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SOME ASPECTS OF THE BIOLOGY OF *Synodontis nigrita* (Curvier and Valencienes, 1864) IN ONAH LAKE, ASABA, NIGERIA

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ABSTRACT

A total number of 655 specimens of *Synodontis nigrita* were caught from Onah Lake, giving a sex ratio of one male to 1.3 females. Fourteen size classes were identified. Fish abundance was highest in size class 90.0 to 99.99 mm (with a total population of 228 specimens) and lowest in the size class 200.9 to 209.99 mm (with a total population of 5 specimens). The total length range for male specimens was 96.5 to 214.0 mm and for females, it was 80.9 to 210.1 mm. The total length of the fish at sexual maturity was 103.5 mm (male) and 114.7 mm (female). The length weight relationship revealed that there was a significant difference ($P<0.001$) between the male and female specimens. Male: Log T_L = -4.200+ 2.721 Log T_L ($r = 0.941$) and Female: Log -4.115 + 2.614 Log T_L ($r = 0.911$). The slope of the regression was less than 3 which implied that the fish increased more in length than in body weight. The gonado-somatic index was (0.37-7.18.6) for females. Fecundity was established at 1037±773 (675 - 3642). Two sets of ova diameter were evident: the small developing ones (0.1 -0.2µ) and the large developed ones (0.6 to 1.3 µ). This observation indicates that the fish was a total spawner, releasing almost the same size of ripe ova when fully matured. The photomicrograph of the organs revealed five maturity stages, beginning from the sertolit cells, which when ripened, releases matured eggs.

Keywords: s*ynodontis nigrita*, Onah Lake, maturity stages, fecundity.

INTRODUCTION

Synodontis nigrita (Curvier and Valenciennes, 1864) is one of the dominant and endemic mochokids of Nigeria inland water body. It supports a thriving commercial fishery in many West African Countries (Fryer and lles, 1972, Ofori-Danson *et al.*, 2002). Structurally, it appears as a small to medium sized fish contributing a substantial quantity of its fisheries resources to the Asaba community and beyond. This genus was the most populous teleost in Africa hence it takes the third position after *Barbus* spp and *Haplochromis* spp (Poll, 1971; Willoughby, 1979).

Previous study on the genus dates back to the sixties. Bishai and Gideiric (1965a, b and 1968) reported on its age and growth, reproductive biology, food and feeding habits in Khartoum. Reports on this genus in Nigeria were by Motwani and Kanwai (1970) on fish and fisheries of the coffer dam, Willoughby (1974) reported the ecology of the genus while Lewis (1974) reported the effect of lake formation on the genus. Recent studies on this species include Olojo *et al.,* (2003) on food and feeding habits of the species in Osun River, Nigeria and Lalèyè *et al.*, (2006) on the biology of the genus in Quémé River, Benin. The biology of this species was investigated in Onah Lake to understand its pattern of recruitment, its production potentials, its length weight relationship and its sex ratio with special emphasis on the photomicrographs of its gonads at different maturity stages.

MATERIALS AND METHODS

Detailed description of the study area was given by Olele and Obi, 2003, (Figure-1). Gill and cast nets were used to sample *Synodontis nigrita* from Onah Lake for one year. The lake was divided into stations to enable the sampling of representative population of this species from the lake. Fishing was carried out between 0500 and 0900 hours on each sampling day. The specimens were conveyed to the laboratory in clean plastic buckets. Fish identification was according to existing key (Idodo-Umeh, 2003). Each specimen was measured and weighed to the nearest 0.1 mm and 0.1 g, respectively. The fish was dissected in order to isolate the gonads. The paired gonads were weighed and recorded in grams. One out of the pair of gonad was preserved in Gilson's fluid (Bagenal, 1967) and used for fecundity estimation. The other gonad was immersed in Bouin's Fixative and processed histological according to the techniques of Lal (2001). The average size of fish at first maturity L_{50} was the length where 50 % of the specimens are at an advanced stage lll of their first sexual cycle (Tweddle and Turner, 1977). This assessment was based on previously determined reproductive season which avoids bias in classifying resting females as immature (Panfili *et al.*, 2004). The gonado-somatic index was calculated according to Gomniez-Marquez *et al.*, 2003). Both absolute and relative fecundity were estimated.

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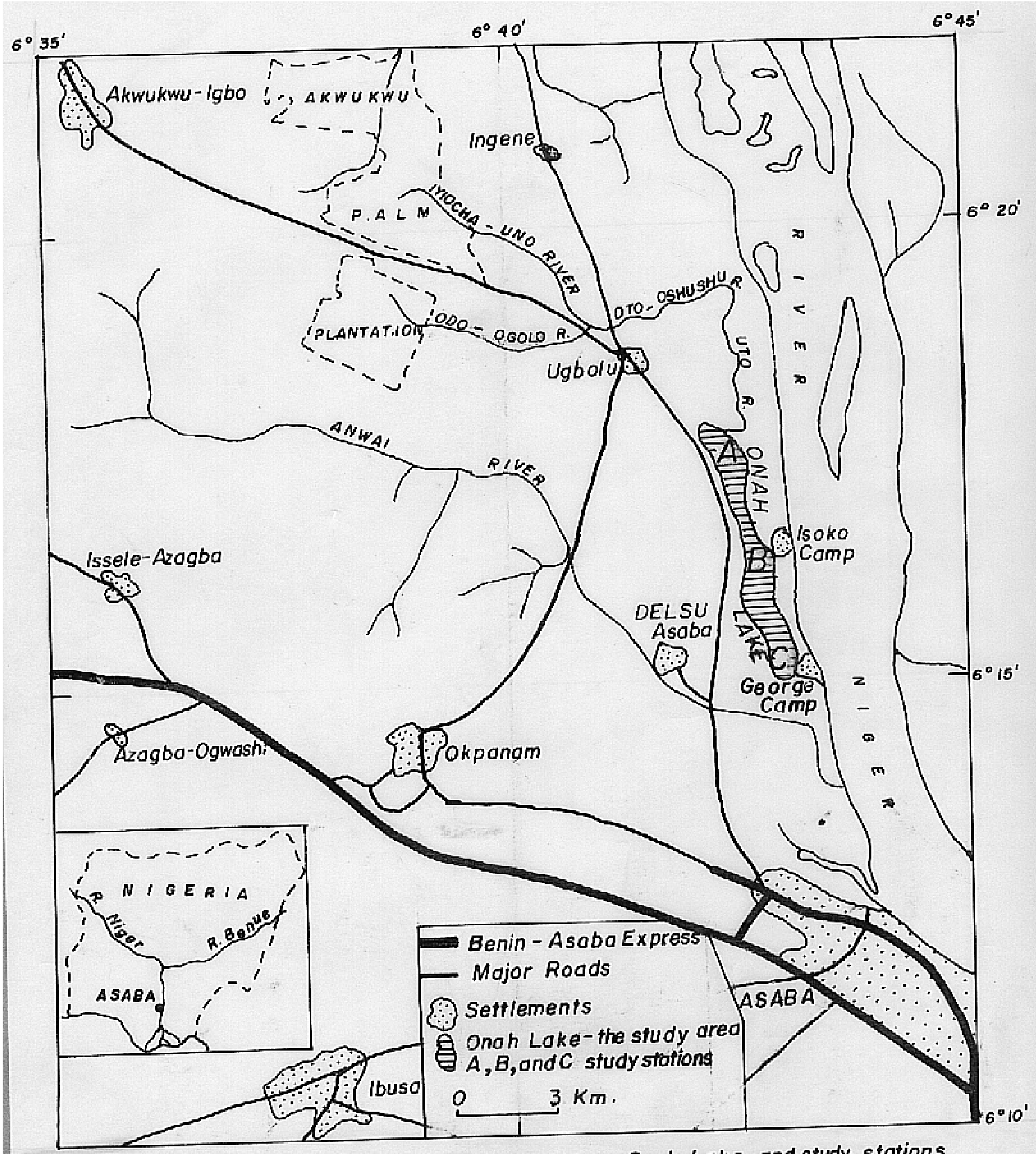

Figure-1. Map of Onah Lake showing the study stations A, B and C.

RESULTS

The result of the present study revealed that 655 specimens possessed observable gonads. The female specimens were 374 while the male specimens were 281 in number. The sex ratios derived from the study was in favor of the female specimens. It gave an average of one male to 1.3 females. This deviation from the expected 1:1 ratio was not statistically significant ($P > 0.05$).

Fourteen size classes were identified (Table-1). The size class where the highest numbers of specimens were encountered was 90.0 to 99.0 mm, contributing 34.8% which makes up 67 males and 161 females. The lowest population was encountered in the size class 200.00 to 209.99 mm. This contributed 0.8%, where only two specimens are male and three specimens are females. The smallest male with matured gonad had a total length of 103.5 mm and a body weight of 36.5g. The smallest female with matured gonad had a total length of 114.7 mm, and a body weight of 42.58g. The length of the fish at sexual maturity was predicted from the graph shown in Figure-2. The graph revealed that the males matured at 122.7 mm, whereas the females matured at 119.00 mm. The average size of the fish at maturity was 120.1 mm.

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Table-1. The size class distribution of specimens used for the study.

Size class (mm)	Male specimen	Female specimen	Both specimens	% Contribution
70.0 - 79.99	-	40	40	6.1
80.0 - 89.99	-	46	46	7.0
90.0 - 99.00	67	161	228	34.8
100.0 - 109.99	48	37	85	12.9
110.0 - 119.99	66	08	74	11.3
120.0 - 129.99	20	34	54	8.2
140.0 - 149.99	8	20	28	4.3
150.0 - 159.99	6	12	18	2.8
160.0 - 169.99	9	7	16	2.4
170.0 - 179.99	5	3	08	1.2
180.0 - 189.99	35	-	35	5.3
190.0 - 199.99	10	-	10	1.5
200.0 - 209.99	2	3	5	0.8
210.0 - 219.99	5	3	8	1.2
Total	**281**	**374**	**655**	**100**

The length weight relationship revealed that there was a significant difference ($P<0.001$) between male and female specimens, expressed thus- Male: Log TW = -4.200 ± 2.72 Log TL (r =0.941); Female: Log T_W = - 4.115 ± 2.614 Log T_L (r =0.91). The *b* value which describes the slope of the regression was less than 3. This was indicative of a negative allometric growth and implied that the fish increased faster in length than in weight.

Morpho-histological examination of the gonads revealed the existence of five maturity stages (Table-2). There were two distinct egg sizes Figure-3F showing the spawning and maturing oocytes. This observation revealed that the fish is a total spawner, releasing almost the same sizes of ripened oocytes during when fully matured. Table-2 shows the developmental stages of gonads for both sexes.

The gonado-somatic index was variable. Matured gonads were observed between the months of May to August, indicating that spawning coincided with the period of the rainy season and period of highest water volume, Figure-4. The spawning period was the same for both sexes. The egg was ovoid in shape with an egg diameter of 1.33 mm and 1.60 mm for ripe and spawning oocytes respectively. The monthly distribution of oocytes as well as a plot of gonado-somatic index against gonad weight showed a peak in August with a gradual decrease from September to October until it dropped finally in November. The egg and ovary were small in size giving rise to a fecundity of 675 - 3642. The egg count was highest in the specimens with total length of 114.7 mm and a body weight of 42.58 g. The specimens with the lowest number of eggs were 161.7 mm in standard length and weighed 60.70g. This implied that the largest specimen was not the most fecund, although such specimens harbored the largest sized oocyte. The relationship between fecundity and fish length and weight was given as F= 5.613, $T_L^{2.17}$ r = 0.813 for males and F= 4.972, $T_L^{2.00}$ r = 0.760 for females. Fecundity data is presented in Table-3.

The relationship between fecundity and total length (r = 0.25); and fecundity and body weight (r = 0.30) was not significant ($P>0.01$). This observation revealed that fecundity was not dependent on fish size or its body weight. However, there was a positive relationship between fecundity and gonad weight (r = 0.71).

DISCUSSIONS

A greater number of female than male specimens were caught in Onah Lake. This observation agrees with that reported by Imevbore, (1970) but contracts with that of (Willoughby, 1977). According to Nikolsky (1963), sex ratio varies annually according to season. Hodgkiss and Hanson, (1978) reported that sex ratio played a considerable role in the determination of breeding activity. Geographical location and ecological habitat has also influenced sex ratio (Willoughby, 1977).

Variation in fish population in different localities using the available gears suggests the influence of inter-related factors: seasonality, recruitment, fishing activity in the regions and changes in fish behavior (guarders). The high population of specimens caught in this study may be due to species reproductive rate and behaviors (guarders). This habit together with decreased predation enhanced fish survival as earlier reported (Ofori-Danson, 1992). Low specimens yield in catches between April and August was due to gradual increase in water level during the inception

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of the rains. This happening created more hiding places for the fishes especially the brood stock which are known to spawns in hiding. However, the present report was not comparable with that of Lalèyè *et al*., (2006) who reported increased catches during April and May. According to them, since this period coincided with the beginning of the rainy season, food and nutrients became abundant through adequate mixing of water body by rapid currents. Such ecological conditions enabled the fish's leave their hiding places, making them vulnerable to catch. The presence of recruits between September and November immediately after spawning in August increased fish abundance in this study. This observation was earlier reported (Motwani, 1970 and Agada, 1986); but contrasts with the observation of Reed *et al*., (1967) and Willoughby, (1979) who reported increased fish abundance from October to January. After the flood, fish abundance decreased due to the reduction in the lake margin suitable for feeding and spawning (Hakanson and Boulian, 2002).

There was significant difference in the length weight relationship of the fish due to sex. This observation agrees with the report of Lalèyè *et al*., (2006). The regression co-efficient (*b* value) in the present study was less than 3 signifying negative allometric growth and implies that the fish became less robust with increase in length. Olele and Obi 2003/2004 reported a positive allometric growth whose *b* value was more than 3. Baijot *et al* (1997) reported that most species have *b* values of 2.5 - 3.5, while Fagade (1979) specifically reported values of 2.9 to 3.4. Differences in regression co-efficient could be influenced by sex, maturity, season and time of the day as a result of stomach content.

The range in size class variation in the present study (80.0 - 210.1mm) contrasts with that reported by Reed *et al* (1967) (250.0mm) in Northern Nigeria. However, it was comparable with that of Tawari-Fufeyin (2009).

Both sexes matured at the same period (August) but they were however not of the same size (103.5 mm Male) and (114.7mm Female). These results were comparable with those of Bishai and Gideiri (1968) and Imevbore (1970). However the present size of fish at maturity (126.0 mm) contrasts with that reported Willoughby (1977). Fish maturation/size class variation was influenced by environmental conditions, physical, biological and genetic factors (Lalèyè *et al*., 2006). These factors accounts for discrepancies observed by different authors. The influence of different environmental conditions on maturity and reproductive traits of fishes have been reported Duponchelle and legendre (2001) and Panfili *et al*., (2004) in other African aquatic system's.

Histological presentation of the various stages of gonad development revealed progressive and steady growth. This was also the nature of development in the gonads of fish samples studied earlier Gomez-Marquez *et al*., (2003); Anene and Keke (2005); Hatikakoty, and Biswas (2006); Sehriban and Erdal, (2007).

The gonado-somatic index (GSI) peaked in August, which showed that spawning probably took place in September/October. These months coincided with the period of flooding in Onah Lake. Such observations are in agreement with the report of Lalèyè *et al*., (2006); but contracts with that of Welcomme (1979); Baras and Lalèyè (2003) on the account that most fishes of floodplain systems spawn well into the rainy season. Both gonado somatic index and oocytes distribution peaked in August, confirming the period of spawning. Again, the presence of fries in September and October was a sign that spawning would have taken place in August. These observations were also reported (Motwani, 1970 and Agada, 1986) in other species. Any differences observed in gonado somatic index was indicative of differences in environmental and climatic conditions of the habitats examined. Fishes spawn during such period of the year when the production of recruits will be maximised (Sehriban and Erdal, 2007).

The fecundity observed in the present study did not show a significant linear relationship with standard length and body weight. However, the relationship was significant between fecundity and ovary weight as well as with gonado somatic index. Wide variation in fecundity was not only attributed to difference in fish abundance and food utilization but had direct bearing with fish of the same species, size and age (Bagenal, 1967). Differences in fecundity maybe due to methods used for their estimation/enumeration (Hatikakoty and Biswas, 2006).

Only two sets of ova diameter were evident: the small developing ones (0.1 - 0.2 mm) and the large developed ones (0.6 - 1.3 mm). This observation indicates that the fish was a total spawner. Lalèyè ***e**t al*., (2006) reported values of 0.8 - 1.5 mm. The highest values (1.15 - 1.20 mm) were reported for *Synodontis batensoda* Tawari-Fufeyin, (2009). Variation in egg diameter has been reported for other tropical fish species (Awachie and Ezenwaji, 1981).

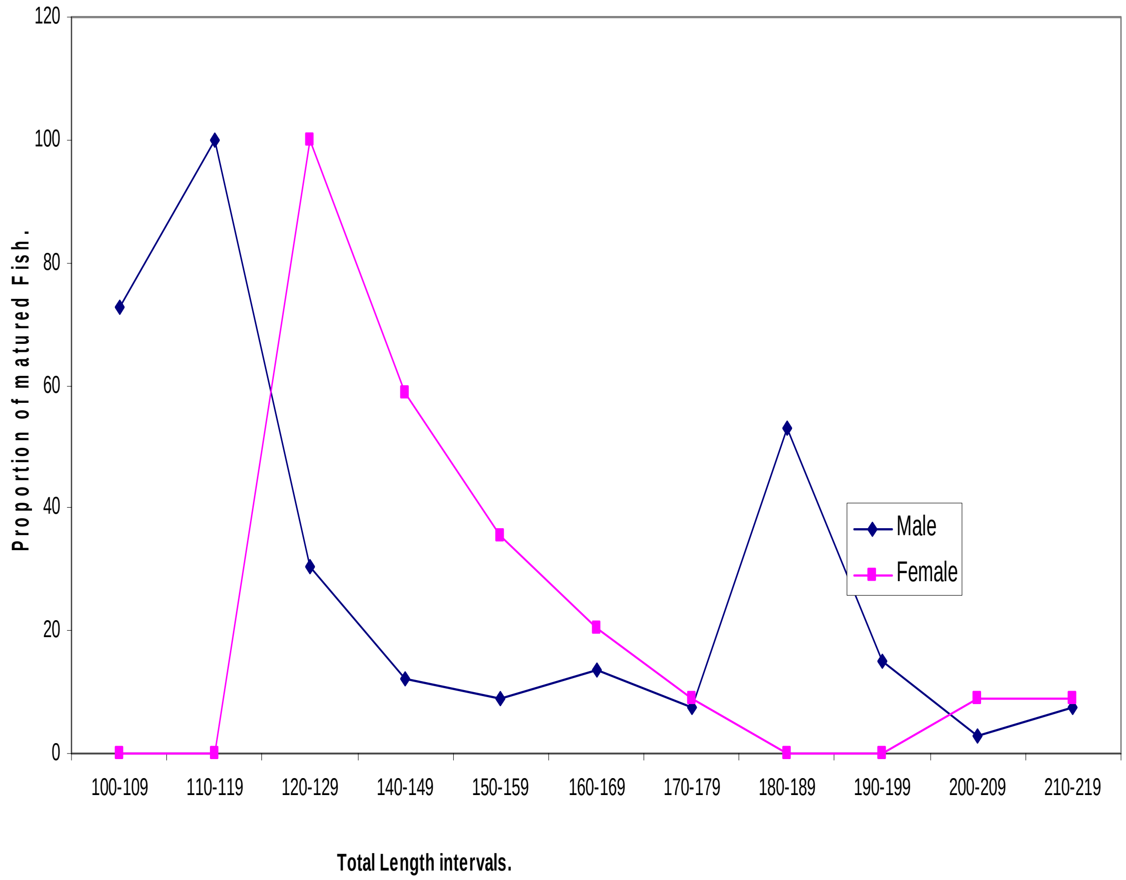

Fig 2 : Percentage frequency of ripe gonad in maturity stages III to IV.

Table-2. Morphology of *Synodontis nigrita* gonads, at different stages of maturity.

Maturity stages	Male gonads	Female gonads
Immature stage.	Sertolit cells which are dominant in nature are prominent. Figure-3aM.	Oocytes cells are small and numerous. Figure-3bF.
Developing stage.	Spermatocyte cells are numerous. Figure-3bM.	Numerous oocytes cells, slightly larger than those of the preceding cells. The nucleus and Balbian bodies are prominent. Figure-3bF.
Pre-spawning stage.	The Spermatid cells are shown. Figure-3cM.	Few matured oocytes about to spawn together with numerous maturing oocytes are shown. Figure-3cF.
Spawning stage.	This is the spawning stage characterized by numerous spermatozoa cells. Figure-3dM.	There is the presence of yolk globules. Figure-3dF.
Post spawning stage.	Empty follicles are shown. Figure-3eM.	The discharging follicle cells are shown. Figure-3eF.

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Male Gonad

Female Gonad

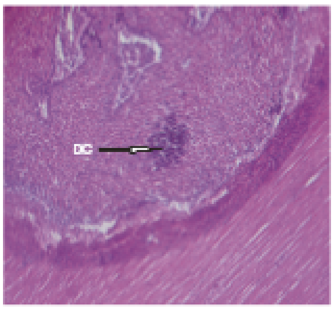

Fig.3aM: Immature/dormant cell

Fig.3aF: Immature/dormant cell

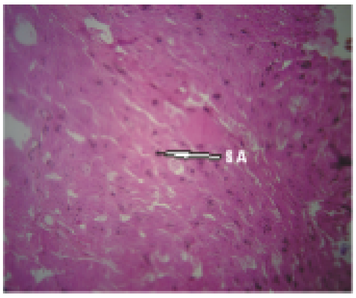

Fig.3bM: Developing phase

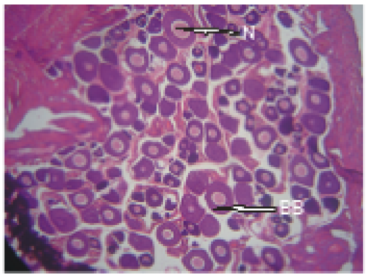

Fig.3bF: Developing phase

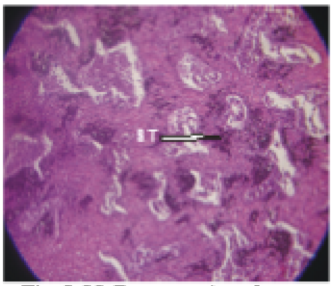

Fig. 3cM: Pre-spawning phase

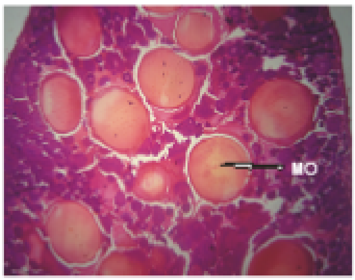

Fig. 3cF: Pre-spawning phase

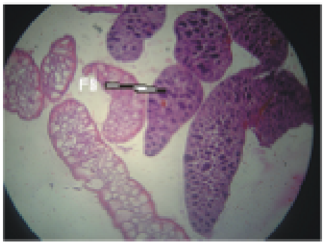

Fig. 3dM: Spawning phase

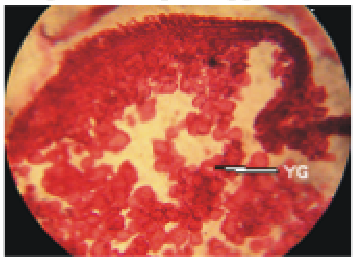

Fig. 3dF: Spawning phase

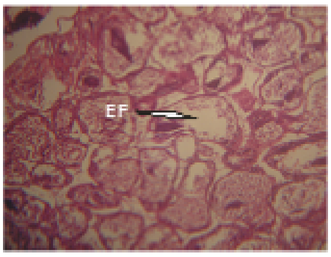

Fig. 3eM: Spent phase

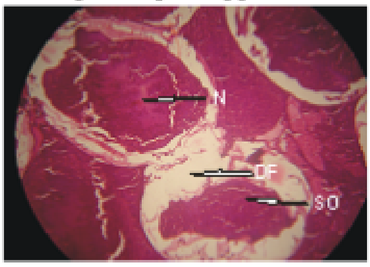

Fig. 3eF: Spent phase

Fig. 3aMF- 3eMF: Photomicrograph and transverse section (Male & Female gonads) of *Synodontis nigrita* (4x10).

DC= Dormant cells, O= Oogonia cells, SA= Spermatocyte stage, N= Nucleus, BB= Balbiani bodies, ST= Spermatid, MO= Matured oocytes, FS= Free spermatozoa, YG= Yolk globules, EF= Empty follicle, DF= Discharging follicles, SO= Shrunken oocyte

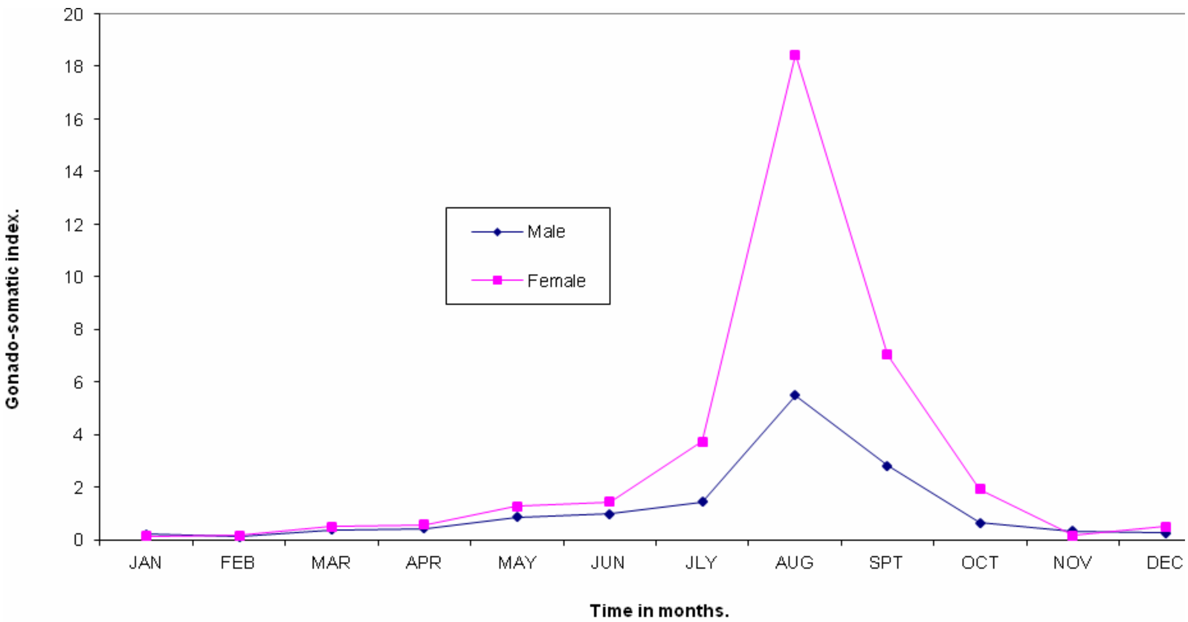

Fig 4: Gonado-somatic index of male and female Synodontis nigrita.

Table-3. Fecundity data for *Synodontis nigrita* caught in Onah Lake.

Total length	Mean ovary wt (g)	Mean body wt (g)	Mean fecundity	Absolute fecundity	Relative fecundity	No of egg/gram of ovary	GSI	Sample size
110.0-125.99	5.2	27.95	2500	89.45	480.7	90	18.6	14
140.0-159.99	6.9	47.50	3167	66.67	458.90	87	14.5	10
160.0-169.99	9.9	62.58	2155	34.44	217.7	69	15.8	01
190.0-199.99	11.8	75.31	3214	42.68	272.4	27	15.6	06
210.0-214.99	13.0	97.90	3742	38.22	287.8	35	13.2	03

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