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Reproductive strategies of the Cichlids in a small reservoir in Ilorin, Nigeria

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ABSTRACT

The reproductive strategies of Cichlids: *Hemichromis fasciatus, Oreochromis niloticus, Sarotherodon galilaeus* and *Tilapia zillii* was studied from June, 2007 to December, 2008. The variability in egg –size (i.e. diameter) were measured using the micrometer eye-piece in a binocular microscope. Fecundity was estimated by direct enumeration and related to the fish species population. The sex ratio was calculated. The mean egg diameter of *H. fasciatus, S. galilaeus, T. zillii* and *O. niloticus* were: 1140 ± 54.74, 1725 ± 95, 1250 ± 129 and 1775 ± 125 mm respectively. There was variability in the egg size with fish species. The mean fecundity were 1100±100 eggs in *H. fasciatus* , 700 ± 70.71 eggs in *S. galilaeus*, 1509 ± 34.74 eggs in *T. zillii* and 366 ± 39.74 eggs in *O. niloticus*. *T. zillii* laid the highest number of eggs. In *O. niloticus* and *S. galilaeus* eggs were moderate in number but the eggs were fairly large in size. *T. zillii* employed the strategy of the force of number and parental care to ensure survival of the off-springs. *S. galilaeus* and *O. niloticus* employed the strategy of parental mouth- brooding. The reproductive strategy of *T. zillii* was efficient but the reproductive strategy of *O. niloticus* was inefficient. The efficient reproductive strategy of *T. zillii* may have resulted in the abundance of this species. *S. galilaeus* are biparental mouth brooders and the reproductive strategy was fairly successful as the population of the fish in the reservoir were moderate. Maternal mouth brooding reproductive strategy allows very few eggs to be brooded and this may be responsible for the low population of *O. niloticus* in the reservoir.

Keywords: Egg diameter, fecundity, Cichlids.

INTRODUCTION

Reproductive strategies are the traits or energy that an adult fish allocates into the reproductive process so as to optimize total number of offspring, which survive over the lifetime of the spawning adult (Wootton, 1987). The forms of energy allocated include number of egg, quality of yolk, parental care, nest building, protection from predators, provision with oxygen in anoxic condition and provision of food. Bond (1996) and Paugy (2002) stated that strategies may ensure the survival of the egg through the force of concealment or protection of the nest, or placing the early feeding stage of the young in close proximity of ample food. The cichlids are perch-like fishes and there are a variety of species in Nigerian freshwater. Four genera of cichlids are common: *Tilapia, Sarotherodon, Oreochromis* and *Hemichromis, Tilapia, Sarotherodon* and *Oreochromis* have deep laterally compressed bodies and double lateral line (Fryer and Iles, 1972). The dorsal fin consists of spiny half which is followed without a break by the second half which has soft branched rays. *T. zillii* is the most

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attractive species, it has an olive-green body but the throat is red (Holden and Reed, 1972; Lowe Mc Connel 1972).

S. galilaeus is silvery grey in colour while *O. niloticus* has white and black vertical bars on the dorsal fin and the tail. *H. fascistus* is distinguished from the other cichlids by the five dark spots on the flank and is yellowish in colour (Fryer and Iles, 1972). These fishes constituted about 80% of the total catch in the reservoir newly impounded in the University of Ilorin, Nigeria.

Some of the reported works on the biology of some cichlids include: Coad (1982) who showed that *Iranocichla hormuensis,* the only species of Cichlid found in Iran, laid eggs with egg width of 2.4 to 2.7 mm mean was 2.5 mm. The maximum length attained by this species was 80 cm.

Nachayev (1989) showed that *Hemichromis bimaculatus* fecundity range was 200 to 500 eggs. Fawole and Arawomo (2000) observed a fecundity of 604 to 2173 eggs and an egg diameter range of 1.00 to 4.5 mm in *S. galilaeus* from a reservoir in Ile-Ife in Nigeria. Bustos et al. (2007) worked on the spawning of the southern lake *Merluccinus australis* in Chilean fjords and showed that the egg size ranged from 0.93 to1.17 mm with a mean diameter of 1.05mm in October 1995 while the diameter of eggs collected in November, 2002 were between 1.09 and 1.30 mm with a mean of 1.17 mm. There was a significant difference in the size of the egg with location. There is paucity of knowledge on comparative studies on the reproductive strategies of the cichlids in the freshwater in Nigeria.

The objectives of this study were:

- To measure the egg diameter of *T. zillii, S. galilaeus, O. niloticus* and *H. fasciatus,*
- To estimate the total number of eggs laid by each fish,
- To relate the total number of eggs to the reproductive strategy of the species,
- To relate the number of eggs to the abundance of each population,
- To calculate sex ratio, condition factor and length/weight relationship of each species.

MATERIALS AND METHODS

Samples were collected from a reservoir in the University of Ilorin, Ilorin Nigeria. The reservoir is located on the South eastern part of the University. It lies on Latitude 8^0 $30^'$ N and longitude $4^0 32^'$ E of town Ilorin. Collection of samples was from September 2007 to December, 2008. The standard length and total weight were measured using the measuring board to the nearest mm. The ovaries were dissected out and the stages of gonad development were identified using Kesteven's (1960) method. The ripe ovaries were preserved in Gilson's fluid. Later the ovaries were washed with water and measurements of the diameter of the eggs were taken using a micrometer eyepiece. Estimation of the total number of eggs of both ovaries of the fish was carried out by counting the number of eggs in a sub-sample then estimating the total number of eggs.

The sex ratios of the fish species were calculated.

The condition factor (K) was calculated using

$K = 100w/L^3$ (Bagenal, 1978)

Where k= condition factor, w = weight, L = length

The length–weight relationship was calculated using

$W = al^b$ Where w = weight b = exponent

A logarithmic transformation of the equation gives the straight line relationship

Log w = log a + b log l, b = regression coefficient, Log a = intercept of the line on Y-axis Species diversity was calculated using Shannon- weaver's index Σ (Pi ln (Pi)

Pi = n/N (Foltz, 1982). n = number of individual species; N = total number of all species; where n is the number of individual of all species

RESULTS

The total number of fishes examined was 577. *S. galilaeus* was 180 while the number of females with ripe gonads was 40, *T. zillii* was 282 with the number of females with ripe gonads being 60. In *O. niloticus* the total number was 15 while 10 were ripe females, *H. fasciatus* were 100 with the number of females being 40. Egg diameter of *H. fasciatus*, *T. zillii*, *O. niloticus* and *S. galilaeus* are shown in Table I.

The egg diameter of *T. zillii* ranged between 1100 to 1400 mm, the egg diameter of *O. niloticus* was 1600 mm to 1900 mm, and the egg diameter of *S. galilaeus* was 1400 to 1800 mm and *H. fasciatus* egg diameter varied from 1050 to 1200mm. There was variation in egg diameter with species.

The fecundity range of *H. fasciatus* was from 1000 to 1200, that of *T. zillii* was from 1406 to 1608; *O. niloticus* was from 300 to 400 and *S. galilaeus* 600 to 800 (Table 1). Fecundity also varied with species. Statistical test for significant difference in the mean number of eggs using T-test showed that there was a significant difference ($P<0.05$).

Six gonad reproductive stages were identified in *T. zillii*, *S. galilaeus*, *H. fasciatus* and *O. niloticus*. This result shows that the different stages of gonad development occurred throughout the study period.

Gonad reproductive stages were:
Stage I – Immature; Stage II – Developing; Stage III – Maturing; Stage IV – Mature (Ripe); Stage V – Ripe (Running); Stage VI – Spent.

The sex ratio was approximately 1: 1.1 (one male to a female). The condition factors of the specimens are shown in table 2; the result shows that the specimens examined were in good condition. Statistical test for significant difference in the condition factor using T-test showed that there was significant difference ($P<0.05$). The correlation coefficient (r) for *O. niloticus*, *T. zillii*, *H. fasciatus* and *S. galilaeus* were 0.836, 0.829 0.512 and 0.709 respectively indicating high correlation between length and weight (Table 3). The Shannon-weavers index value obtained for these species showed that diversity was high.

Breeding habits: Two females of *O. niloticus* were caught with eggs in their mouths (figures 1&2) .Their total length, standard length and total weight were 26.2cm, 21.5cm and 350g respectively for the first fish and the second fish total length was 24.00cm, standard length was19.4cm and total weight was 270.The total number of eggs in the mouths of the two fishes were 10 and 14eggs respectively. The two fishes were caught in December, 2007 and 2008 respectively. On dissection no egg was found in their ovaries. The eggs brooded by the two fishes were relatively few compared to the total number of eggs laid by these fishes. Fish fry was not found in the mouth of any fish during the study period.

Table 1: Egg diameter and fecundity of: *Tilapia zillii, Hemichromis fasciatus, Sarotherodon galilaeus* and *O. niloticus.*

Fish	Egg diameter(mm) range mean S.D	Total number of eggs Mean S.D
Hemichromis fasciatus	1050 – 1200	1000 – 1200
	1140 ± 54.72	1100 ± 100
Sarotherodon	1400 – 1800	600 – 800
galilaeus	1725 ± 95.74	700 ± 70.71
Tilapia zillii	1100 – 1400	1406 – 1608
	1250 ±129.1	1509 ± 34.74
Oreochromis niloticus	1600 - 1900	300 – 400
	1775 ± 125.83	366 ± 39.74

Table 2: Condition factor of: *H. fasciatus, Sarotherodon galilaeus, Tilapia zillii* and *Oreochromis niloticus.*

Fish species	Condition factor range
Hemichromis fasciatus	1.03 – 2.85
Sarotherodon galilaeus	2.28 – 5.00
Tilapia zillii	1.50 – 4.52
Oreochromis niloticus	1.82 – 3.7

Table 3: Length-weight relationship of *H. fasciatus*, *S. galilaeus*, *T. zillii* and *O. niloticus.*

Fish Species	Log a	+ b log l	r
S. galilaeus	- 263.222	+ 132.533 L	0. 70949
T. zillii	- 299.541	+ 145.049 L	0. 82952
O. niloticus	- 431.019	+ 73.5863 L	0. 83696
H. Fasciatus	- 104.858	+ 41.059 L	0. 5189

Figure 1: *Oreochromis niloticus* Female brooding eggs in its mouth (December, 2007).
⟶ Indicates Egg.

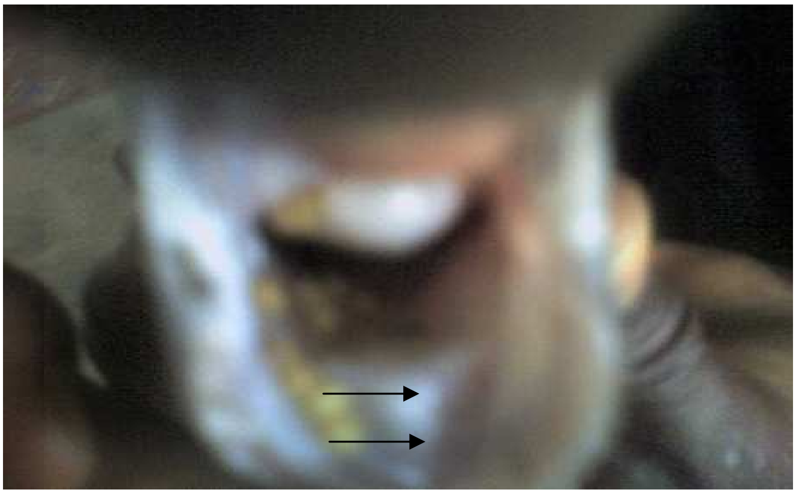

Figure 2: *Oreochromis niloticus* female brooding eggs in the mouth (December, 2008).

DISCUSSION

The results showed that there were variations in the number of eggs laid with fish species; also fecundity was not size dependent. Bustos et al. (2007) made similar observation in *Merluccinus australis*. Mouth brooder *O. niloticus* had the least number of eggs while *T. zillii* which guards the eggs had the highest number of eggs. Fawole and Arawomo (2000) observed that there were different sizes of eggs in the ovary. Similar Observations was made on the present work.

Fecundity in relation to the preponderance of the fishes showed that *T. zillii* which had the highest number of eggs also had the highest number of fishes in the reservoir. The number of eggs produced by *O. niloticus* was few and they were the least in number in the reservoir (Achionye–Nzeh, 2008).

S. galilaeus is a bi-parental mouth brooder, the number of eggs laid were almost twice the clutch size of *O. niloticus*. This is due largely to the fact that two parents are involved in mouth brooding.

However *T. zillii* is a guarder and both parents guard the eggs, thus adequate care is provided by the parents for the young ones through their reproductive strategy. The reproductive strategy may have contributed to the total population of fish in the ecosystem.

The maternal mouth brooder has the constraint of the eggs being carried in the mouth by one parent so the clutch size has to be reduced, only a few of the eggs (in this study between ten to fourteen eggs) were brooded, thus reducing the number of offspring produced; this may be responsible for the reduced population of *O. niloticus* in the reservoir (Achionye -Nzeh, 2008).

S. galilaeus laid fairly moderate amount of egg which was brooded by both parents and this may have accounted for the population of the fish being moderate in the lake.

H. fasciatus also had moderate number of eggs which was guarded by both parents, this resulting in moderate population of *H. fasciatus* in the water.

The reproductive strategy of *T. zillii* ensured that most of the eggs developed into fry and eventually to adult fishes thereby maintaining a high population of the fish.

The reproductive strategy of maternal mouth brooding did not favour increase in fish population because a parent brooded the eggs and the eggs may not have sufficient oxygen to develop into young ones (Figs 1&2). The results obtained in this study showed that the maternal parent was brooding very few eggs compared to the total number of eggs laid. This may be the reason for the low population of *O. niloticus* in the reservoir. The strategy of bi-parental mouth brooding was fairly successful and the population was moderate in the reservoir. The strategy of guarding of eggs and the eggs exposed to sufficient oxygen supply was the most successful among the cichlids studied because *T. zillii* was the dominant cichlid in the reservoir.

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