



CERTAIN REPRODUCTIVE CHARACTERISTICS OF THE ELECTRIC CATFISH (*Malapterurus electricus*, Gmelin, 1789) IN OVIA RIVER, SOUTHERN NIGERIA

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ABSTRACT

The sex composition, gonad morphology and maturation, gonadosomatic index (GSI) and fecundity of *Malapterurus electricus* were studied for a period of six months (May to October, 2014) in Ovia River, Nigeria. Three hundred and thirty-two (332) fish specimens comprising of 147 males and 185 females were examined giving a male to female ratio of 1:1.26. Paired gonads were revealed in both sexes; and four and five gonad maturation stages were observed for males and females respectively. Mean GSI was 0.27 ± 0.24 SD in males and 5.92 ± 6.82 SD in females. Fully matured ovaries were observed from May to September with GSI varying from 7.85 to 15.52. Fecundity varied between 218 and 3216 eggs with an average of 705.42 ± 411.09 SD and it correlated significantly ($P < 0.001$) only with ovary weight. The mean condition factor index (1.39) of the fish population of *M. electricus* showed that the fishes were in good condition to grow and reproduce.

Keywords: Maturity stages, spawning, freshwater, reproductive strategy

INTRODUCTION

Malapterurus electricus, commonly called the Electric catfish, belongs to the Family Malapteruridae. It is widely distributed in Nigeria freshwater bodies. It is used as food, and along the shores of Lake Kainji, smoked *M. electricus* is a popular delicacy (Moller, 1995). *M. electricus* is also used in ethnomedical practice for the healing of ailments, such as dull memory, cancer, stroke, and underdeveloped foetus; it is rated second only to *Clarias* spp. in its usage in ethnocythyological practice (Orilogbon and Adewole, 2011).

Biological studies on *M. electricus* in Nigerian waters are scanty (Reed *et al*, 1967; Sagua, 1978; Akinsanya *et al*, 2007 and Adeniyi *et al*, 2012) and very little is known of its reproductive biology. According to Aroaye (2001) the process of reproduction is inevitable as it helps to replenish the fish population density, which could have remained depleted due to natural and fishing mortality. Comprehensive knowledge of reproductive strategies employed by a species in response to environmental factors (such as pH, dissolved oxygen, turbidity, BOD, electrical conductivity,

mineral content, e.t.c) will determine the degree of survival of that species in such environment (Opadokun and Ajani, 2015). Since the sustainable exploitation and management of this species requires an understanding of its reproduction, this study is aimed at investigating its sex composition, gonad morphology and maturation, fecundity and other reproductive traits in Ovia River.

MATERIALS AND METHODS

Study area

The study was carried out in Ovia River at Ikoro Village in Ovia North-West local government area of Edo State, Nigeria (Fig 1). The River (Latitudes $5^{\circ} 20'$ and $6^{\circ} 35'$ N and Longitudes $5^{\circ} 05'$ and $5^{\circ} 40'$ E) takes its source from Akpata hills in Ekiti State and flows through Ikoro and other villages and towns before draining into the Atlantic ocean via the Benin River. The entire stretch of the river lies in an area with a tropical rainforest climate. The river provides a source of water for domestic use and the major human activities in the area are fishing, farming and trading.

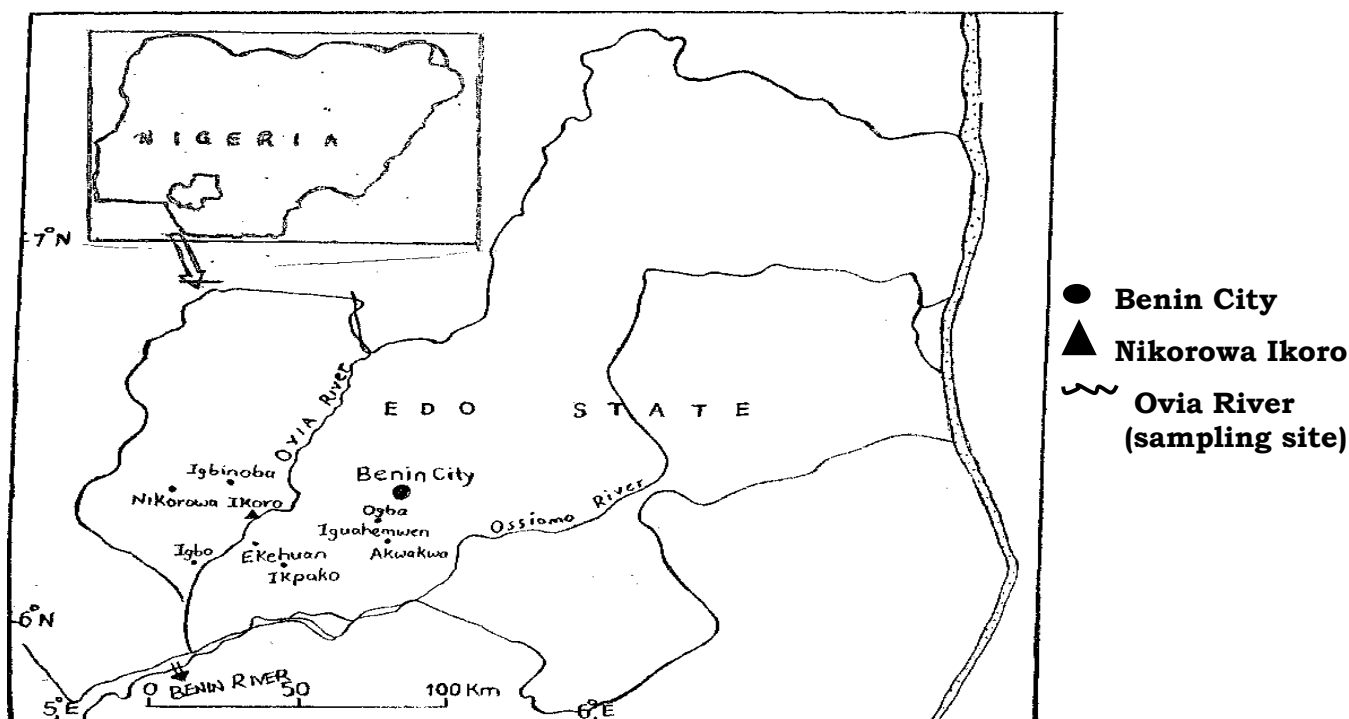


Fig 1: Map of Ovia River showing the sampling site: inset (Map of Nigeria)

Fish sampling

Monthly samples of *M. electricus* were collected from Ovia River for six months (May to October 2014) with the assistance of artisanal fishermen using fishing traps, gill and cast nets of various mesh sizes. Specimens were brought to the University of Benin Laboratory, where morphometric measurements of total and standard lengths were taken to the nearest 0.1cm and specimens weighed to the nearest 0.1g using a top-loading Mettler balance. The fish specimens were dissected, sexed and the state of the gonads were recorded using the keys of Nilkosky (1963). Testes and ovaries were detached and weighed to the nearest 0.01g. Mature ovaries were preserved in Gilson’s fluid and the number of eggs in each pair of ovaries estimated by direct count. Monthly and overall sex ratios of the population were subjected to the chi-square test.

The relationship between fecundity and the total length, body weight and ovary weight was described by the equation.

$$F = aX^b$$

Where F is fecundity, X is the body length in centimeters or body and ovary weight in grams, b is the slope and a is the intercept. The logarithm transformation of the equation is $\text{Log } F = \text{Log } a + b \text{ Log } X$

The gonadosomatic index (GSI) was calculated for each gonad using the formula:

$$GSI = \frac{\text{Weight of gonad (g)}}{\text{Body weight (g)}} \times 100$$

The Condition Factor (K) was computed from the equation:

$$K = \frac{100W}{L^b}$$

Where W = the observed total weight for each fish, L = the observed standard length of each fish. Data in this study were analyzed using the SPSS package version 16.0.

RESULTS

i. Sex composition

A total of 332 fish specimens were examined, of which 147 (44.28%) were males and

185 (55.72%) were females resulting in a sex ratio of 1:1.26 which was significantly different (P<0.05) from the expected 1:1 ratio in favour of females (Table 1). Almost equal proportion of both sexes were observed in all the months of study, except in July were females significantly (P<0.05) outnumbered males.

Table 1: Variation in sex ratio of *Malapterurus electricus* from Ovia River

Month	Total № of fish sexed	№ of Males	№ of Females	Sex ratio (m:f)	χ^2	P -value	Sig.
May	18	8	10	1:1.25	0.222	0.637	P>0.05
June	36	14	22	1:1.57	1.778	0.182	P>0.05
July	75	26	49	1:1.88	7.053	0.008	P<0.05
August	60	25	35	1:1.40	1.667	0.197	P>0.05
September	117	60	57	1:0.95	0.077	0.782	P>0.05
October	26	14	12	1:0.86	0.154	0.695	P>0.05
Total	332	147	185	1:1.26	4.349	0.037	P<0.05

P > 0.05 = no significant difference, P < 0.05 = significant difference

ii. Gonadal Maturation and Gonadosomatic Index (GSI)

Although sampling was not carried out throughout the year, four (I, II, III & IV) and five (I, II, III, IV & V) gonadal developmental stages were observed for males and females respectively (Tables 2 and 3). Spawning male and spent male and female specimens were not encountered. Fully matured female gonads (stages IV and V) were observed from May to September, a period that coincided with the rainy season.

During the study period, the gonadosomatic index (GSI) for males ranged between 0.06% and 1.80% with a mean of $0.27 \pm 0.24\%$ while it ranged

between 0.11% and 25.21% with a mean of $5.92 \pm 6.82\%$ in females of *M. electricus* (Tables 2 and 3). The mean monthly changes in GSI for ripe and spawning females ranged from 7.83 to 15.52%. The maximum value of GSI, which represents the peak spawning period, was in July (Table 4).

The condition factor index (K) of fishes sampled ranged from 0.41 to 3.04 with a mean of 1.39. For matured females, the highest condition index was 1.52 in August and the lowest condition index of 1.27 in June. A condition index of 1.4 shows that, the fish is near spawning.

Table 2: Morphology of the testes of *Malapterurus electricus* at different stages of maturity

	Maturity stage	Length of fish (cm)	Structure and Colour of testes	GSI range	Mean GSI
I	Immature	10.7 – 16.2	Testes are very small, thin, threadlike and cream coloured. They occupy less than $\frac{1}{3}$ of visceral cavity.	0.06 – 0.28	0.14
II	Resting	13.2 – 18.4	Thin, threadlike elongated and light cream coloured.	0.16 – 0.46	0.26
III	Ripening	13.2 – 19.1	Testes are flattened, elongated and cream coloured. Occupy about $\frac{2}{3}$ of visceral cavity.	0.21 – 0.81	0.42
IV	Ripe	18.0	Thicker, elongated and whitish in colour. Occupy almost the whole length of the visceral cavity.	1.80	1.80

Table 3: Morphology of the ovaries of *Malapterurus electricus* at different stages of maturity

	Maturity stage	Length of fish (cm)	Structure and colour of ovaries.	GSI range	Mean GSI
I	Immature	12.5 – 15.3	Small, cylindrical, cream coloured ovaries. Occupy less than $\frac{1}{3}$ of visceral cavity. Oocyte not distinguishable to naked eyes	0.14 – 0.57	0.27
II	Resting	12.0 – 18.0	Same as stage I above, but ovaries are dull yellow in colour.	0.11 – 1.52	0.68
III	Ripening	14.0 – 17.0	Larger, elongated yellowish ovaries with clearly visible oocytes.	0.79 – 7.24	3.72
IV	Ripe	13.0 – 18.3	Very large, yellowish ovaries containing large oocytes and occupying $\frac{2}{3}$ of visceral cavity.	5.68 – 22.16	11.49
V	Spawning	14.4 – 18.5	Very large, deep yellow ovaries occupying almost the whole length of visceral cavity.	12.52 – 25.21	18.66

Table 4: Mean monthly relationship between Gonadosomatic Index (GSI) and Condition Factor (K) for female *Malapterurus electricus*

Month	TF	TG F	MTL ± SD (cm)	MTW ± SD (g)	MGW ± SD (g)	GSI	K
May	10	3	17.5 ± 1.3 (16.0 – 18.3)	78.6 ± 21.5 (53.8 – 91.3)	6.4 ± 4.1 (3.12 – 10.95)	7.83	1.41
June	22	10	16.1 ± 1.6 (13.0 – 17.5)	55.2 ± 17.51 (30.0 - 85)	6.3 ± 2.4 (3.31 – 9.78)	12.11	1.27
July	49	15	16.3 ± 1.5 (14.0 – 18.6)	63.7 ± 21.6 (37.5 – 110.7)	10.2 ± 5.0 (3.17 – 20.08)	15.52	1.42
August	35	19	16.2 ± 1.4 (12.8 – 19.1)	64.2 ± 15.2 (41.5 - 102.1)	9.6 ± 4.0 (3.55 - 18.68)	15.06	1.52
September,	57	3	15.5 ± 0.50 (15.0 – 16.0)	50.3 ± 12.0 (41.5 - 64)	7.3 ± 2.0 (5.99 – 9.6)	14.50	1.36
October	12	---	---	---	---	---	---
TOTAL	185	50	81.6	312	39.8	65.02	6.98

Legend: TF = Total Females, TGF = Total Gravid Females, MTL = Mean Total Length, SD = Standard Deviation, MTW = Mean Total Weight, MGW = Mean Gonad Weight, GSI = Gonadosomatic Index, K= Condition Factor

Fecundity

Fecundity varied between 218 and 3216 eggs with an average of 705.42 ± 411.09 eggs in 50 ripe females of total length range of 12.8 to 19.1cm, body weight of 30.0 to 110.7g and ovary weight of 3.12 to 20.08g.

The relationship between fecundity (F) and total length (TL) and fecundity and body weight (BW) showed no significant correlation

($P > 0.05$) with correlation coefficients (r) of 0.066 and 0.185 respectively (Fig 2 and 3). These relationships are represented by the equations below.

$$\text{Log F} = 2.453 - 0.294\text{TL}$$

$$\text{Log F} = 2.364 - 0.250\text{BW}$$

However, fecundity had a highly significant correlation ($P < 0.001$) with ovary weight ($\text{Log F} = 0.344\text{OW}$) (Fig 4).

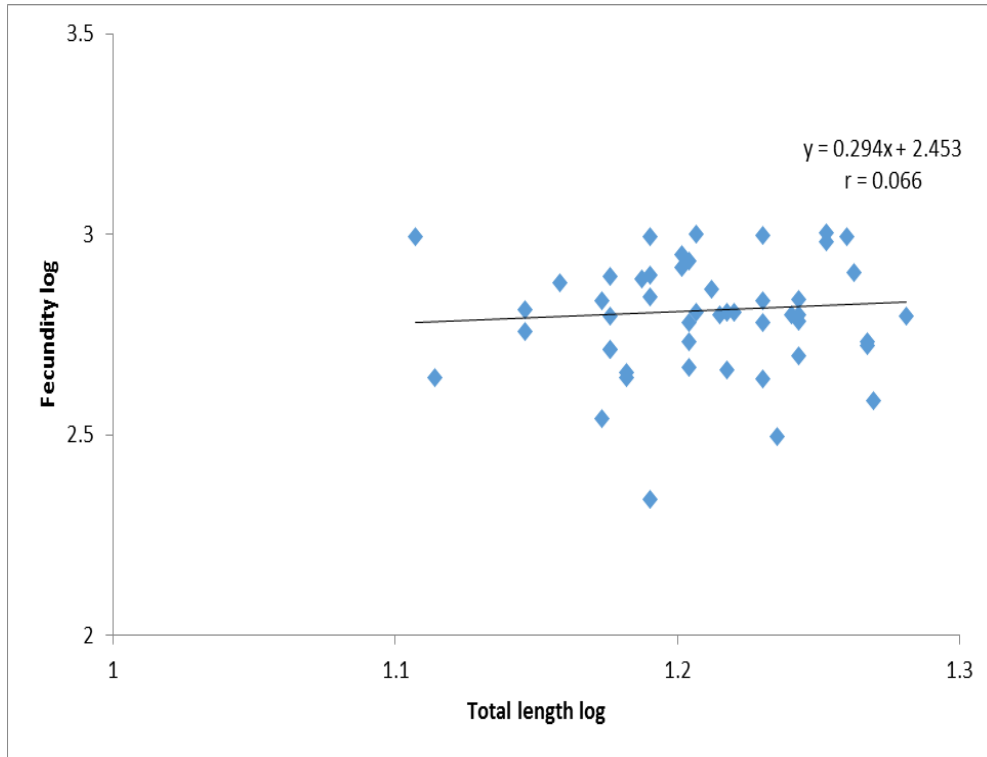


Fig 2: Relationship between fecundity and total length of *Malapterurus electricus*

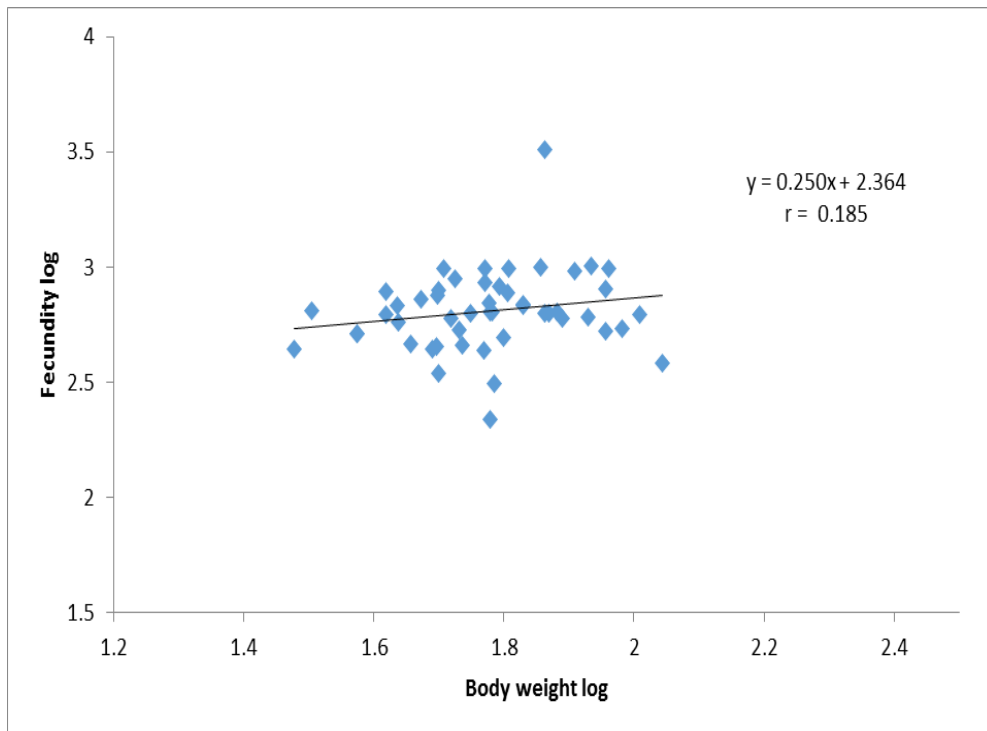


Fig 3: Relationship between fecundity and body weight of *Malapterurus electricus*

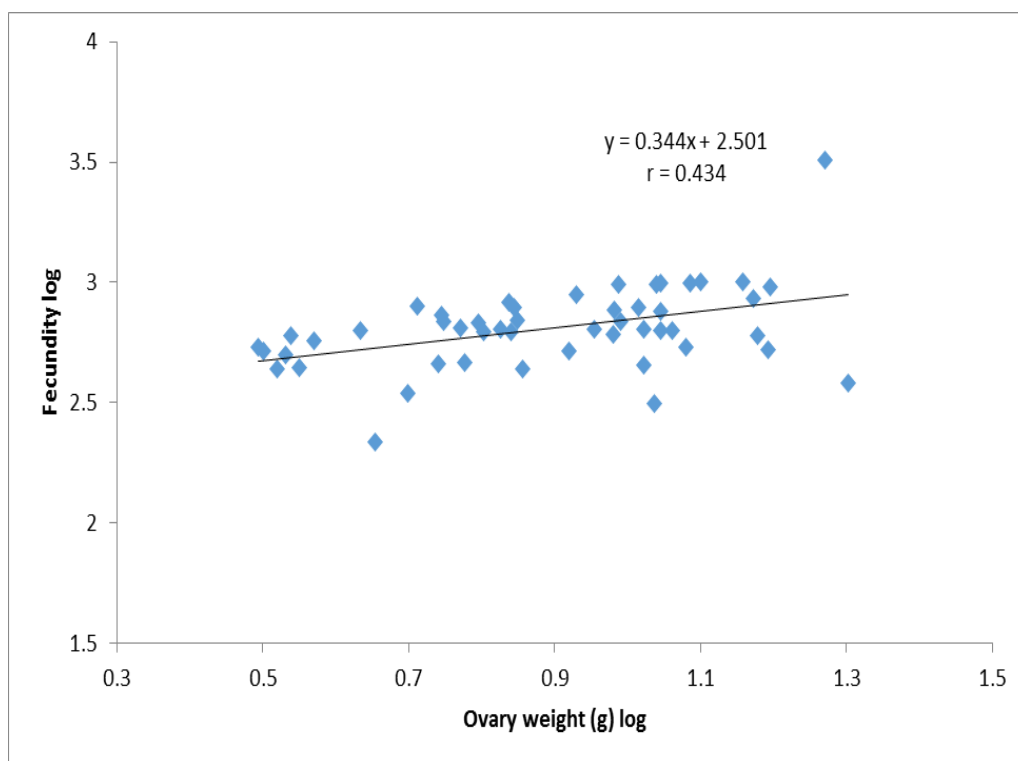


Fig 4: Relationship between fecundity and ovary weight of *Malapterurus electricus*

DISCUSSION

Malapterurus electricus exhibit a paired gonad structure in both sexes, like in most fishes. Sex ratio results indicate that females outnumbered males during the study period, a reproductive strategy to ensure reduced competitions among the males for courtship activities with the females during the season of reproduction (Aroaye, 2001).

All gonad stages were observed with unaided eyes and showed visible morphological changes during development, as observed in most oviparous fishes. Similar observations have been reported by Aroaye (2001) in *Synodontis schall*, Oboh *et al.* (2013) in *Synodontis schall*, Oboh and Omoigberale (2014) in *Chrysichthys furcatus* and Opadokun and Ajani (2015) in *Gymnarchus niloticus*. The presence of fully mature females in the rainy season months of May to September suggest that spawning occurred during this period. This agrees with Olatunde (1989) observation that breeding of most tropical fishes coincided with the rainy season when physico-chemical conditions of the aquatic environment are favourable. This however cannot be

fully ascertained since sampling was not all - year round in the present study.

The observed fecundity range of 218 to 3216 eggs (mean = 705.42 ± 411.09 eggs) appears low when compared with those of other freshwater catfishes: *Synodontis schall* with 10,000 to 90,000 eggs (Halim and Guma, 1989), 7,910 to 64,450 eggs (Aroaye, 2001), 1,530 to 13,965 eggs (Oboh *et al.*, 2013) and *Chrysichthys nigrodigitatus* with 3,046 to 28,086 eggs (Ekanem, 2000). Low fecundity is usually associated with parental care during development of embryo and fry. Among equal sized fish, fecundity varied remarkably: fish measuring 17.0cm in total length at different times had ovary weights of 9.78g, 7.19g, 3.46g, and 12.19g; and produced 684 eggs, 436 eggs, 602 eggs and 992 eggs respectively. Similar observations have been reported by Saha and Saha (2011), Gupta and Banerjee (2013), Oboh and Omoigberale (2014) and Pal and Mahapatra (2016) in different fishes and this may be due to variation in age, condition factor, availability of space and food etc.

The observed dispersion in the relationship of fecundity and total length and body weight may be as a result of the inclusion of fish for fecundity estimates which have already spawned at least once and so gave a low egg count (Siddiqui, 1979). The mean GSI value in this study indicates that *M. electricus* utilizes 5.29% of its body weight in egg production. In each mature ovary, the large oocytes were rounded, yellowish and of almost uniform diameter, an indication of total spawning in *Malapterurus electricus*.

The condition factor which reflects the well-being of a fish, can be affected by factors like sex, season, age and maturity stages of fish (Edal *et al*, 2010). However, in the present study, the mean condition factor index (1.39) of the fish population of *Malapterurus electricus* showed that the fishes were in good condition to grow and reproduce.

CONCLUSION

The findings of this study clearly revealed that *M. electricus* has paired gonads in both sexes. Fully matured ovaries occurred between May to September, a period that coincided with the rainy season. A fecundity range of 218 to 3216 eggs is low when compared to other fresh water catfishes and it utilizes 5.29% of its body weight for egg production. The present study therefore contributes important baseline data on the reproductive biology of *M. electricus* in Nigeria.

REFERENCES

- Adeniyi, S. A., Orjiekwe, C. L., Ehiagbonare, J. E., Josiah, S. J. (2012). Nutritional composition of three different fishes (*Clarias gariepinus*, *Malapterurus electricus* and *Tilapia guineensis*). *Pak. J. Nutr*, 11(9): 793 - 797.
- Akinsanya, B., Otubanjo, O. A. and Hassan, A. A. (2007). Helminth Parasites of *Malapterurus electricus* (Malapteruridae) from Lekki Lagoon, Lagos, Nigeria. *Journal of American Science*, 3(3): 5 - 10.
- Araoye, P. A. (2001). Morphology of the gonads in the reproductive cycle of *Synodontis schall* (Pisces: Mochokidae) in Asa Lake Ilorin, Nigeria, *Journal of Aquatic sciences*, 16(2): 105-110.
- Edah B. A., Akande A. O., Ayo-Olalusi, C., and Olusola, A. (2010). Computing the wet – dry weight relationship of *Oreochromis niloticus* (Tilapia). *Internet Journal of Food Safety*, 12: 109 - 117.
- Ekanem, S. B. (2000). Some reproductive aspects of *Chrysichthys nigrodigitatus* (Lacepede) from Cross River Nigeria. *NAGA, the ICLARM Quarterly*,

23(2): 24-27.

Gupta, S. and Banerjee, S. (2013). Fecundity study of *Amblypharyngodon mola* (Ham.-Buch., 1822) from an Undisturbed Wetland of West Bengal. *Fishing Chimes*, 33(6): 67- 69.

Halim, A. I. A. and Guma, S. A. (1989). Some aspects of the reproductive biology of *Synodontis Schall* (Bloch-schneider, 1801) from the White Nile near Khartoum. *Hydrobiologia*, 179(3): 243 - 251

Møller, P. R. (1995). *Electric fishes: history and behaviour*. Chapman and Hall, London. 584pp.

Nilkosky, G. V. (1963). *The Ecology of fishes*. London Academic Press. 352pp.

Oboh, I. P. and Omoigberale, M. O. (2014). Fecundity and spawning frequency of *Chrysichthys furcatus* Gunther, 1864 (Osteichthyes: Bagridae) from Jamieson River, Nigeria. *Peak Journal of Agriculture Sciences*, 2(2): 21-29.

Oboh, I. P., Ogbeibu, A. E. and Ogoanah, S. O. (2013). Gonadal development, fecundity and spawning pattern of *Synodontis schall* (Pisces: Mochokidae) from Jamieson River, Nigeria. *Research and Reviews: Journal of Zoological Sciences*, 1(2): 13 - 23.

Olatunde, A. A. (1989). Some aspects of the biology of *Synodontis schall* (Bloch and Schneider) in Zaria, Nigeria. *J. Aquat. Sci*, 4: 49-54

Opadokun, I. O. and Ajani, E. K. (2015). Some aspects of the reproductive biology of *Gymnarchus niloticus* Cuvier, 1829 (Knife fish) in Lekki Lagoon, Nigeria. *International Journal of Fisheries and Aquatic Studies*, 2(3): 166 -170.

Orilogbon, J. O. and Adewole, A. M. (2011). Ethnoichthyological knowledge and perception in traditional medicine in Ondo and Lagos States, Southwest Nigeria. *Egyptian Journal of Biology*, 13: 57- 64.

Pal, M. and Mahapatra, B. K. (2016). Fecundity and GSI of Mourala, *Amblypharyngodon mola* (Hamilton-Buchanan, 1822) from South Bengal district of West Bengal, *International Journal of Fisheries and Aquatic Studies*, 4(5): 47- 53.

Reed, W., Burchard, J., Hopson, A. J., Jenness, J. and Yaro, I. (1967). *Fish and Fisheries of Northern Nigeria*. Kaduna Ministry of Agriculture. 226pp.

Sagua, V. O. (1978). Observations on the food and feeding habits of the African electric catfish;

Malapterurus electricus, *J. Fish. Biol.*, 15: 61 - 69.

Saha, B. K. and Saha, A. (2011). Fecundity and gonadal maturity of Gongota Loach *Somileptes gongota* (Hamilton) (Cobitidae) from Netrakona

water. *Bangla J Sci Ind Res*, 46(4): 573 -578.

Siddiqui, A. Q. (1979). Reproductive biology of *Tilapia zilli* (Gervais) in Lake Naivasha, Kenya. *Env. Biol. Fish*, 4(3): 257 - 262