

Some Reproductive Aspects of *Chrysichthys nigrodigitatus* (Lacépède) from Cross River, Nigeria

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Abstract

Between May and October 1990, fecundity, egg size and condition factor of *Chrysichthys nigrodigitatus* (Lacépède) in the Cross River, Nigeria, were studied. The fecundity (F) of this population varied from 3 046 eggs (total length, L=28.5 cm) to 28 086 eggs (L=64 cm). A mean relative fecundity of 231 eggs/cm or 13 eggs/g of fish was obtained for this population. The fecundity of this population can be estimated with the formula $F=2.511 \cdot L^{2.30}$ or $F=52.893 \cdot W^{0.78}$, total length being in cm and weight (W) in g. The mean egg diameter of this population varied from 0.65 mm to 3.54 mm. Condition factor (CF) of the population varied from 0.24 to 1.34 with 0.977 as the mean; 52.8% had CF higher than the mean and 47% had CF above unity. Smaller fish in this population were in better condition than bigger ones. The egg size and condition factor obtained in this study are evidence that the Cross River population of *C. nigrodigitatus* can provide excellent broodstock.

Introduction

The silver catfish, *Chrysichthys nigrodigitatus* (Lacépède), is a highly valued foodfish in Nigeria and other West African countries (Ezenwa 1981; Hem 1986; Obiekezie and Enyenihi 1988). For this reason, investigations had been conducted into the possibilities of its culture by Silvalingam (1972), Ezenwa (1982) and Ekanem (1992). To ensure successful breeding of this species, Ezenwa et al. (1986) examined the quality of populations of the species in different water bodies in Nigeria to see which of these could be used as broodstock. These authors examined fecundity, egg size and condition of the different populations and used these as criteria for their recommendations.

Environmental factors were found to cause location-related differences in fecundity of the same species of salmon (Rounsefell 1957). Similar findings were made

for American plaice, *Hippoglossoides platessoides*, in the Grand Banks (Pitt 1964) and Pacific herring, *Clupea pallasii*, in British Columbia (Nagasaki 1958). Jones (1974) discovered that the fecundity of turbot, *Scophthalmus maximus*, was proportional to the body weight and to the cube of the length.

A knowledge of fecundity is important in stock size estimation and stock discrimination (Holden and Raitt 1974). Leone (1967) used fecundity and egg size as criteria for separating three populations of surf smelt, *Hypomesus pretiosus* (Girard). Condition factors of different populations of the same species give some information about food supply and the timing and duration of breeding (Weatherley and Rogers 1978). The condition factor can also be used in assessing the well-being of fish (Oni et al. 1983).

After a comparative study of *C. nigrodigitatus* at various locations Ezenwa et al. (1986) showed that egg

size, fecundity and condition factor varied with individual fish and location. They established that the population of *C. nigrodigitatus* in Warri River produced larger eggs and had higher fecundity than those from other locations. Since Hulata et al. (1974) pointed out that larger eggs enhance fry and larval viability, Ezenwa et al. (1986) used this premise to recommend the Warri River population as the best broodstock.

Similar studies conducted on other species of *Chrysichthys* in Nigerian waters include the work on egg size of *C. auratus* in Lake Kainji (Ajayi 1972) and that of *C. walkeri* in Lekki Lagoon (Ikusemiju 1976). Nwadiaro and Okorie (1986) worked on the reproductive biology of *C. filamentosus* in Oguta Lake. No such studies have been conducted on *C. nigrodigitatus* or other *Chrysichthys* species of the Cross River. This study is, therefore, a continuation of the one started by Ezenwa et al.

(1986) and is focused on the Cross River population of *C. nigrodigitatus*.

This study was carried out to determine the fecundity of *C. nigrodigitatus* of the Cross River and to relate it to the length and weight of the fish. Other objectives were to determine the egg size and the condition factor of this population.

Materials and Methods

The fish used in this study were wild fish bought from local fishers as they landed at the Cross River bridge near Itu, about 57 km from Calabar. The fishers caught the fish using hooks and seine nets from the Cross River estuary from dugout canoes. Fig. 1 shows the Nigerian coast and the sample collection point. Collection of specimens lasted from May to October 1990, during which 502 female *C. nigrodigitatus* were examined. Of this number 53 were gravid.

The total length (**L**) of each gravid specimen was measured to the nearest 0.1 cm on a measuring board, while the whole body weight (**W**) was taken to the nearest 0.5 g using a triple beam balance. These measurements were used later to determine the condition factor (**CF**), as well as the fecundity-length and fecundity-weight relationships. After measurement, ovaries were carefully excised from the body cavity of each fish and preserved in modified Gilson fluid (Simpson 1951). This preservation procedure worked satisfactorily for this species as reported by Ezenwa (1981). It hardened the eggs, helped in breaking the ovarian tissue and in liberating the eggs. Ovaries of each fish were preserved for a minimum of five days before the eggs were counted and measured.

Fecundity (**F**) here is absolute fecundity, which is the total number of eggs in the ovaries of a fish prior to spawning (Bagenal 1978). The preserved ovaries were washed several times to get rid of the pre-

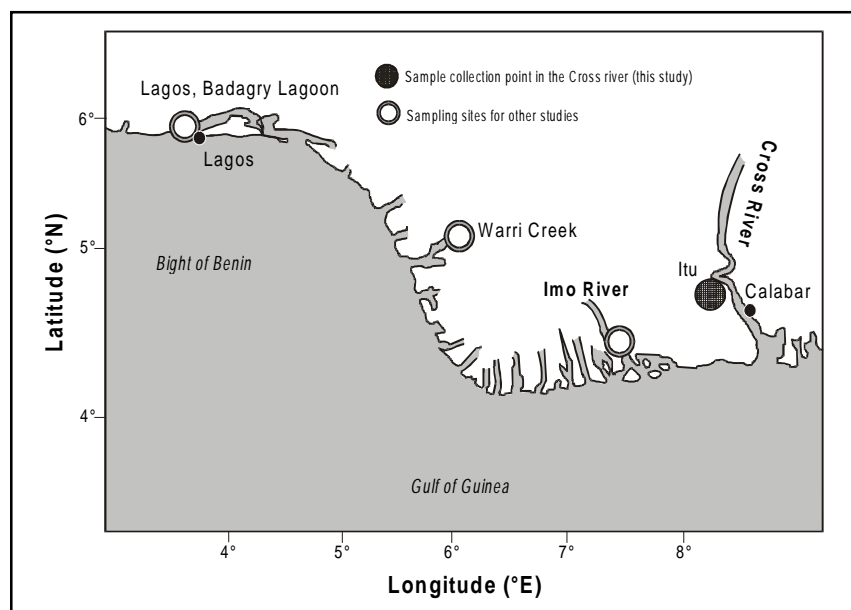


Fig. 1. Map of Nigerian coast showing sample collection point.

servative. Eggs were then separated from the ovarian tissues and placed on filter paper to remove excess water before being weighed using the Mettler P1210 chemical balance.

Eggs in a 1-gram subsample were counted. Counting was done for five similar subsamples. The mean number of eggs in the five subsamples gave the number of eggs per gram of weight. Fecundity was calculated by multiplying the total weight of eggs by the number of eggs per gram weight. Relative fecundity (**RF**) was obtained as the number of eggs per unit length (cm) or the number of eggs per unit weight (g) of fish.

Scatter diagrams of fecundity against length and fecundity against weight were drawn. A regression line was fitted on each scatter diagram by the least squares method (Draper and Smith 1966). Fecundity-length and fecundity-weight relationships were of the form

$$F = AL^B; \text{ and} \quad (1)$$

$$F = aW^b \quad (2)$$

after Healey and Nicol (1975), where **a**, **A**, **b** and **B** are constants, **L** is total length in cm and **W** is whole body weight of the fish in g.

The egg size was determined by measuring the diameter of 100 randomly selected eggs per female fish. Measurement of egg diameter was done with a calibrated eyepiece micrometer.

Measurements of length and weight recorded for each fish were used in calculating Fulton's condition factor (**CF**). The formula used in calculating the condition factor was given by Ricker (1975) as

$$CF = \frac{100W}{L^3} \quad (3)$$

Condition factors and other parameters were calculated for four length and weight groups (Table 1). Mean **CF** for all 53 female fish was also calculated.

Results

Mean values of the different parameters calculated for the species are presented in Table 1. Absolute fecundity varies with individual fish from 3 046 eggs (for a fish with **L** = 28.5 cm and **W** = 214.7 g) to 28 086 eggs (for a fish with **L** = 64 cm and **W** = 2.2 kg). Fecundity-length and fecundity-weight relationships of *C. nigrodigitatus* of the

Table 1. Mean condition factor and relative fecundity for four length and weight groups of *Chrysichthys nigrodigitatus* from Cross River, Nigeria.

Sample size (n)	Mean total length (cm)	Mean weight (g)	Mean condition factor (CF)	Fecundity (F)	
				Mean egg number/cm	Mean egg number/g
12	53.4	1 564	0.9050	318	14
15	45.4	941	0.9946	280	13
10	41.4	693	0.9690	174	10
16	34.0	402	1.0200	170	15

Cross River are shown in Figs. 2 and 3, respectively. Fecundity-length and fecundity-weight relationships of this population can be expressed in exponential form by the formulae:

$$F = 2.511 L^{2.30} \text{ and}$$

$$F = 52.893 W^{0.78}$$

Mean relative fecundity and the standard deviation were obtained as 13 ± 6 eggs/g or 231 ± 87 eggs/cm of gravid female fish.

Egg diameter was found to vary from 0.65 mm to 3.45 mm. Neither did the largest egg belong to the biggest fish nor was the smallest egg found in the smallest fish. The smallest gravid fish, with $L = 28.5$ cm, had eggs with a mean diameter of 1.02 mm, whereas the biggest fish, with $L = 64$ cm, had a mean egg diameter of 2.30 mm. Eggs with

the greatest mean diameter of 3.54 mm were found in fish of intermediate size (i.e., $L = 39.0$ cm and $W = 486.5$ g) caught in August.

The CF of this population varied from 0.24 to 1.34. A fish which had CF = 0.24 was in the worst condition. Fish in the best condition had a CF of 1.34. About 47% of the total number of female fish in this study had a CF above unity. The mean CF for the population of female *C. nigrodigitatus* from the Cross River was 0.977 and 52.8% of the samples used in this study had a CF greater than the mean. Smaller fish in this population were in better condition than bigger ones (Table 1).

Discussion

Fish with mean L of 45.4 cm in this study had a mean F of 12 063, which is comparable to 12 602 re-

corded for this species of similar size in Badagry Lagoon and 11 316 in the Imo River. It is much lower than 16 300 recorded for fish of similar size in Warri Creek by Ezenwa et al. (1986). In this respect, the Warri Creek population is superior to all others.

Great disparity is noted between the fecundity of fish at the above locations and the *C. nigrodigitatus* population of Lake Adejire where the maximum number of eggs counted was 2 884 (Fagade and Adebisi 1979). This indicates that the lake's population has a lower fecundity. This could be due to the greater abundance of food in the river than in the lake or due to freer movement in search of food along the river, whereas food search and supply in the lake are limited by the area. Although this has not been substantiated for *C. nigrodigitatus*, studies in Oguta Lake have shown that there is a relationship between the fecundity of *C. filamentosus* and food availability (Nwadiaro and Okorie 1986).

Absolute fecundity of 28 086 eggs found in 64 cm fish in this study is the highest so far reported for *C. nigrodigitatus*. For the genus *Chrysichthys*, this fecundity is only superceded by 34 200 eggs estimated for *C. auratus longifilis* of the Niger River (Imevbore 1970).

A mean relative fecundity of 280 eggs/cm for gravid female *C. nigrodigitatus* of mean $L = 45.4$ cm for the population in Cross River is exactly the same as that obtained for Badagry Lagoon, and is higher than the 251 eggs/cm calculated for the Imo River (but lower than 363 eggs/cm calculated for the population of the Warri River). However, the overall mean relative fecundity of 231 eggs/cm is low and cannot be compared since there is no other comparative figure available.

The fecundity-length and fecundity-weight relationships observed in this study correspond well with earlier findings by Fagade and Adebisi (1979) for this species in Lake Asejire. Fecundity is propor-

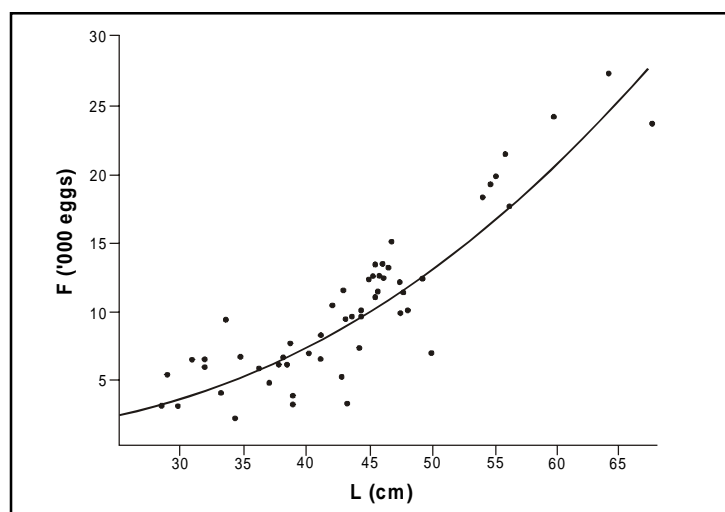


Fig. 2. Fecundity-length relationship of *Chrysichthys nigrodigitatus* from Cross River, Nigeria. See text.

tional to fish size when length is considered but is not quite so when weight is considered. The relative fecundity of 15 eggs/g found in fish of mean length 34 cm is greater than 10 eggs/g found in 41.4 cm fish. Although this shows that a higher condition factor favors greater fecundity, the use of fish weight to determine the fecundity should be treated with caution since somatic weight changes near the spawning period and introduces some errors.

In the exponential formula linking fecundity to total length, the exponent **B**, with the numerical value 2.30 obtained for the Cross River population of *C. nigrodigitatus*, is within the range 2.3-5.3 calculated for a variety of species by Bagenal (1978). The value is also close to 3.05 calculated for the *C. nigrodigitatus* population of Lake Asejire (King 1997). Calculations with total length instead of standard length may cause the slight differences in **B** values.

The findings of Ezenwa et al. (1986) on populations of this species at Badagry Lagoon, Warri River and Imo River confirmed that there are regional differences in the fecundity of *C. nigrodigitatus* as found in other fish species (Nagasaki 1958; Pitt 1964; Leone 1967; Bagenal 1978). However, the difference between 14 eggs/g relative fecundity obtained by Hem (1986) for this species in Cote d'Ivoire and 13 eggs/g obtained in this study indicates that the regional difference is slight.

This study found variations in egg size even in individuals of the same length. Similar findings were reported by Ezenwa et al. (1986). The variations are probably due to differences in individual ovulation time and the stage of egg development, which was treated in detail by Ezenwa (1981) and Hem (1986). This makes it more reasonable to deal with egg size of individual fish.

In this study, about 13% of the sample below **L** = 45 cm had egg diameter above 2.80 mm, which was a criterion Ezenwa et al. (1986) used to recommend the Warri River

population as suitable broodstock. A mean egg diameter of 3.54 mm obtained from a fish of 39 cm total length in this study is only surpassed in size by 4 mm diameter recorded for this species in the Niger River by Imevbore (1970). This indicates that broodstock obtained from the Cross River estuary may prove to be the best, as Hulata et al. (1974) pointed out that large eggs enhance fry survival and larval viability. The maximum egg size for this species greatly exceeds 2.1 cm that Ajayi (1972) reported as the maximum egg diameter for *C. auratus*, and the 2.40 mm reported for *C. walkeri* by Ikusemiju (1976), showing that *C. nigrodigitatus* has bigger eggs than the other two members of the genus.

A mean condition factor of 0.977 obtained in this study for female *C. nigrodigitatus* is higher than 0.9673, 0.9159 and 0.7859 reported for the Badagry Lagoon, Warri River and Imo River populations, respectively (Ezenwa et al. 1986). The fact that 58.2% of the samples examined had condition factors above the mean and 47% had their condition factors above unity indicate that the majority of fish in the population of the Cross River are in excellent condition. Following Bagenal's (1978) ex-

planation about condition factor and habitat, *C. nigrodigitatus* population of the Cross River is better adapted to survive in a poorer environment than populations from other locations studied and can therefore provide excellent broodstock.

It is interesting to note that smaller fishes in this population are in better condition than the bigger ones, as revealed in the four size groups in this study. This may be because smaller fishes are more efficient in finding food than the bigger ones.

The **CF** obtained for *C. nigrodigitatus* in this study is within the range of 0.77-1.80 which Nwadiaro and Okorie (1985) reported for *C. filamentosus*, but is much below the range of 1.53 - 2.55 reported for *C. auratus* (Ajayi 1972). This suggests that the condition factor of *C. nigrodigitatus* is quite distinct from that of *C. auratus*.

While discussing the condition factor of *C. filamentosus*, Nwadiaro and Okorie (1985) mentioned that data are lacking on the condition factors of *Chrysichthys* species from different water bodies in Nigeria. It is hoped that the data presented here will help fill some of the gaps and stimulate further studies that would help in the conservation of *Chrysichthys*.

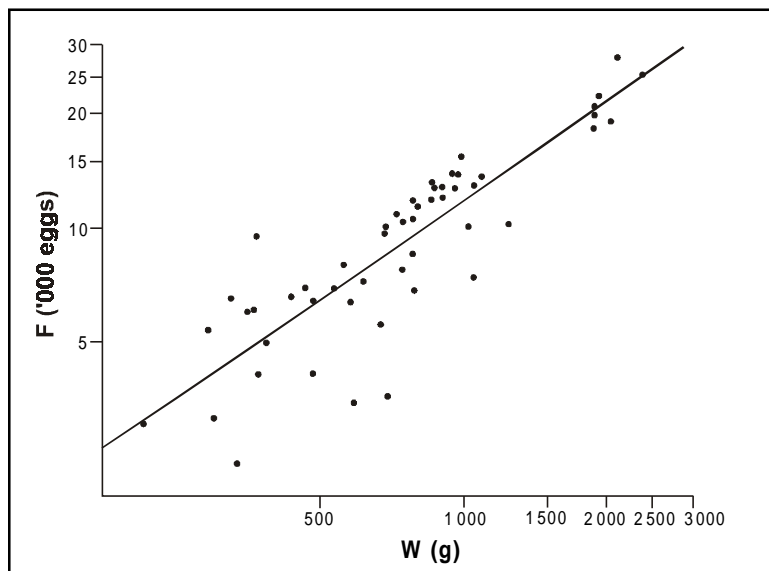


Fig. 3. Fecundity-weight relationship of *Chrysichthys nigrodigitatus* from Cross River, Nigeria. See text.

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