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RELATIONSHIP BETWEEN FECUNDITY AND BIOMETRIC INDICES OF THE SILVER CATFISH *Chrysichthys nigrodigitatus* (Lacepede) IN THE CROSS RIVER ESTUARY, NIGERIA

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ABSTRACT

The relationship between fecundity and biometric parameters of silver catfish, *Chrysichthys nigrodigitatus* from the Cross River estuary was studied between July and October 2012. A total of 120 gravid female fish were examined. The results show that fecundity of *C. nigrodigitatus* ranged between 975 eggs for fish of total length 23.2 cm, total weight 99 g, ovary weight 15 g and mean egg diameter 2.43 mm to 11,280 eggs for fish of total length 50.0 cm, total weight 1420.0 g, ovary weight 80.0 g and mean egg diameter 3.44 mm. There was a positive significant relationship between fecundity (F) and total length (TL), total weight (TW), ovary weight (OW) and mean egg diameter (MED) as follows: $F = 2.457TL^{1.9225}$ ($r = 0.8457$ and $r^2 = 0.7152$, $P<0.05$), $F = 61.51TW^{0.6098}$ ($r = 0.890$, $r^2 = 0.7921$, $P<0.05$), $F = 28.162OW^{1.2468}$ ($r = 0.9457$, $r^2 = 0.8943$, $P<0.05$), $F = 704.44MED^{1.0624}$ ($r = 0.2128$, $r^2 = 0.0453$, $P<0.05$). Fecundity and mean egg diameter increases with total weight (TW). This finding is essential for evaluating the aquaculture strategies required to intensify commercial production and management of *C. nigrodigitatus* stock since it is a valuable source of protein in Nigeria.

INTRODUCTION

Silver catfish, *Chrysichthys nigrodigitatus* commonly called "Inagha" by the Efik and Ibibio tribes in Nigeria, is an important food fish for the inhabitants of the Cross River estuary. It is appreciated by consumers for its taste and meat quality and is mostly smoked and used in traditional and continental dishes. According to Enin (2007), *C. nigrodigitatus* is known to be the most dominant fish in trawl catches accounting for a considerable frequency of occurrence in both artisanal and trawl fishery of Cross River estuary. Offem et al. (2008) reported that *C. nigrodigitatus* is a highly valued food-fish included among the dominant commercial catches exploited in major rivers of Africa. It is exploited mainly by hook and line and the gillnet fisheries in the Cross River estuary, Nigeria (Holzlohner et al., 1998). It forms 10.0% of the catches of the gillnet fishery in the central Cross River estuary, Southern Nigeria (Holzlohner et al., 1998).

Fecundity is an index which measures the number of eggs carried by a gravid female fish or shrimp. It is one of the various reproductive characteristics of fish species, thus fecundity estimate is of great importance for fisheries science (Hunter and Goldberg, 1980). In fisheries science, fecundity is important in the following areas: stock assessment, eggs and larval survival studies, standing stock size estimates, exploited stock prediction, re-

cruitment of back shell and fin fish species (Shalloof and Salama, 2008) and formulation of management strategies (Komolafe and Arawomo, 2007). In aquaculture, fecundity is used as an important criterion in the selection of aquaculture candidates (Mayer et al, 1989). Several scientists have researched the reproductive biology of *C. nigrodigitatus*, including Offem et al. (2008), Aransiola (1989), Ekanem (2000), Ezenwa et al. (1986), Fagade and Adebisi (1979) etc. Investigation into the possibility of culturing *C. nigrodigitatus* to meet the demand is ongoing (Ezenwa, 1982 and Ekanem, 1992). Presently, fish farmers in the southern part of Nigeria who embarked on trial culture and breeding of this species have failed due to lack of information on various aspects of its reproductive biology. The objective of the present study is to determine the relationship between fecundity and biometric indices such as total weight (F/TW-g), total length (F/TL-cm), egg diameter (F/ED-mm) and ovary weight (F/OW-g) of *C. nigrodigitatus* from the Cross River estuary, Nigeria.

MATERIALS AND METHODS

Study area description

The study area for this research is the Cross River estuary, Nigeria, which lies approximately between latitude 4° and 8° N and longitude 7° 30 and 10° E in the southern part of Nigeria. It takes its rise from the Cameroon Mountain and meanders westwards into Nigeria and then southward through high rainforest formation before discharging into the Atlantic Ocean at the Gulf of Guinea. The study area has a mangrove forest vegetation (Ama-abasi et al., 2004) with climate characterized by long wet season from April to October and a dry season from November to March. Mean annual rainfall is about 2000 mm (Akpan and Offem, 1993). A short dry period known as August break occurs in August. There is usually a cold, dry and dusty period between December and January, referred to as the harmattan season. Temperatures generally range from 22 °C in the wet to 35 °C in the dry seasons. Relative humidity is generally above 60% at all seasons, with close to 90% during the wet season (Akpan and Offem, 1993; Ama-abasi et al., 2004).

Collection and identification of C. nigrodigitatus *species and their sexes*

One hundred and twenty freshly caught gravid females of *C. nigrodigitatus* were collected between July and October 2012 from the catches of the artisanal fisheries at Nsidung beach, Calabar, a major landing point of the artisanal fisheries of the Cross River estuary. Samples were transported in ice-packed containers to the Fisheries and Aquaculture laboratory, Institute of Oceanography, University of Calabar, for further analysis.

Identification of *C. nigrodigitatus* was based on the identification key given by Fischer et al. (1981). Differentiation of sexes was based on external features (anal opening) and internal features such as gonad.

Measurements of biometric indices

The following biometric parameters were measured for each specimen: Total length (TL), Total weight (TW) and Gonad weight (GW). Total length was measured from snout to the base of the caudal fin rays. Measurements were taken to the nearest 0.1 cm and 0.1 g using measuring board for length and Metlar-2000D electronic weighing balance for weight.

Procedures for fecundity estimation and measurement of egg diameter

Eggs from each specimen were removed by cutting-open the abdominal part of the fish with a sharp pair of scissors. Each specimen was cut-opened through the cloaca.

Eggs were washed in distilled water and weighed using Metlar-2000D electronic weighing balance to the nearest 0.1 g (Ama-abasi, 2006).

The eggs removed from each sample were fixed in Gilson fluid in order to loosen the tissues surrounding the eggs (Davenport, 1960).

Fecundity (F) was determined as the product of total weight of eggs in the ovary and count in 1 g of egg mass as shown below:

F = total weight of eggs in the ovary x count in 1 g of egg mass

The diameters of 30 eggs per fish were measured according to Lampert et al. (2004); Mesa et al. (2007) using a stereo microscope with an ocular micrometer eye piece.

Statistical analysis

Values of regression coefficient 'b' intercept 'a' and coefficient of correlation 'r' in relationship between fecundity and body parameters (F/TL-cm, F/TW-g, F/OW-g and F/MED-mm) for C. nigrodigitatus from the Cross River estuary were determined by linear and power regressions.

RESULTS

Fecundity of C. nigrodigitatus *from the Cross River estuary*

Fecundity was determined for one hundred and twenty (120) specimens of *C. nigrodigitatus* collected from the Cross River estuary. Fecundity of *C. nigrodigitatus* ranged between 975 eggs for fish of total length (TL-cm) 23.2 cm, Total weight (TW-g) 99 g, ovary weight (OW-g) 15 g and mean egg diameter (MED-mm) 2.43 mm to 11,280 eggs for fish of total length (TL-cm) 50.0 cm, Total weight (TW-g) 1420 g, ovary weight (OW-g) 80 g and mean egg diameter (MED-mm) 3.44 mm.

Relationship between biometric indices and fecundity of C. nigrodigitatus *from the Cross River estuary*

Fecundity of *C. nigrodigitatus* from the Cross River estuary showed a linear relationship with the total length (cm). Power regression equation for fecundity and total length as shown in Figure 1 is as follows:

$$F = 2.457TL^{1.9225} (r = 0.8457 \text{ and } r^2 = 0.7152, P<0.05)$$

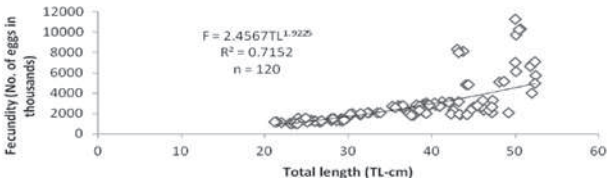

Fig 1. Power relationship between Fecundity and Total Length (TL-cm) of *C. nigrodigitatus* from the Cross River estuary

Fecundity of *C. nigrodigitatus* from the Cross River estuary showed a linear relationship with the total weight (g) (Figure 2). Power regression equation for fecundity and total weight (g) as shown in Figure 2 is as follows:

$$F = 61.51TW^{0.6098} (r = 0.890, r^2 = 0.7921, P<0.05)$$

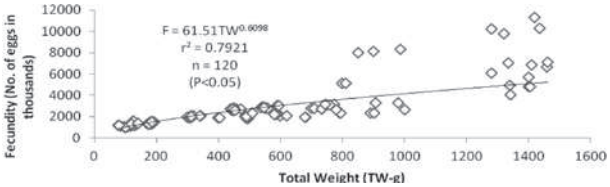

Fig 2. Power relationship between Fecundity and Total Weight (TW-g) of *C. nigrodigitatus* from the Cross River estuary

Fecundity of *C. nigrodigitatus* from the Cross River estuary showed a linear relationship with the Ovary Weight (g) (Figure 3). Power regression equation for fecundity and ovary weight as shown in Figure 3 is as follows:

$$F = 28.162OW^{1.2468} (r = 0.9457, r^2 = 0.8943, P<0.05)$$

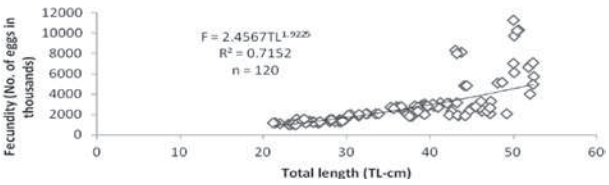

Fig 3. Power regression of Fecundity against Ovary Weight (OW-g) of *C. nigrodigitatus* from the Cross River estuary

Fecundity of *C. nigrodigitatus* from the Cross River estuary showed a linear relationship with the mean egg diameter (MED-mm) (Figure 4). Power regression equation for fecundity and mean egg diameter as shown in Figure 4 is as follows:

$$F = 704.44MED^{1.0624} (r = 0.2128, r^2 = 0.0453, P<0.05)$$

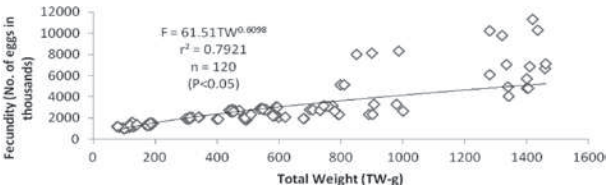

Fig 4. Power relationship between Fecundity and Mean Egg Diameter (MED-mm) of *C. nigrodigitatus* from the Cross River estuary

DISCUSSION

The use of fecundity as a criteria for estimation of population parameters and maintenance of *C. nigrodigitatus* fishery in Cross River estuary cannot be overemphasized in fisheries science. Fecundity is necessary to evaluate the reproductive capacity of individual fish species. In the present study, *C. nigrodigitatus* showed a significant (P<0.05) positive correlation between fecundity and total length, total weight, ovary weight and mean egg diameter. Fecundity ranged between 975 eggs for fish with total length 23.2 cm, total weight 99.0 g, ovary weight 15.0 g and mean egg diameter 2.43 mm to 11280 eggs in fish with total length 50.0 cm, total weight 1420.0 g, ovary weight 80.0 g. This result indicated that bigger sized *C. nigrodigitatus* contributed a higher number of eggs and smaller fish had a smaller number of eggs. These findings are lower than the results obtained by Abraham and Akpan (2012)

who estimated the highest fecundity for uninfected gravid females of *C. nigrodigitatus* to be 28,676 eggs.

Also, fecundity results from the present study were found to be lower than 28,086 eggs reported by Ekanem (2000) for Cross River population but higher than 2,884 eggs reported by Fagade and Adebisi (1979) for Lake Adejire as the highest fecundity estimated for *Chrysichthys nigrodigitatus*. In this study, the range of mean egg diameter observed (2.43 mm to 3.44 mm) falls within the range reported by Imevbore (1970), Ekanem (2000) and Abraham and Akpan (2012) for gravid females of *C. nigrodigitatus* from the Cross River system.

Offem et al. (2008) reported that the growth of eggs has a course similar to that of the entire ovaries. In this study, egg diameter of *C. nigrodigitatus* which varied in fish of the same length or weight agrees with Isa et al., 2012. However, this observation corroborates the findings of Domagala and Trzebiatowski (1987) who have shown that as a rule older and larger females produce larger eggs. Begenal (1957) observed that environmental factors and food supply might affect the fecundity of fish. It is possible that the variation in fecundity of *C. nigrodigitatus* in the Cross River estuary may be due to environmental conditions and food availability in the estuary. This type of variation was also reported by some previous studies of other fish (Doha and Hye, 1970).

CONCLUSION

The result of this study showed that *C. nigrodigitatus* from the Cross River estuary is highly fecund with positive correlation between fecundity and total length, total weight, ovary weight and mean egg diameter. Fecundity and egg diameter was found to increase with fish total weight. Knowledge about fecundity of C. *nigrodigitatus* is essential for evaluating the aquaculture strategies required to intensify commercial production and management of its stock since it is a valuable source of protein in Nigeria.

Sažetak

ODNOS PLODNOSTI I BIOMETRIJSKIH INDEKSA KOD SREBRNOG SOMA *Chrysichthys nigrodigitatus* (Lacepede) U ESTUARIJU RIJEKE CROSS U NIGERIJI

Odnos plodnosti i biometrijskih parametara srebrnog soma, *Chrysichthys nigrodigitatus* iz estuarija rijeke Cross, proučavan je od srpnja do listopada 2012. godine. Pregledano je ukupno 120 gravidnih ribljih ženki. Rezultati pokazuju sljedeće kretanje plodnosti *C. nigrodigitatus*: od 975 jajašca kod ribe dužine 23,2 cm, ukupne težine 99 g, težine jajnika 15 g i promjera jajašca 2,43 mm do 11280 jajašca kod ribe ukupne dužine 50,0 cm, ukupne težine 1420,0 g, težine jajnika 80,0 g i promjera jajašca 3,44 mm. Pozitivna je i značajna veza između plodnosti (F) i ukupne dužine (TL), ukupne težine (TW), težine jajnika (OW) i promjera jajašca (MED): $F = 2{,}457TL^{1.9225}$ ($r = 0{,}8457$ i $r^2 = 0{,}7152$, $P<0{,}05$), $F = 61{,}51TW^{0.6098}$ ($r = 0{,}890$, $r^2 = 0{,}7921$, $P<0{,}05$), $F = 28{,}162OW^{1.2468}$ ($r = 0{,}9457$, $r^2 = 0{,}8943$, $P<0{,}05$), $F = 704{,}44MED^{1.0624}$ ($r = 0{,}2128$, $r^2 = 0{,}0453$, $P<0{,}05$). Plodnost i promjer jajašca povećavaju se zajedno s ukupnom težinom (TW). Ovakvi rezultati važni su za ocjenjivanje strategija u akvakulturi radi povećanja komercijalne proizvodnje i stoka srebrnog soma (*C. nigrodigitatus*), budući da je riječ o vrlo vrijednom izvoru bjelančevina u Nigeriji.

Ključne riječi: plodnost, *C. nigrodigitatus*, estuarij rijeke Cross, biometrijski indeks, težina jajnika

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