Egyptian Journal of Aquatic Biology & Fisheries
Zoology Department, Faculty of Science,
Ain Shams University, Cairo, Egypt.
ISSN 1110 – 6131
Vol. 23(1): 245 -252 (2019)
www.ejabf.journals.ekb.eg

Assessment of fecundity of *Brycinus macrolepidotus* in Akomoje water reservoir, Abeokuta, South West, Nigeria

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ARTICLE INFO

Article History:
Received: Nov. 23, 2018
Accepted: Jan.30, 2019
Online: Feb. 2019

Keywords:
Brycinus macrolepidotus
Akomoje reservoir
Fecundity
Abeokuta
Nigeria

ABSTRACT

Overfishing and threat of extinction globally has been a topic of concern in the fisheries sub-sector over the years. This study assessed some aspect of the biology of *Brycinus macrolepidotus* in Akomoje reservoir, lower River Ogun, Nigeria. A total number of 838 fish specimens were collected bi-monthly for a nine month period from commercial catches using cast nets and long line. A total number of 51 mature female were selected for fecundity analysis which was limited to only sexually gravid female fish. Length and weight of experimental fish were measured. Data were subjected to analysis of variance (ANOVA), descriptive and inferential statistics. Correlation statistics was carried out to ascertain relationship between absolute and relative fecundity with length and weight of fish. Length and weight of experimental fish ranged between 14.5-39.4 cm and 938-1956 g. The relative fecundity ranged between 441 and 3,597 eggs with a mean of 1,702±0.16 eggs while absolute fecundity ranged from 5,838 to 39,208 eggs with a mean of 14,326±0.52 eggs. Strong positive relationship existed between total length and absolute fecundity (r= 0.74), and relative fecundity (r = 0.81). The reproductive potential of the species in this water body showed the ecological suitability of the species to its environments and to its thriving fisheries. The skewed sex ratio observed is an indication of threat to the species abundance in the lower River Ogun. Therefore, the habitat should be monitored towards sustainable methods of managing the stock in the reservoir.

INTRODUCTION

Brycinus macrolepidotus, True big-scale tetra (Valenciennes, 1850) is a freshwater fish native to Africa, it occurs throughout most of inter-tropical Africa, but is absent from the Gambia basin (Paugy, 1986). The fish thrive well in both lacustrine and riverine conditions but are more common in rivers than lake, (Saliu, 2002). This fish species is of commercially important, but there are no known management and conservation actions for the protection of its fishery.

Fish fecundity is an essential component in assessing the reproductive biology of a named fish species. This aspect must be understood so as to aid explanation of the differences in the productive ability of the fish, enhance efforts to increase

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harvest of fish. This is due to the direct influence fecundity has on fish productivity, recruitment and stock management. Bagenal and Braum, (1978) defined the concept of fecundity as the number of mature eggs in the ovary of female fish before spawning. However, fecundity is not constant but varies with environmental conditions and factors unique to species (Shafi, 2012).

Studies had been conducted on the family Alestidae in Nigeria by various authors, which included that of Adeosun *et al.* (2016) on the natural diets and length-weight relationship of *B. macrolepidotus* in lower Ogun River, Akomoje, Ogun State. Ikomi and Sikoki (2003) researched on the ecology of the African longfin tetra, *B. longipinnis* (Günther, 1864) in the Jamieson River while the length-weight relationships and food and feeding habits of some Characids (Osteichthyes: Characidae) from Anambra River, Nigeria was investigated by Echi and Ezewanji (2016). However, not much had been documented on the reproductive biology of this species.

Estimation of fecundity is not only important in assessing the reproductive capacity of the species but, equally important as it helps to distinguish between different forms of the species (Stiassny and Mamonekene, 2007). Knowledge of fecundity is also essential in population dynamics studies with aim at good management of the fisheries resources of Nigerian (Ekanem, 2000; Ikpi and Okey, 2010) and proper utilization of its resources (Ikpi and Okey, 2010). Though this fish species is of high commercial value in the South West, Nigeria, there are few literatures on its reproductive biology in Nigerian waters. The study thus investigated fecundity of the experimental fish and also determined the relationship between size and fecundity.

MATERIALS AND METHODS

Study area

The study was carried out in lower River Ogun, Akomoje Reservoir in Abeokuta, Ogun State. The river is located in Abeokuta North Local Government of Ogun State, and it lies between Longitude 3°21’E to 5°25’E and Latitude 7°21’E to 8°41’N North of Abeokuta with a size of 1000 hectares. Ogun River is a perennial river in Nigeria, which has a coordinate of 3°28’E and 8°41’N from its source in Oyo State to 3°25’E and 6°35’N in Lagos State where it enters Lagos Lagoon. Akomoje Reservoir takes its source of water from River Ogun, the Reservoir not only serves as a source of fishing site, but also serves as portable water processed by Ogun State Water Corporation. Some of the fish fauna of the reservoir included *Coptodon zillii* (Gervais, 1848), *T. mariae* (Boulenger, 1899), *Sarotherodon galilaeus* (Pellegrin, 1919), *Chrysichthys nigrodigitatus* (Lacépède, 1803), *C. auratus* (Geoffroy Saint-Hilaire, 1809), *Mormyrus rume* (Valenciennes, 1847), *Hydrocynus forskalis* (Cuvier 1819), *Hepsetus odoe* (Bloch, 1794), *Parachana obscura* (Günther, 1861).

Sample collection

B. macrolepidotus was sampled monthly from the Akomoje water reservoir between November 2015 and July 2016. Sampling was carried-out during the day (07:00am–12:00pm hours). Fish samples were transported in ice chest to the wet laboratory of the Department of Aquaculture and Fisheries Management for subsequent analysis.

Sex determination

The sex of each specimen was identified by visual examination and later confirmed during examination of the gonads (Layachi *et al.*, 2007), after which the fish was dissected and the gonads inspected using the keys of Nikolsky (1963). Testes of juvenile males were thin, thread like with very small projections, whitish in colour and extend to about 1/2 of the abdominal cavity. In adult males, the testes were creamy in colour with very conspicuous granules. The juvenile females had thin, pink to white tubular structures occupying about 1/4 of the abdominal cavity. In gravid females, that were about to spawn eggs were readily discernable in the ovaries which increased in size and filled most of the abdominal cavity (Bagenal, 1978).

Determination of fecundity

A total of fifty-one mature females were collected for the analysis of the fecundity which was limited to only sexually gravid female fish. The specimens were dissected to remove the ovaries, and information on their total length (cm) and weight (g) were recorded following the method described by Abdul (2015). The ovaries were preserved in Gilson fluid for 7 days. The fluid was prepared as described by Ekanem (2000). Preservation in the fluid is to harden the eggs, resulting in the break down of the ovarian tissues and then liberate the eggs and aid individual counting of eggs. The ovaries were then washed to remove the fluid. Tissue around the eggs were removed and eggs placed on a pile of filter paper to remove excess water and eggs were weighed using Chemical balance (Metler P1210). Absolute and Relative fecundity were estimated for every female specimen.

Absolute fecundity (F)

A hundred eggs were manually counted and weighed. Total number of eggs (F) was then estimated using the formula:

$$F = \frac{w \times n}{y}$$ ……………………………………………………..(Bagenal, 1978).

Where: w = weight of the paired ovaries.

n = 100 (number of eggs in the small sample).

y = weight of the sample of 100 eggs.

Relative fecundity (RF)

The relative fecundity of each specimen was calculated by using the formula;

$$RF = \frac{F \times 1000}{w}$$ ………………………………………………………… (Saliu, 2002).

Where: F = total number of eggs.

w = weight of the fish (in g).

Data analyses

Data analyses was done using descriptive statistics (mean, standard deviation and percentage), and inferential statistics (analysis of variance (ANOVA), Duncan multiple range test and student t- test). Chi- square test was carried out to see the departure of the population sex ratio from the expected ratio 1:1 of normal population. Simple linear regression was used to establish the relationship between the parameters; total length and body weight, total length and fecundity, body weight and fecundity using Statistical Package for Social Sciences (SPSS) software Gradpack version 20.0

RESULTS

Sex determination revealed that 277 were females (32.7%) and 571 were males (67.3%) given a sex ratio of Female: Male as 1:2.1, which was significantly ($p< 0.05$) different from the normal hypothesized sex ratio 1:1 (Table 1). The percentage of male samples was high in November, February and March and decreased in the month of December and then increased equilibrium in June and July. However, the percentage of female sample increased from November to February and then followed irregular pattern between May and July (Figure 1). Male fish in the population were significantly ($p<0.05$) higher than the female fish during the study.

Table 1: Monthly sex ratio of *Brycinus macrolepidotus* in Akomoje water reservoir, Ogun State.

Month	Frequency	Male	Female	Sex ratio (F:M)	X^2	p<0.05
Nov 2015	112	75	37	1:2.0	12.89	*
Dec 2015	88	53	35	1:1.5	3.68	*
Jan 2016	69	43	26	1:1.7	4.18	*
Feb 2016	122	85	37	1:2.3	18.88	*
Mar 2016	107	80	27	1:3.0	26.2	*
Apr 2016	80	50	30	1:1.7	5.44	*
May 2016	86	57	29	1:1.9	9.12	*
June 2016	94	64	30	1:2.1	12.3	*
July 2016	89	63	26	1:2.4	15.38	*
TOTAL	848	571	277	1:2.1	101.13	*

*: Significant

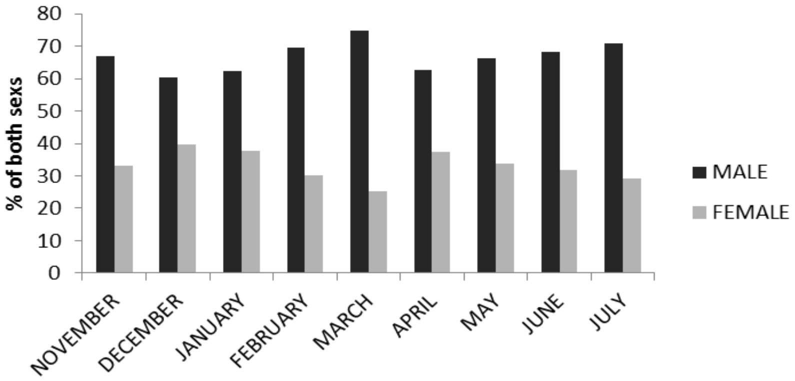

Fig. 1: Monthly percent sex ratios of *Brycinus macrolepidotus* in Akomoje Water Reservoir Ogun State.

The length class and weight per length class of the samples ranged between 14.6 cm to 38.0 cm and 938 – 1380 g (Table 2). The mean absolute fecundity and mean relative fecundity with respect to the various size groups are also shown (Table 2). Number of eggs in sampled fish per month is shown in Table 3. Samples collected in the month of July had the highest number of eggs in their ovaries with a mean of 894.8±0.49.

Table 2: Mean absolute fecundity and relative fecundity of *Brycinus macrolepidotus* with respect to the various length classes

Lclass (cm)	Freq	MW(g)	Mean RF(eggs)	Mean AF(eggs)
14.5-19.4	5	938	838	9245
19.5-24.5	7	941	1492	17148
24.5-29.5	22	1300	1867	16006
29.5-34.5	14	1400	1804	13221
34.5-39.4	3	1380	1956	13683
MEAN TOTAL	10.2	1191	1702	14326

Lclass (length class), Freq (frequency), MWg (Mean Weight in gram), AF (Absolute fecundity), RF (Relative Fecundity)

Table 3: Monthly number of eggs in sampled *Brycinus macrolepidotus*

Month	Fish sampled	Eggs (mean±SE)
NOVEMBER	7	563.5±0.27
DECEMBER	5	338.45±0.16
JANUARY	6	646.66±0.39
FEBRUARY	5	871.73±0.22
MARCH	7	567.43±0.22
APRIL	5	497.8±0.24
MAY	6	491.72±0.20
JUNE	5	748.53±0.41
JULY	5	894.8±0.49

Length and fecundity relationship

To establish the correlation between length and fecundity, the logarithmic values of fecundity (Y) were plotted against logarithmic values of total length (X) (Figures 2 and 3). The relationship between the fecundity and total length showed a linear relationship between the two variables.

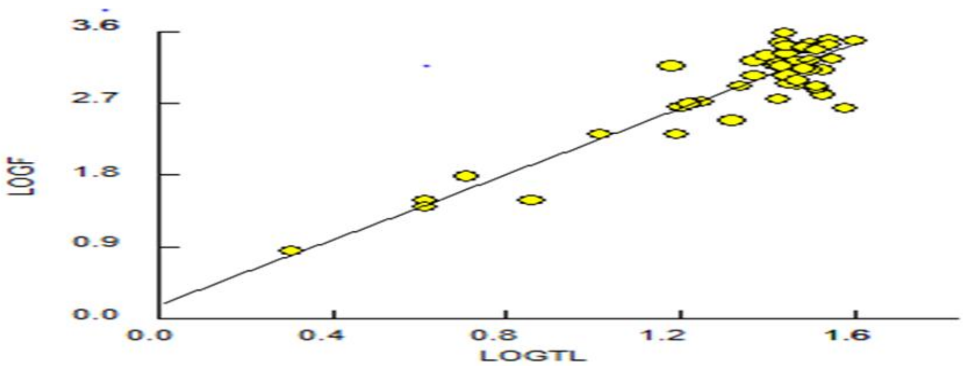

Fig. 2: Length:absolute fecundity relationship of *Brycinus macrolepidotus*

Where LOGF = Log of absolute fecundity

LOGTL = Log of total length

The relationship between length and fecundity was LOG F = LOG0.1660 + 2.0694LOGTL and R = 0.9428

Where, Y = Log absolute fecundity and X = Log total length of fish.

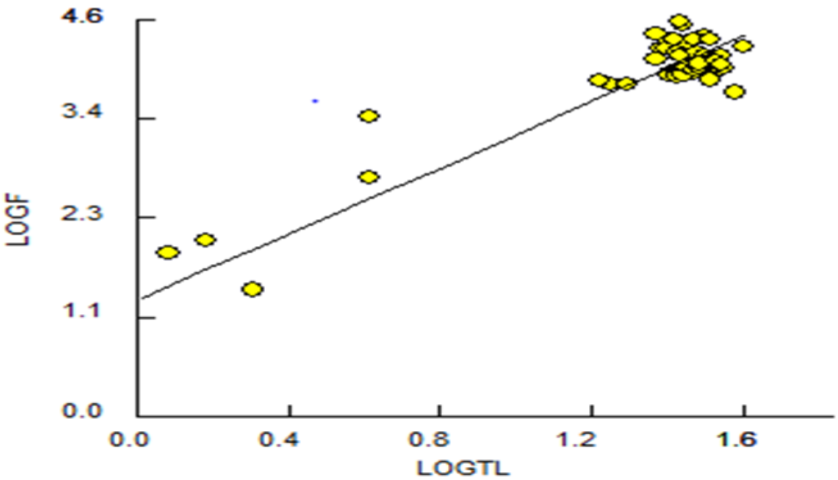

Fig. 3: Length:relative fecundity relationship of *Brycinus macrolepidotus*

LOG F = LOG1.3498 + 1.9384LOGTL

R = 0.9121

Total length and fecundity correlation and co-efficient calculated showed 0.81 for absolute fecundity and 0.74 for relative fecundity. Total length of fish were significant at 95% probability level. 'r' calculated values were also significant at 95% level of significance. The regression equations obtained for the relationship between total length and fecundity of *B. macrolepidotus* were different and dependent on their total length. Fecundity significantly increased with increase in total length.

DISCUSSION

Sex ratio of 1:2 on the overall observed in this study in favour of males agreed with the research of Allison *et al*. (1998) for *Cynoglosus* species, Olatunde (1999) for *Synodontis schall*, and Suresh *et al*. (2006) for *Macrognathus pancalus.* The preponderance of the male specimens over the female as observed in Akomoje reservoir has similarly been observed by Paugy (1980) in populations of the species from four basins in Ivory Coast. The sex ratio was observed to be deviated from the normal 1:1, male: female expected value in natural population. Shafi (2012) reported a high preponderance of female over males.

The observed linear relationship between the absolute fecundity and the total length of the experimental fish agreed with the findings of Ekanem (2000) for *C. nigrodigitatus*, Marimuthu *et al*. (2009) for Climbing Perch (Anabas Testudineus, Bloch) and Lawson (2011) for Mud skipper, *Periophthalmus papilio* (Bloch and Schneider 1801). However, Dadebo (2016) reported a curve linear relationship for *Synodontis schall* (Bloch and Schneider, 1801). The strong positive correlations recorded between fecundity and total length in this study indicated that total length can be used to determine the fish's potential egg production. However, Egwui *et al* (2007*)* reported that in C*larias gariepinus* (Burchell, 1822), fecundity was directly correlated with body weight (r=0.7609) and also with standard length (r=0.8266). The mean absolute fecundity which was highest in the wet months indicated that the peak of the species spawning period was in the wet season. Also, abundance of the plankton as recorded by previous studies supports the hatchlings and fry in most tropical waters (Nkwoji *et al.*, 2010; Okogwo, 2010).

Fecundity estimates of *B. macrolepidotus* in Akomoje reservoir were lower than those previously reported for *Brycinus nurse* in Ivory Coast Paugy (1980). Ikomi and Sikoki (2003) recorded fecundity variations in *B. longipinnis* (Gunther, 1864) from 160 (in females measuring 6.6 cm SL and weighing 9.0 g) to 1130 eggs (in a 9.0 cm SL fish that weighed 18.0 g). Nandikeswari (2016) reported fecundity variation of *Terapon jarbua* from 13,475 to 115,920 based on 41 ovaries of the species ranging in total length from 173–278mm and weight 65-298gm. These variations are as a result of differences in the geographical location of the populations, since different set of environmental factors would operate within the different habitats (Shafi, 2012). Differences could also be attributed to the size (length and weight), species and food availability of the species.

This study provided some basic information on the fecundity potential of *B. macrolepidotus* that would be helpful in the management of the species. There was a preponderance of males over females within the population of *B. macrolepidotus* in the Reservoir. The Akomoje water Reservoir population of *B. macrolepidotus* had lower mean values relative fecundity but higher absolute fecundity estimates than other population previously studied. Fecundity of *B. macrolepidotus* in the present study was comparatively low. It is recommended that further studies on gonadosomatic indices and size at sexual maturity of the fish be carried out.

ACKNOWLEDGMENT

The authors are grateful to the laboratory technologist and Assistant at the Department of Aquaculture and Fisheries Management, Federal University of Agriculture, Abeokuta, Nigeria.

Authors' contributions

AEO and AFI designed the study and sample collection and data analysis were done by AEO. OMTO and AEO participated in results, statistics and interpretation. AEO wrote the draft manuscript, while OMTO and AFI edited it.

Conflict of interest Declaration

The authors declare no conflict of interest.

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