecundity of the species was between 73 eggs and 1810 eggs with a mean fecundity of 815 eggs. The relative fecundity was between 0.26 eggs and 26.82 eggs per gram body weight. The correlation coefficient between log. fecundity and log. standard length was r = 0.370 and tested statistically (t_{cal} = 15.0>t_{tab} = 2.617; df 637).

Keywords: *Breeding season, breeding habits, sex ratio, gonadosomatic index, fecundity, Oreochromis niloticus*

INTRODUCTION

The fish family Cichlidae presents an array of fishes with great diversity. Over 2000 species of the family had been reported in Africa, India, Israel and Syria (Fryer and Iles, 1972; Lowe-McConnell, 1975). This family had over 200 species reported in inland waters of West Africa (Harbot, 1975; Holden and Reed, 1978). Breeding habits therefore differ markedly within the family but the care of eggs and larvae is an essential feature common to all species (Trewavas, 1983; Getachew, 1989).

Oreochromis niloticus is one of the dominant cichlids in inland water bodies of Nigeria and is of commercial importance (Arawomo, 1993). Various aspects of its reproductive biology have been reported by Ita (1978), Madu and Ita (1986) and Arawomo (1993). The knowledge of fish breeding habits and fecundity helps in establishing its production potential and invariably its exploitation and management. This study further

examines the breeding behaviour of *O. niloticus* in a typical tropical reservoir.

MATERIALS AND METHODS

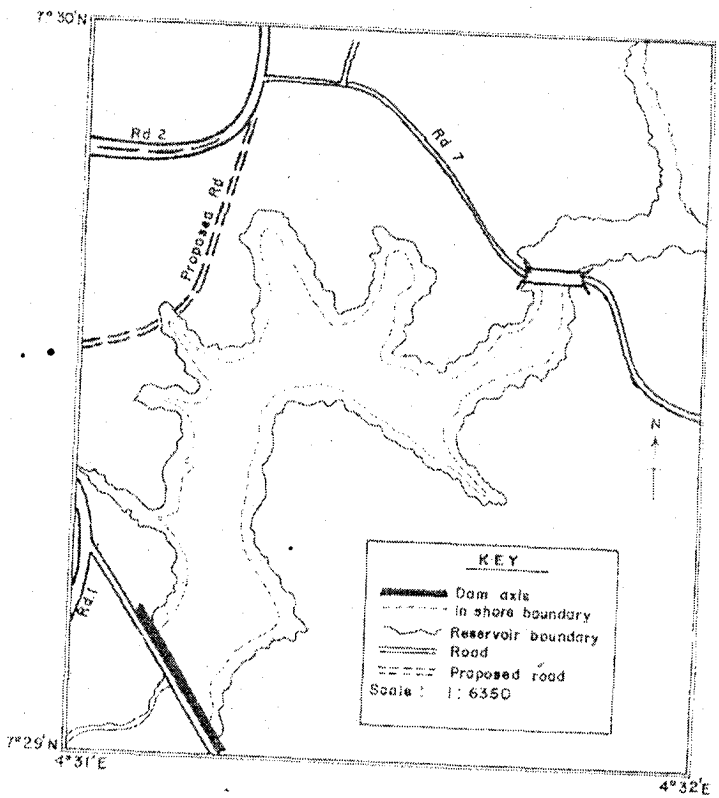
Opa reservoir is located on the campus of Obagemi Awolowo University, Ile-Ife, Nigeria. The reservoir is about 0.95 square kilometer (Longitudes 4°31'E to 4°32' E and Latitudes 7°29' N to 7°30' N; Figure 1) while the maximum depth is 6.4m. The catchment area is characterized by annual dry (October to March) and rainy seasons (April to September).

The substratum of the reservoir is mainly mud and sand. Shoreline vegetation is dense with submerged aquatic macrophytes, some of which eventually decompose during the rainy season.

Specimens of *O. niloticus* examined for this study were caught between October 1997 and February 2000. The fish were caught either by gillnetting or castnetting. The total length, standard length and weight of fish were taken in the laboratory. Each fish specimen was slit open ventrally from the anus to the pectoral fin and its sex and stage of gonadal maturation determined visually (Roberts, 1989).

All gonads were removed, weighed and gonadal stages noted (Hyndes *et al.*, 1992). The ovaries collected from each fish specimen were pre-

Fig. 1: Opa reservoir showing study site



served separately in modified Gilden's fluid (Simpson, 1951; Barbieri, 1989). The preserved ovaries were periodically shaken to ensure the separation of eggs from ovarian tissues. The number of eggs in each pair of ovaries were determined by direct counting. Egg diameters were measured with ocular micrometer under a binocular microscope. The gonad weight expressed as a percentage of the fish body weight was used as gonadosomatic index GSI (Patterson, 1992). The GSI was used to follow the seasonal changes in the gonad of *O. niloticus* in the habitat.

RESULTS

A total of 1580 fish specimens were caught while 1430 male and female specimens were used for study. Out of 639 female fish examined, 12.05% had one batch of eggs in their ovaries while the rest had two batches. Mature eggs were yellowish and pear shaped with diameters varying between 2.12mm and 2.69mm with a mean of 2.47±0.02. Male and female in their third and fourth stages of gonadal development constituted 63.98% and 64.8% respectively.

The ratio of male fish to female fish was 1:0.8. Irrespective of whether the specimens were caught off shore or inshore by castnetting or gillnetting, the sex ratio remained similar (Table 1).

The gonadosomatic index was used to follow the seasonal development of the gonads. In the female fish, gonadosomatic indices varied between 0.12 and 4.06 with a mean of 1.05±0.01. In the testes of male fish, the index was 0.39 ± 0.02 with values between 0.03 and 1.67. As shown in Figure 2, the gonadosomatic indices increased with the development of gonads in both male and female fish. However, the indices decreased in spawning and spent fish.

In this study, the male fish specimens were 55.3% of the total catch. Gillnetting accounted for 57.4% while castnetting accounted for 42.6% of the total catch. The peak breeding periods observed for the male fish were May and October and April and November for the female fish (Figure 3).

Mature male and female fish specimens had characteristics reddish-brown breeding dress on the ventral surface especially around the pharyngeal region. In this study eleven female fish specimens were caught with eggs in their mouths. Their measurements range from 18.0cm total length, 13.8cm standard length and a weight of 110gm to 37.7cm total length, 29.7cm standard length and a body weight of 969gm. The number of eggs found in the mouth varied from 39 to 241, per individual.

Table 1: Sex ratio of *O. niloticus* using two different fishing gears

Fishing gear	Reservoir area	Total No. of fish caught	Male Specimen	Female Specimen	Sex ratio
Gillnetting	Inshore	564	301	263	1:0.9
Gillnetting	Offshore	257	139	118	1:0.9
Total		**821**	**440**	**381**	**1:0.9**
Castnetting	Inshore and Offshore	609	351	258	1:0.7
Grand Total		**1430**	**791**	639	**1:0.8**

Fig. 2: Male and Female GSI Variation with stages of goad maturation

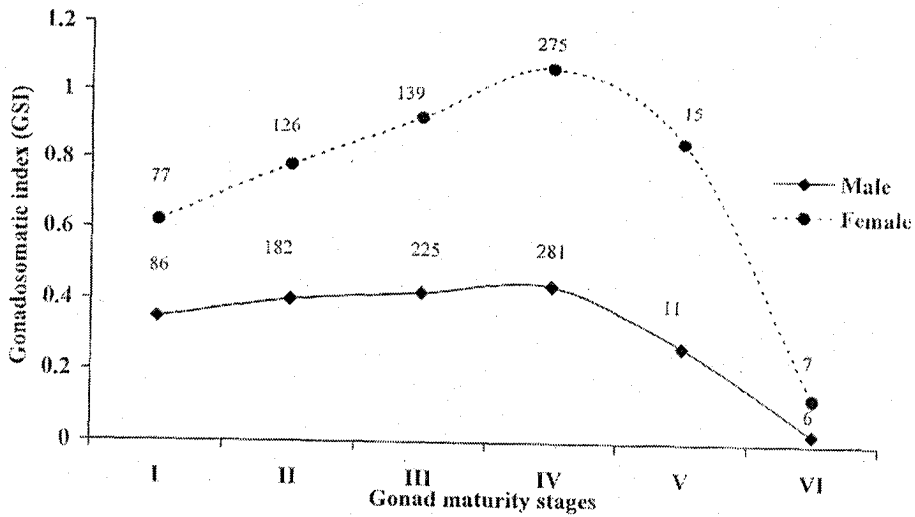
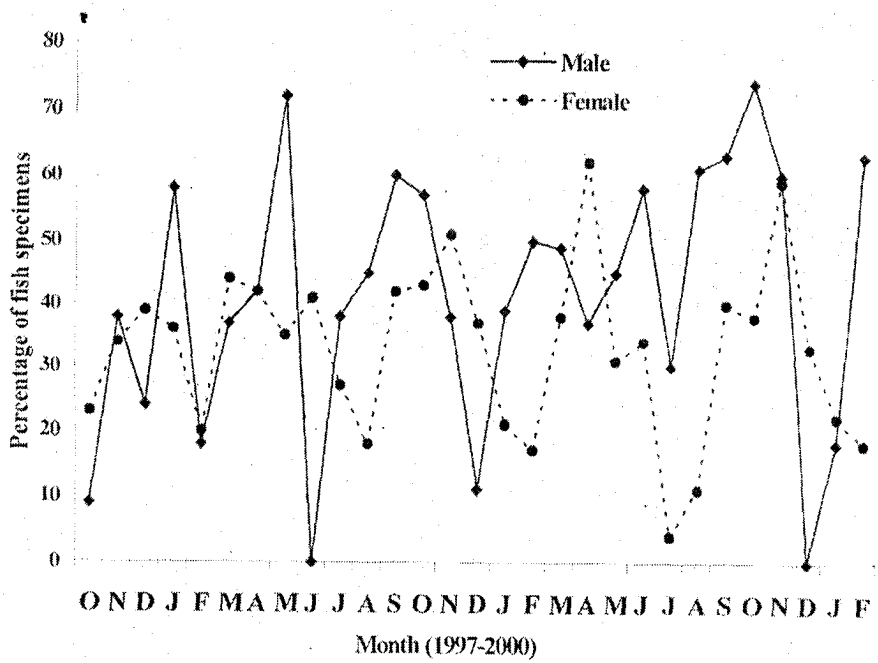


Fig. 3: The percentage of male and female *O. niloticus* specimens in stage IV gonadal development



A relatively few number of eggs in the mouth was an indication that some of them have been lost as the fish struggled to escape when captured and the serial arrangement of the eggs in the mouth was altered. Throughout the sampling period only one fish specimen was caught with 46 alevins in the mouth. Some of the alevins were probably lost during capture (Fig. 4).

$F = al^b$ (Bagenal, 1978)

where F = Fecundity
b = slope of the regression line
l = standard length (cm)
a = intercept of the regression line

Through logarithm transformation, the regression line becomes

Log (F) = b log (1) = a

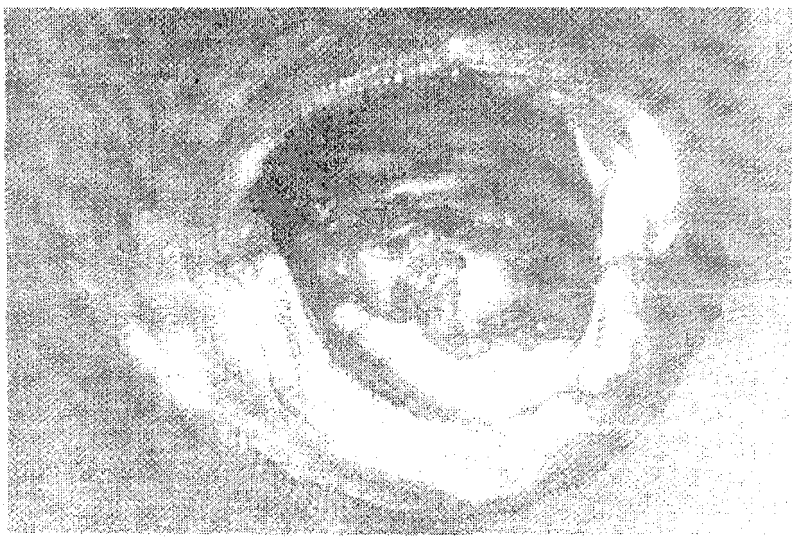


Fig. 4: Female *O. niloticus* carrying alevins in its buccal cavity

The total length of fish specimen examined ranged from 13.7cm to 31.0cm, 10.5cm to 24.4cm standard length while the weight ranged from 56cm to 540gm. Total fecundity in the ovaries ranged from 73 eggs in a fish of 18.8cm total length, 15.4cm standard length and a weight of 126gm to 1810 eggs in a fish of 29.7cm total length, with 23.0cm standard length and a weight of 487gm. The mean relative fecundity was 3.34± 0.11 eggs per gram body weight of fish. Individual values of relative fecundity ranged from 0.26 eggs to 26.82 eggs per gram body weight.

The relationship between fecundity and standard length of fish is given as:

The relationship between fecundity and standard length for *O. niloticus* in this study in Log F = 2.425 + 2.67 Log 1. A correlation factor of r = 0.370, $P < 0.0001$ obtained between logarithm fish fecundity and logarithm fish standard length (Fig. 5) was statistically tested and significant ($t_{cal.} = 15.0 > t_{tab.} = 2.617$; df 637).

DISCUSSION

Mature eggs of *O. niloticus* were yellowish and pear shaped with a mean diameter of 2.47mm. This was also the observation of Latif and Rashid (1972) who recorded a mean average diameter of 2.95mm for the same species. In Opa reservoir, the sex ratio for the species was approximately one male to one female 1:0.8

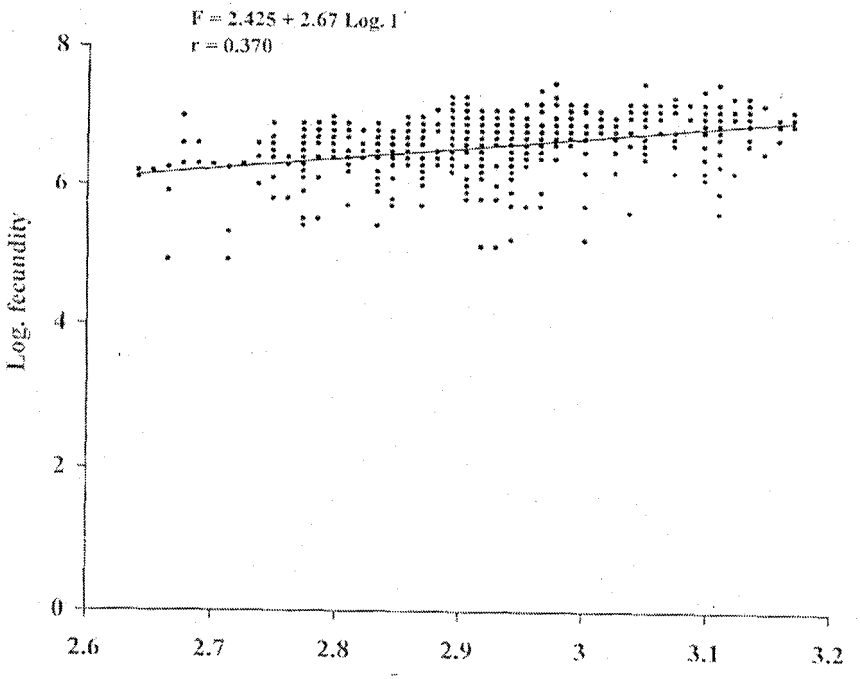


Fig. 5: Graph of Log. Fecundity against Log. Standard length

(male to female). This result shows no significant difference as reported by Okorie (1973) for *O. niloticus* in lake Victoria. A sex ratio of 1:1 was also reported for the species in lakes Edward and George by Fryer and Iles (1972).

The gonadosomatic index shows a steady increase in gonad maturity stages (I-IV). The drop in the indices of gonad maturity stages (V-VI) was expected. There were fewer or no eggs in the ovary after spawning. The gonadosomatic indices for the female and male fish specimens were 1.05 and 0.39. In the white Nile, Babiker and Ibrahim (1979) recorded 2.47 and 0.49 for female and male *Tilapia nilotica*. In Opa reservoir the highest gonadosomatic indices were 4.06 and 1.67 for female and male fish while the highest gonadosomatic indices for the same species showed 3.58 and 0.77 for female and male fish in the white Nile. The high gonadosomatic indices obtained in this study show that *O. niloticus* have ripe ovaries with large deposits of yolk in the eggs.

Bagenal and Braum (1978) had reported that fecundity in fish species characteristically varied among individuals of the same size and age. This was observed in Opa reservoir where the fecundity of *O. niloticus* varied between 73 eggs to 1810 eggs with a mean of 815 eggs. The result of this study is relatively compared to what was observed in Lake Naivasha by Babiker and Ibraham (1979) where the species fecundity ranged between 300 eggs and 2800 eggs. In Opa reservoir the low fecundity of *O. niloticu* and its wide variation might be attributed to differential

abundance of natural food materials as reported by Fagade *et al* (1984) and Komolafe and Arawomo (2003). It is also confirmed of the existence of some degree of parental care in the species (Lagler *et al.*, 1977). The relatively low fecundity might also be attributed to the mouth breeding habits of the species and limited space available for incubation of eggs and rearing of alevins in the buccal cavity.

The presence of two batches of eggs in the ovaries was an indication that the species bred more than once in a season. Multiple spawning was also observed on *T. zillii* and *S. galilaeus* in the same habitat (Komolafe, 2004; Fawole, 1996). McEvoy and McEvoy (1991) observed that multiple spawning was only possible where there was a long period of adequate food supply. The frequency of spawning in the species might be influenced by the by the abundance and seasonal availability of natural food materials which they selectively fed upon in the reservoir (Komolafe and Arawomo, 2003).

CONCLUSION

The reproductive behaviour of *O. niloticus* in Opa reservoir was studied. The species was observed as a mouth brooder. Few alevins were caught in the mouth of a female specimen. The fecundity of *O. niloticus* is relatively high and the gonadosomatic indices increased with the progressive development of the gonads. *O. niloticus* bred throughout the study period.

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