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Original Article

GONADOSOMATIC INDEX AND FECUNDITY OF *SYNODONTIS BATENSODA* (RUPPELL, 1832) IN KANGIMI RESERVOIR, KADUNA STATE, NIGERIA

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ABSTRACT

The gonadosomatic index and fecundity of *Synodontis batensoda* was investigated. Two hundred and twenty three (223) specimens were collected for the study from June 2014 to 2015. Highest absolute fecundity (7867±0.00) was obtained from fish with total length range from 35 to 39cm. Specimens with total length range between 15 and 19cm recorded the lowest fecundity (890.28±116.84). The relationship for fecundity-body weight (r = 0.804), fecundity-total length (r = 0.855), fecundity-ovary weight (r = 0.804), body weight-total length (r = 0.661), body weight-ovary weight (r = 1.00) while total length-ovary weight (r = 0.350) showed a significant and weak positive relationship at 0.01 level. The monthly gonadosomatic index in males varied from 3.87±0.33 to 0.44±0.12 and in females between 6.48±0.28 and 0.48±0.10. The gonadosomatic index for males was not significantly different from the females gonadosomatic index at $P>0.05$. The mean gonadosomatic index for males, females and combined sex during the dry season was lower than the rainy season significantly ($P<0.05$). The species investigated were observed to spawn within the rainy months and they are multiple spawners.

Keywords: Gonadosomatic Index, Fecundity, *Synodontis batensoda*, Kangimi

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INTRODUCTION

The reproductive cycle of fish varies widely. Some fish reproduce many times a year, while others reproduce annually. Some species reproduce only once in their lifetime, dying after releasing their eggs or sperm. Fishes like other life forms carry out reproduction to ensure their existence is not limited to a period (Barton, 2007). The physical and chemical condition of aquatic environment is not constant. Fish species that are able to reproduce despite prevailing environmental conditions succeed in their habitat (Moyle and Czech, 2000). Teleost fishes have received a growing attention from fishery scientist over last few years (Agarwal, 2008). This is due to economic interest as teleosts are being extensively used for aquaculture development to increase fish production for the nutritional requirements of increasing human population. The quantity of matured eggs produced by a female fish before spawning is termed fecundity. Total number of eggs laid during the spawning season can be used in estimating fish population (Lawson, 2011). Fecundity of fish stock is one of the important components of fishery biology as it has direct bearing on fish production, stock recruitment and stock management (Shafi, 2012).

The species examined belong to the family Mochokidae (Genus: *Synodontis*). In local waters, there are about twenty (20) *Synodontis* species (Reed *et al.*, 1967; Olaosebikan and Raji, 2013). The body of *Synodontis* species are scale less, they possess shield that are bony on the sides and top of the head. They have rather short dorsal fins, consisting of a strong serrated spine and 6-7 branched rays, followed by a large adipose fin. The anal fin is short-based and the tail is deeply forked and has pointed lobes (Reed *et al.*, 1967).

Studies on the biology (Essien-Ibok *et al.*, 2015) of *Synodontis* species have been conducted including ecology (Ofori-Danson, 1992), feeding habits (Akombo *et al.*, 2010) and reproductive parameters such as fecundity estimate, egg size and gonad development (Oboh *et al.*, 2013). The scarcity of literature on aspects of reproductive biology of *Synodontis* species in the reservoir prompted the work. An investigation on the reproductive potential and breeding season was conducted in this study.

MATERIALS AND METHODS

STUDY AREA

The study was conducted at Kangimi reservoir, Igabi Local Government Area, Kaduna State. The reservoir is within the Savannah region between latitude 10°46'N and longitude 7°25'E (Fig. 1).

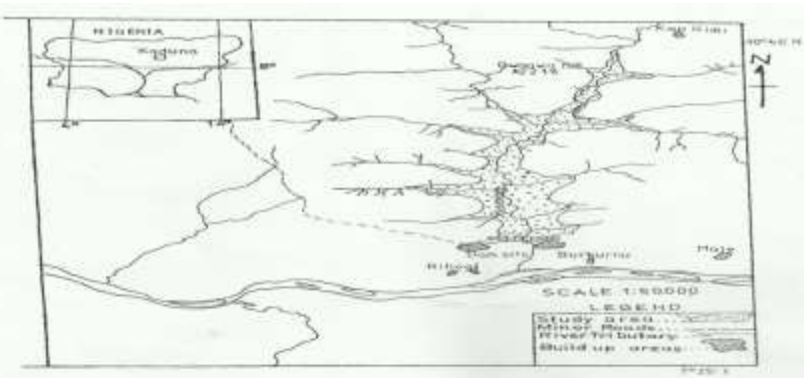

Fig 1: Map of study area (Insert is map of Nigeria showing location of Kaduna).

COLLECTION OF FISH SPECIMENS

Fish were collected from two landing sites. At each of the sampling stations, fish was randomly collected once a month. Method of sampling employed was sampling of commercial catches, fish caught by fishermen. The fishermen used traps and gill nets. The stretched mesh size of the nets ranged between 1cm and 5cm. Sampling covered a period of 12 calendar months, June, 2014 to May, 2015. Fish specimens sampled were conveyed in appropriately labeled ice boxes to the Fisheries/Hydrobiology laboratory, Department of Biology, Ahmadu Bello University, Zaria for analysis. In the laboratory, fish samples were preserved in a deep freezer at 0°C until examination and analysis. Identification of fish was done using text by Reed *et al.* (1967) and Olaosebikan and Raji (2013).

MORPHOMETRIC MEASUREMENT

Fish sample taken from the deep freezer were allowed to thaw before determining the total length and body weight of the fish. Measurement taken from the tip of the snout to the end of the caudal fin was recorded as the total length (cm) of the fish. The length measurement was done with a meter rule. The body and ovary weight were measured with Ohaus sensitive electric balance (Model: SE3001F) and recorded in gram.

FECUNDITY ESTIMATE

The ovaries were dissected out and preserved in 10% formalin. Fecundity was estimated by gravimetric method. Three subsamples of 1g each from a preserved ovary were taken and the number of mature ova was counted in each subsample and then the absolute fecundity (F) was estimated using the equation:

$$F = \frac{Gw \times En}{Sw}$$

Where: Gw = Gonad weight, En = Egg number in the subsamples, Sw = Subsample weight (Wooton, 1998). The number of eggs by unit weight (g) of fish gave the relative fecundity.

Least square method was used to study the relationship between fecundity and fish body weight, total length, ovary weight. The equation Y= a+ bX was Log transformed to Log Y= Log a + b Log X. Where: Y=Fecundity, X= Measurements such as body total length, fish body weight, ovary weight. Intercept (a) and slope (b) are the constant (Agarwal, 2008). A scatter diagram was obtained when fecundity values were plotted against body weight; total length and ovary weight.

GONADO SOMATIC INDEX (GSI)

The gonads of the dissected fish were removed and weighed. The breeding season of the fish was investigated by calculating the GSI as:

GSI=Weight of gonad/Weight of fish x 100 (Hirpo, 2012).

DATA ANALYSIS

The mean and standard error of fecundity and GSI was calculated. Correlation was applied to study the relationship between fecundity and fish body weight, total length, ovary weight. The relationship was tested for significance at 0.01 and 0.05 levels. Least squares regression analysis was used to estimate the values of intercept (a) and slope (b) for fecundity- body weight, fecundity-total length and fecundity-ovary weight. Bar-chart was used to illustrate the monthly variation in the Gonadosomatic index (GSI) of the species. Student's t-test was employed to establish whether GSI values were significantly different between sexes and seasons.

RESULTS

FECUNDITY

The highest fecundity was 7867 obtained from fish specimens with total range from 35 to 39cm while the lowest absolute fecundity 890.28 was obtained from species with total length range between 15 and 19cm. Relative fecundity fluctuated between 18.22±1.81 in fish with total length range 30-34cm and 9.69±0.86 in fish with total length range 15-19cm (Table 1). The relationship between fecundity-body weight, fecundity-total length and fecundity-ovary weight are presented in Fig. 2, 3 and 4, respectively. There was a significant and strong positive relationship for fecundity-body weight (r = 0.804), fecundity-total length (r = 0.855), fecundity-ovary weight (r = 0.804), body weight-total length (r = 0.661), body weight-ovary weight (r = 1.00) while total length-ovary weight (r = 0.350) showed a significant and weak positive relationship at 0.01 level.

Table 1: Mean Values of Fecundity, Body and ovary Parameters of *Synodontis batensoda*

	Total Length of Fish (cm)				
Parameters	15-19	20-24	25-29	30-34	35-39
Fish Body Weight(g)	95.15±8.34	122.88±10.2	238.55±18.3	328.56±1.99	441.60±0.00
Ovary Weight(g)	4.21±0.52	5.09±0.76	12.32±2.29	15.37±1.55	14.70±0.00
Absolute fecundity	890.28±16.84	1938.73±257.54	3250.25±413.76	5520±336.35	7867±0.00
Relative fecundity	9.69±0.86	16.58±1.76	14.71±1.26	18.22±1.81	11.4±0.00
Fish Specimen Examined	6	10	13	8	1

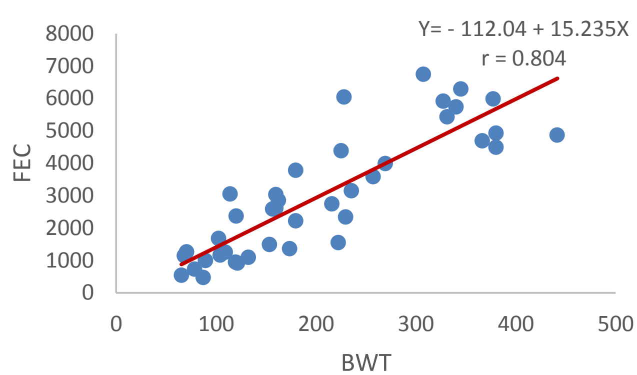

Fig. 2: Correlation between fecundity (FEC) and body weight (BWT) of *Synodontis batensoda*

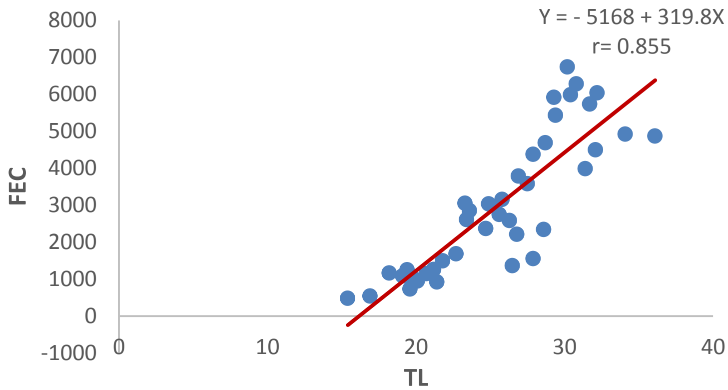

Fig. 3: Correlation between fecundity (FEC) and total length (TL) of *Synodontis batensoda*

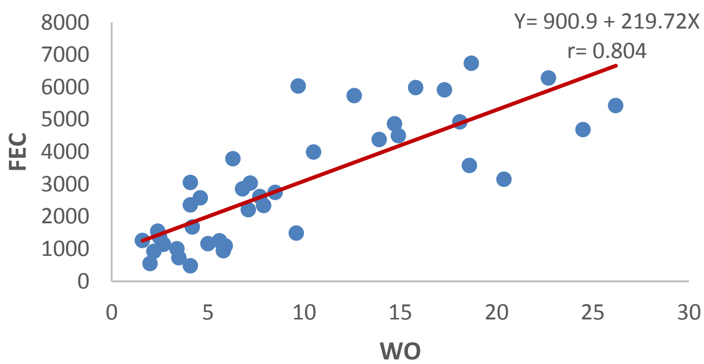

Fig. 4: Correlation between fecundity (FEC) and ovary weight (OW) of *Synodontis batensoda*

GONADOSOMATIC INDEX

Mean gonadosomatic index in *S. batensoda* is given in Table 2. The mean monthly gonadosomatic index in males varied from 3.87±0.33 (September) to 0.44±0.12 (February) and in females between 6.48±0.28 (July) and 0.48±0.10 (March). The monthly gonadosomatic index of males and females is given in Fig. 5. The monthly gonadosomatic index values variation in males and females were significant at $P<0.05$. The gonadosomatic index for males was not significantly different from the females gonadosomatic index at $P>0.05$. The mean gonadosomatic index for males, females and combined sex during the dry season was lower than the rainy season significantly ($P<0.05$) Table 3.

TABLE 2: MONTHLY VARIATION IN THE GONADO SOMATIC INDEX (GSI) OF *SYNODONTIS BATENSODA*

	Males			Females		
Month	Min	Max	Mean±SE	Min	Max	Mean±SE
June	2.79	3.77	3.05^{ef}±0.13	3.79	5.33	4.22^{de}±0.15
July	1.70	3.82	2.64^{e}±0.17	4.45	8.65	6.48^{f}±0.28
August	2.33	4.08	3.17^{ef}±0.21	3.25	4.55	3.87^{d}±0.11
September	2.34	5.56	3.87^{f}±0.33	3.16	6.25	4.97^{e}±0.21
October	1.92	3.55	2.38^{de}±0.22	2.99	4.71	3.57^{d}±0.19
November	0.97	1.89	1.43^{bc}±0.15	1.05	3.41	2.15^{c}±0.47
December	0.76	0.76	0.76^{a}±0.00	1.44	1.81	1.65^{bc}±0.08
January	0.41	0.87	0.63^{ab}±0.10	0.52	1.15	0.92^{ab}±0.08
February	0.27	0.67	0.44^{a}±0.12	0.52	2.52	1.50^{bc}±0.42
March	0.13	1.62	0.68^{a}±0.26	0.17	0.84	0.48^{a}±0.10
April	0.93	1.33	1.08^{abc}±0.12	1.86	2.37	2.13^{c}±0.11
May	1.48	1.83	1.74^{cd}±0.06	1.60	2.12	1.84^{c}±0.07

Means with different superscript in each column are significantly different (P<0.05). Key: Min = minimum; Max = maximum;
SE = standard error

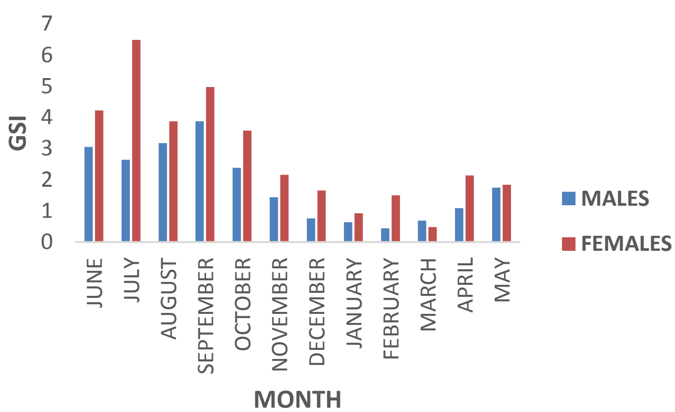

Fig. 5: Monthly variation in the gonadosomatic index (GSI) of *Synodontis batensoda*

TABLE 3: COMPARISM OF SEASONAL MEAN GONADOSOMATIC INDEX (GSI) OF *SYNODONTIS BATENSONDA*

	Season		
Sex	Rainy (n = 5)	Dry (n = 7)	P. Value
Male	2.89 ± 0.35	1.06 ± 0.25	0.001*
Female	4.28 ± 0.76	1.77 ± 0.38	0.009*
Combined	3.70 ± 0.53	1.49 ± 0.31	0.003*

Mean ± Standard Error; * significantly different (P < 0.05)

DICUSSION

It was established in this work that there is a relationship between fish size and number of eggs. The larger fish produced more eggs than smaller fish. The fecundity of *S. batensoda* showed a better relationship with body weight than with length and ovary weight. The relationship observed in this study between fecundity and fish body weight (0.804), total length (0.855) and ovary weight (0.804) were significant and positively strong. This differed from the findings of Olele and Etim (2011) who documented that the relationship between fecundity and total length (r = 0.25), body weight (r = 0.30) was weak positive and that the relationship was not significant for *Synodontis nigrita* in Onah Lake, Asaba, Nigeria. It was observed that fecundity was not dependent on fish size or its body weight. However, there was a strong positive relationship between fecundity and gonad weight (r = 0.71). In this work, fecundity increase as body weight, total length and ovary weight increases, implying that for each body weight, total length and ovary weight increase there is an increase in fecundity by 1.182, 2.504 and 2.341, respectively.

Also in this research, the breeding pattern of the species was established. High GSI indicate breeding and was considered the spawning period. Fish with low GSI were collected during the dry season. The collection during rainy months had the highest GSI. The maximum GSI value for male was observed in June. The female fish GSI was at the peak in July. It means that the fish invest more energy towards gamete production in rainy season. Run-off water during the rainy season introduces nutrients in the reservoir thereby stimulating the important process of primary production which serves as the base for trophic energy transfer. Water quality parameters tend to be at optimal levels which favour the breeding of warm water fish species within the tropics (Olatunde, 1989). The higher GSI during the rainy season corroborates the report of other workers, for example, Oboh *et al.* (2013) stated that male and female specimens of *Synodontis schall* from Jamieson River, Nigeria start breeding activities at the onset of the rains and continue during the rainy season. In the present work, the male was observed to have lower GSI than the female and is similar with the findings of many researchers, for example, Hirpo (2012) documented that the mean GSI of *Oreochromis niloticus* in Lake Babogaya, Ethiopia ranged from 0.7 – 3.5 for females and from 0.6 - 2.1 for males. Similarly, Offem *et al.* (2008) observed the GSI for female *Chrysichthys nigrodigitatus* to be higher than that for males and opined it was probably due to heavier ripe female gonads. Individuals within a species that channel more energy into production of gamete tend to have higher GSI values (Buxton, 1990). This study indicates that *S. batensoda* in Kangimi reservoir breed within the rainy months and the species are multiple spawners.

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