Global Science Research Journals

ISSN: 2408-5464 Vol. 6 (2), pp. 455-466, April, 2018

http://www.globalscienceresearchjournals.org/

Global Journal of Fisheries and Aquaculture

Full Length Research Paper

Gonado-somatic index, sex ratio and fecundity of *Chrysichthys nigrodigitatus* of Cross River at Ahaha, South – South Nigeria

***Okey IB, Ikpi GU and Usor E**

Department of Fisheries and Aquatic science, Cross Rivers University of Technology, Obubra Campus, P.M.B. 102, Calabar
*Corresponding Author. E-**mail**: piusbass@yahoo.com

Accepted 23 January, 2017

This study was to investigate some aspect of the reproductive biology of *C. nigrodigitatus* of Cross River at Ahaha. Fish samples were collected from the fishermen at their landing site at Ahaha beach between June and November 2014 using various types of fish gears. One hundred and ninety six (196) specimens were collected and taken to the laboratory for gonado somatic index, sex identification, length-weight and fecundity studies. Linear regression was used to determine the relationships between length, weight and fecundity. The overall sex ratio of approximately 1:2 in favour of females was obtained. The females recoded a higher weight ranged of 96.90 – 608.20g than males with 83.20 – 564.40g. The regression equation shows a negative allometry for both sexes with the male showing a better growth coefficient (1.44) than female (1.34). Out of the 129 females specimen sampled 64 (49.61) were gravid indicating a fairly high percentage of fecund fish. Fecundity ranged from 1,682eggs in fish with total length of 19.80cm and body weight of 168.60g to 16,039eggs with total length of 49.30cm and weight 605.30g. The highest monthly absolute fecundity of 32,436eggs in September is an indicating the peak spawning period for *C. nigrodigitatus*. The relative fecundity ranged from 48.26 to 104.32eggs/cm and 3.71to 8.68eggs/g total length and body weight respectively. The gonado-somatic index ranged from 2.49 – 10.31g with the highest recorded in the month of September. The GSI increase gradually from June to August and starts decreasing to November, while the monthly condition factor which ranged from 0.82 – 2.81 shows a decreases as the gonad weight increased. The study provides a baseline information on some aspects of reproduction which is important in the management of *C. nigrodigitatus* and will recommend further study on the food habit as to determined it suitability as aquaculture candidate.

Keyword: Reproductive Biology, Sex Ratio, Gonado- Somatic Index, Fecundity, *Chrysichthys nigrodigitatus*, Cross River

INTRODUCTION

Chrysichthys nigrodigitatus commonly known as silver catfish, "Inagha" by the Efiks and Ibibios tribes and "three bone fish" in the central Cross River, Obubra inclusive. It belongs to the family Bagridae and occurs in most major rivers of Africa including Nigeria, Senegal, Cambia, Ivory Coast, Zaire and Gabon (Ezenwa, 1981). It is appreciated by consumers for its taste and flesh quality and is mostly sold fresh or smoked and used in traditional and continental dishes (Eyo *et al.,* 2013). According Andem *et al*., (2013) and Offem *et al.,* (2008), *C. nigrodigitatus* is known to be the most dominant fish in commercial catches exploited in both artisanal and trawl

fishery of the Cross River, however, this had not been the case of recent due to its high exploitation. Because it is a highly valued food-fish in Cross River State, Nigeria and other West African countries (Ezenwa, 1981; Hem, 1986; Obiekezie and Enyenihi, 1988), with high demands, the natural stock has been reduced (Francis, 2003). The population of many fish species are on the decline, with some grouped into threatened or endangered species category (Francis and Elewuo, 2012). Many factors such as over fishing, habitat loss and degradation, pollution, introduction of exotic and non-native species have been attributed to this decline. According to Stiassny (1981) a number of fresh water fishes that may become extinct within the next 20-30 years are estimated at 300 species, if frequency biological assessment studies are not conducted to enhance proper management procedure. Reproductive biology of fish is an essential factor that enables the determination of the appropriate management practice which should be done to conserve species of fish in their habitat. Reproductive strategies depend on the abiotic environment, food availability, pressure of predators and the habitat of parental fish (Wootton, 1990). The study of fecundity is useful in the estimation of population and productivity. Gonadosomatic Index (GSI) is the measure of the relative weight of the gonad with respect to total or somatic weight (King 1996). The gonado-somatic index is reliable indicator of gonadal state of fish. The gonado - somatic index is particularly helpful in identifying the time and season of spawning as the ovaries of gravid females swiftly increases in size just prior to the spawning (Jaya and Saksena, 2013). The utility of gonadosomatic index as the indicator of the reproductive activity of the stock has been studied of different fish species (Saksena, 1987; Jaya and Saksena, 2013; Oso *et al.,* 2013, Okafor, 2011).

Fecundity of any animal is an adaptation which ensures the survival of species under the condition in which it has been evolved and lived (Jaya and Seksena, 2013). Knowledge about fecundity of a fish has been an essential feature for evaluating the commercial potentialities of its stock, egg production, life history, culture and management of the fishery. The measure of fecundity in fishes is a basic determinant of productivity and contributes to the development of pisciculture. Fecundity estimates are important for understanding the dynamics of fish population predicting trends in population abundance and estimating spawning stock biomass (Eldridge and Jarvis, 1995). The knowledge of fecundity can also species give useful information whilst planning a breeding programme of that species. This is because it enables one to predict the number of eggs that could be spawned or stripped, the type of rearing facilities that should be required, and the extent to which various fish culture equipment could be put into use (Eyo and Mgbenka, 1992). The determination of the fecundity of a particular fish species may also be employed in estimating the population of that species of fish and in some taxonomic and racial fish studies (Bagenal, 1979). Several studies have been carried out on the fecundity of some fishes found in Nigerian waters. Such works include those of Oboh and Omoigberale (2014), Francis and Elewuo (2012), Ikpi and Okey, (2010), Offem et al (2008), Egwui, *et al.* (2007) and Allison *et al* (2008). Several scientists have also researched on the reproductive biology of *C. nigrodigitatus* including Ekanem (2000); Aransiola (1989), Ezenwa *et al.,* (1986), Offem *et al.,* (2008). Disparities in the fecundity of *C. nigrodigitatus* recorded were attributed to some biological and environmental factors. After a comparative study of *C. nigrodigitatus* at various locations Ezenwa *et al*. (1986) showed that egg size, fecundity and condition factor varied with individual fish and location. They established that the population of *C. nigrodigitatus* in Warri River produced larger eggs and had higher fecundity than those from other locations.

Gonadosomatic index (GSI) is one of the parameters used in reproduction studies of fish. The use of GSI to detect hydrated ovaries and therefore detect reproductive period from increase in weight has been established by Hunter and Macewicz (2001).

Several workers have reported on the GSI, fecundity and egg size of different fish species from Nigerian waters and these include Ikomi (1996); King (1996 and 1997); Ikomi and Odum (1998); Shinkafi *et al*. (2002); Saliu and Fagade (2003); Anene and Okorie (2008) and Fawole and Arawomo (2009). Total spawners are said to produce a large number of small eggs which are deposited over short period of time while multiple spawners produce fewer and larger eggs and with a longer breeding period which may last throughout the year, where only a proportion of the eggs ripe in the gonad at one spawning (Lowe-McConnell, 1987), though total spawners are said to have a higher GSI than multiple spawners (Wootton, 1990). The percentage of body weight of fish that is used for egg production is determined by the gonadosomatic index.

Sex ratio is expressed by using that ratio of the male and female individual in the population. Sex in fishes can be determined by both environmental and genetic factors. Most researchers have reported sex ratios in favour of female populations. The studies on sex ratio provides information on the proportion of male to female fish in a population, it also indicates the dominance of sex in s given population and the basic information necessary for fish reproduction and stock size assessment (Vicentini and Araujo, 2003). Onah (2013), Ikpi and Okey (2010) reported sex ratios in favour of females populations of *M. rume* and *L. coubie* respectively from Cross river at Ahaha.

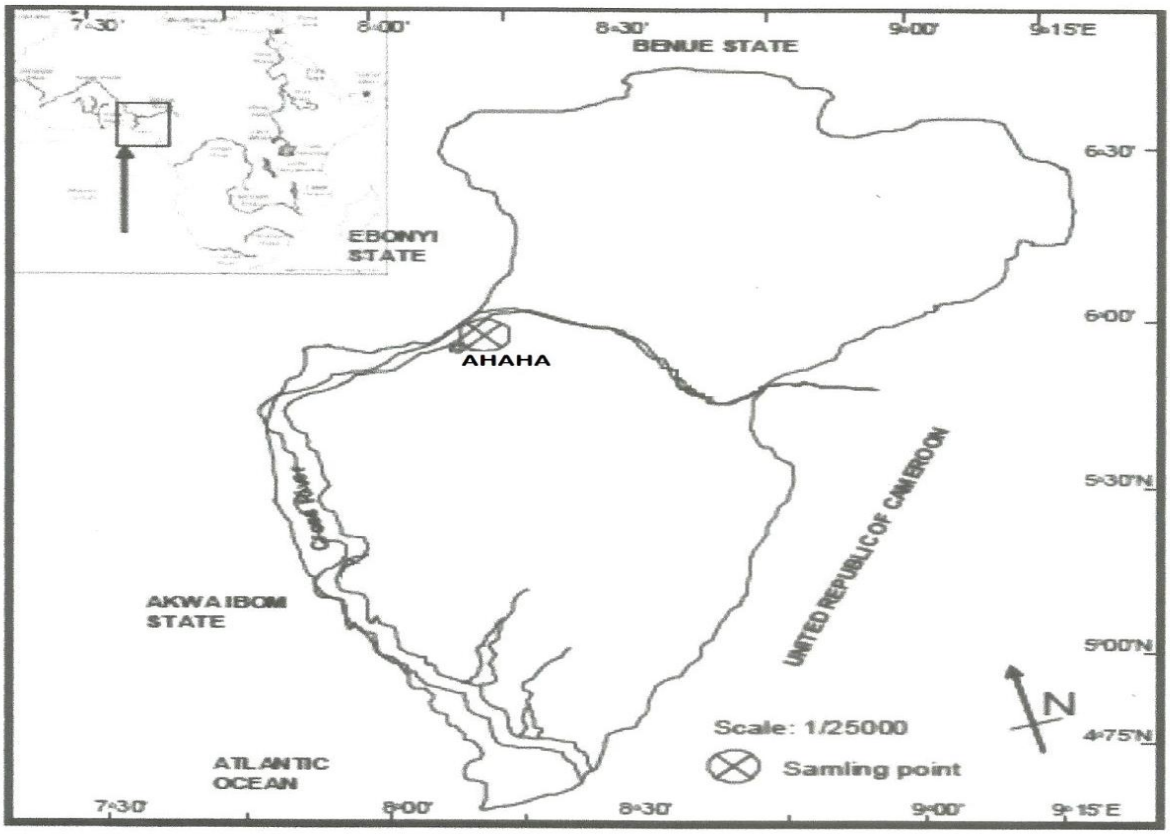
Due to the dwindling nature and the complaint by fishermen on the reduction of the resources over the years it became obvious to embark on this study to provide information on the current status of this species in the study area for proper management and conservation in the Cross river tributary. This study is

therefore to investigate some aspect of the reproductive biology of *C*. *nigrodigitatus* of Cross River at Ahaha.

MATERIALS AND METHODS

Study Area

Study was conducted at the major tributary of Cross River flood plain at Ahaha in Obubra Local Government Area. The Cross River is located at the South-Eastern part of Nigeria on latitude 4^0 15' – 7^0 00'N and longitude $7^0$15' – 9^0 30'E (Figure 1). Hydrologically, the whole Central Southern part of Cross River State is dominated by the drainage basin within Nigeria of 40,000km^2 (Offem *et al.,* 2008). The Cross River lies in an area within the tropical rainforest climate with two main seasons, the raining and dry seasons. The wet season is characterized by high precipitation between April – October, while the dry season extends from November – March and is marked by low precipitation. Fishing, petty trading, civil service and farming have remained the traditional occupation of the people in the study area. Ahaha is the main fish landing site maybe due to it stony beach and accessibility to both Cross River and Ebonyi States. Gears mostly use by fishermen in the study area constitutes principally beach seine nets, gills nets, cast nets, hook and lines. Fishing at Ahaha is basically artisanal with fishermen using non-motorized boat to carry out fishing both in the day and night. Their catches are mostly dominated by fishes of the family. Claridae, Bagridae, Cichlidae, Characidae, Mormyridae, Cyprinidae, Synodontidae and Osteoglosidae.



MAP OF THE CROSS RIVER MAIN TRIBUTORY SHOWING THE STUDY AREA.

Fish samples

Fish samples for this study were collected for six months between June-November 2014. They were obtained from catch landings of fishermen who fished both day and night using mostly artisanal fish gears such as beach seines, gill nets, cast nets, fish traps, hooks and lines. The samples were identified fresh immediately after collection using the FAO (1981) and Idodo- Umeh (2003) identification chart and transported in an ice box from the landing site to Wet Laboratory of the Department of Fisheries and Aquatic Science, CRUTECH, Obubra for further examination.

Determination of Length – Weight and Sex Ratio

The length and weight of the specimens were measured using a measuring board and weighing balance respectively. The sex of each sample was identified by visual examination and separated based on external morphology. The sex ratio was calculated according Oso *et al*, (2013) using the formula

$$\text{Sex ratio} = \frac{\text{Number of female}}{\text{Number of male}}$$

Determination of gonado- somatic index and fecundity

The gravid females were dissected and the ovaries was detached and weighed to the nearest 0.0lg for gonado-somatic index (GSI) study. The data on the body and gonad weights was used to compute the gonado- somatic index according to king (1995) and Howaida *et al*, (1998).

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

Fecundity was determined by preserving the ovaries in a Gilson's fluid for one week. The fluid enhances the separation of the ova from the ovarian tissues. The eggs were removed, cleaned thoroughly be rinsing with 70% alcohol and distilled water and blotted dry (Bagenal, 1978). The numbers of eggs in each ovary was determined by gravimetric method (direct enumeration) according to Bagenal, 1978). A sub-sample of known weight will be collected and the number of eggs in that sample counted and multiplied by the weight of the whole gonad. Fecundity was calculated according to the formula of Le Cren (1951)

$$F = \frac{\text{Weight of gonad (g)}}{\text{Weight of sub- sample (g)}} \times N \text{ (Number eggs in the sub- sample)}$$

Data Analysis

Chi-square was use to estimate the monthly and overall sex ratios of the population using the statistical package (SPSS version 20) to show any deviation from a ratio of 1:1 Scatter diagrams of length and weight of both sexes, fecundity against total length, body weight and GSI of gravid females were plotted using linear regression technique and the best predictive equation for fecundity was computed as logarithm transformation of the equation.
The formula $Y = a + bX$ (Steel and Tourrie, 1980), and the curve described by the formula $Y = aX^b$
Where:
X= total length (TL), body weight (BW), Y= Fecundity (F), a = constant, b = exponent.

RESULTS

Sex Ratio

A total of 196 samples were examined of which 67 (34.18%) were males and 129 (65.82) were females giving an overall ratio of 1:1.93 though not significantly different from the expected ratio of 1:1. However fluctuation occurred from month to month with female dominance except in November where male were more than female although not significant (P>0.5). The values of the chi square (x^2 = 3.46) were significant (P< 0.5) across the months except for the months of June and November (Table 1).

Table 1: The sample size and sex ratio of *Chrysichthyes nigrogiditatus* of Cross River and Ahaha

Month	Sample Size	M	F	Sex Ratio (M:F)	Chi Square (X^2)
June	23	8	15	1:1.88	3.26
July	47	15	32	1:2.13	4.38*
Aug	41	13	28	1:2.15	4.65*
Sept	36	11	25	1:2.27	6.13*
Oct	26	8	18	1:2.25	5.44*
Nov	23	12	11	1:0.92	2.18
Total	196	67	129	1:1.93	3.46

X^2 = 3.46; * Significant at P < 0.05

Length- weight relationship of the *C. nigrodigitatus* of Cross River.

Length- weight relationship of the sexes is expressed by the following regression equations (Table 2). The length ranged from11.60 – 56.10cm, 9.80 – 41.20cm and 19.80 – 49.30cm for females, males and gravid specimens respectively. The females recorded a higher weight ranged of 96.90 – 608.20g than males with 83.20 – 564.40g. The regression equation (growth coefficient) indicates a negative allometric growth pattern for the both sexes with male showing a better growth coefficient (1.44) than female (1.34). The regression analysis shows a high correlation values of r^2 = 0.90 and 0.86 for females and males respectively. This shows a very high association between weight and length of *C. Nigrodigitatus* in the study area.

Table 2: Regression model for different variables of Length and Weight of C. *nigrodigitatus* of Cross River at Ahaha.

Variables	Regression Model			Range	Sample Size	R^2
L/W (Female)	LogW= 1.340LogL	0.498	+	11.60-56.10cm, 96.90-608.20g	129	0.90
L/W (Male)	LogW= 1.435LogL	0.391	+	9.80-41.20cm, 83.20-563.4g	67	0.86
L/W (Gravid)	LogW= 1.495LogL	0.249	+	19.80-56.10cm, 168.60-608.20g	64	0.98
L/W (Combined)	LogW= 1.367LogL	0.465	+	9.60-56.10cm, 83.20-608.20g	196	0.88

L = Total Length, W = Body Weight

Fecundity, Gonado Somatic Index (GSI) and Condition factor

Fecundity, gonado-somatic index and condition factor were estimated for 64 gravid female specimens of *C. nigrodigitatus*; ranged in length between 19.80-56.10cm and weight 168.60-608.20g. Out of the total number of 129 females sampled 64 (49.61%) were fecund indicating a fairly high per cent of fecund fish**.** The fecundity ranged from 1,682 in fish with total length 19.80cm and body weight 168.60g to 16,039 eggs with length 49.30cm and weight 605.30g. The highest absolute fecundity of *C. nigrodigitatus* of 32,436 eggs was recorded in September and the lowest of 9048 eggs in November, (Figure 2).

The mean monthly fecundity shows that the highest mean of 2857.45±56.47 eggs was recorded at the month of September while the least mean of 1519.33±11.47eggs was in June. The mean total length and weight showed that the highest of 32.53±6.84cm and weight 483.63±74g was recorded in October while the least was in November. The monthly relative fecundity per total length (F/L) and gram weight (F/w) ranges from 48.26 to 104.32 eggs/cm and 3.71 to 8.68 eggs/g respectively the highest relative fecundity per length was recorded September while the least was in July (Table 3). The gonado-somatic index ranged from 2.49 – 10.31g with the highest mean of 6.43 ±7.21g recorded in the month of September. The GSI increase gradually from June to August and started decreasing to November. The condition factor ranged from 0.82-2.81and its monthly variation shows a decrease with increase in the gonad weight (Figure 3).

Relationships of Fecundity and Gonado somatic index on total Length and body weight of *C. nigrodigitatus* from Ahaha in Cross River, Nigeria

The relationships of the various reproductive parameters on length and weight of gravid specimens is shown in Figures 4-7. The regression equations of the parameters is also shown in Table 4. The relationship revealed that fecundity on length and weight were more related than those of gonadosomatic index. The regression equations for fecundity/ total length and fecundity body weight are: F = 2.08 LogL+ 0.267, r^2= 0.90 and F = 1.41 LogW – 0.114, r^2= 0.94 while those of GSI against length and weight are: GSI = 0.161 LogL+ 0.614, r^2= 0.017 and GSI = 0.157 LogW+ 0. 477, r^2= 0.021 respectively. the positive correlation value recorded for the both fecundity and GSI for the parameters of length and weight is an indication that increase in weight and length will subsequently result to an incerase in fecundity and GSI of *C. nigrodigitatus* specimens. Higher correlation were obtained between the fecundity on length and weight than with GSI. However, the correlation between fecundity against body weight (r^2= 0.94) was higher than against total length (r^2= 0.90). the relationship between GSI on length and weight also revealed a highher correlation value againnst weight (r^2= 0.021) than length (r^2= 0.017).

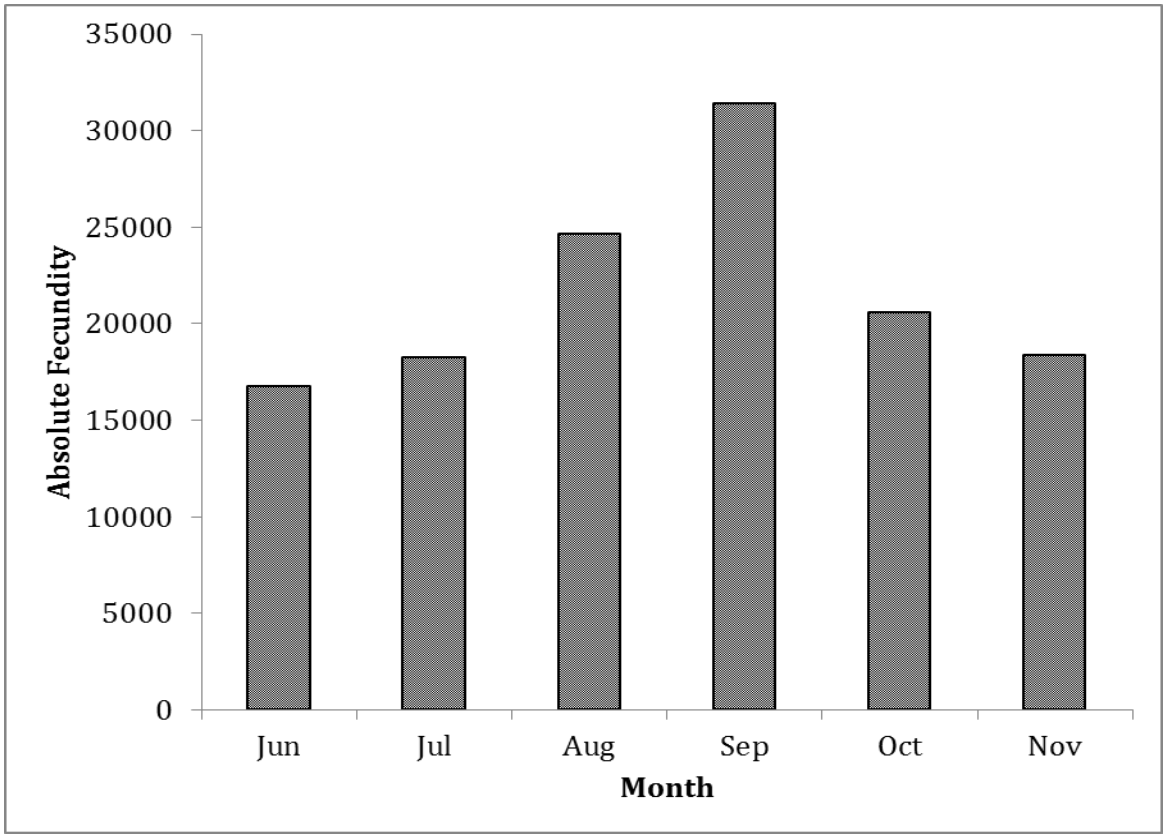


Figure 2: Monthly variation in absolute fecundity of *C. nigrodigitatus* of cross river at Ahaha 2014

Table 3: Mean monthly variation in sample size, fecundity and relative fecundities of gravid females *C. nigrodigitatus* of Cross River at Ahaha.

Month	Sample Size	Mean Length (cm)	Mean Weight (g)	Mean Fecundity	Mean GSI	Relative Fecundity (F) (F/L)	(F/W)
June	9	29.74 ± 5.28	243.26 ± 12.69	1865.11 ±28.46	2.14 ±3.42	62.71	5.43
July	12	31.48 ±10.86	409.42 ±8.39	1519.33 ±11.47	2.63 ±1.72	48.26	3.71
Aug	15	25.82 ±11.72	317.93 ±19.41	1642.13 ±8.41	3.23 ±2.19	63.60	8.68
Sept	21	27.41 ±17.08	329.09 ±14.43	2857.45 ±56.47	6.43 ±7.21	104.32	5.91
Oct	19	32.53 ±6.84	483.63 ±5.74	2281.78 ±17.38	5.51 ±2.88	70.14	4.71
Nov	8	24.08 ±2.24	301.33 ±4.28	2295.50 ±38.42	3.37 ±6.74	95.33	7.62
TOTAL	N = 64 gravid females						

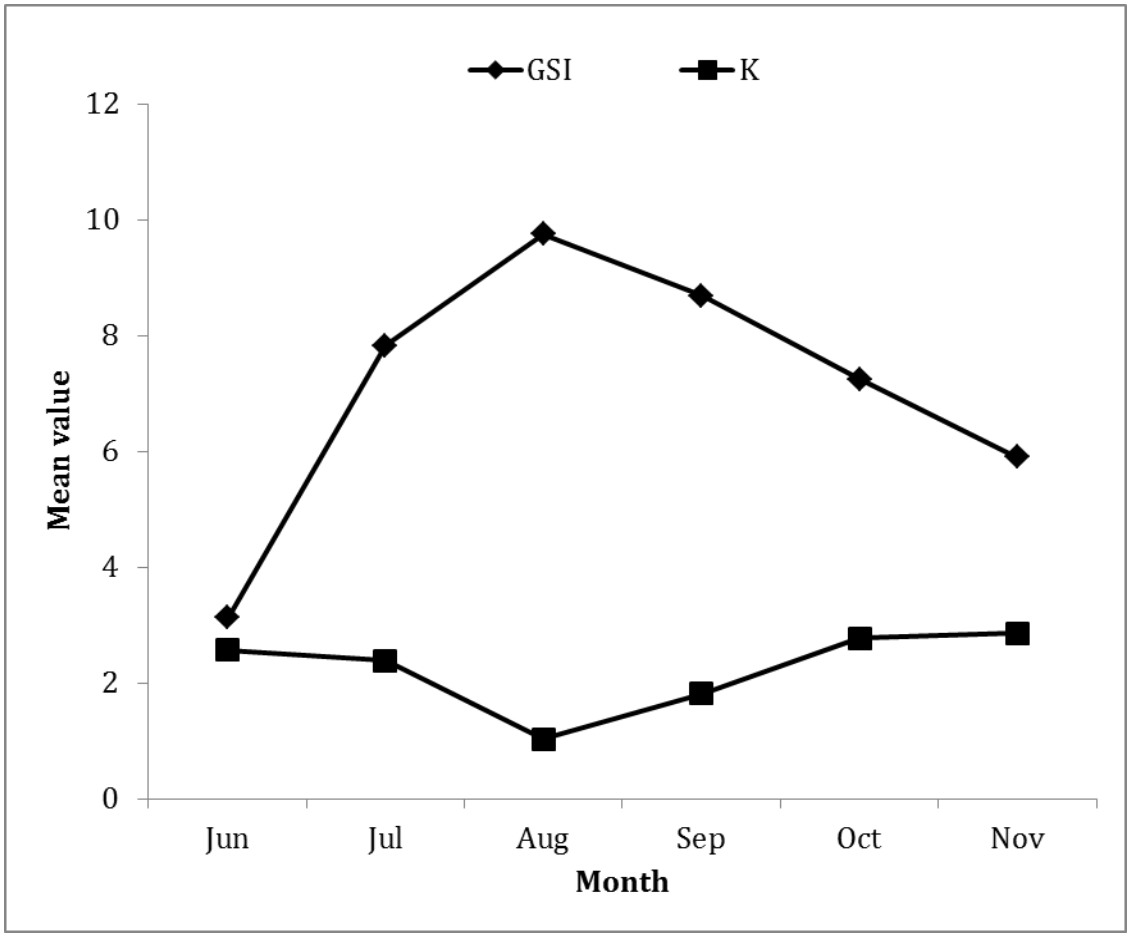


Figure 3: Monthly variation in the Condition factor and gonadosomatic index of gravid females *C. nigrodigitatus* of cross river at Ahaha 2014

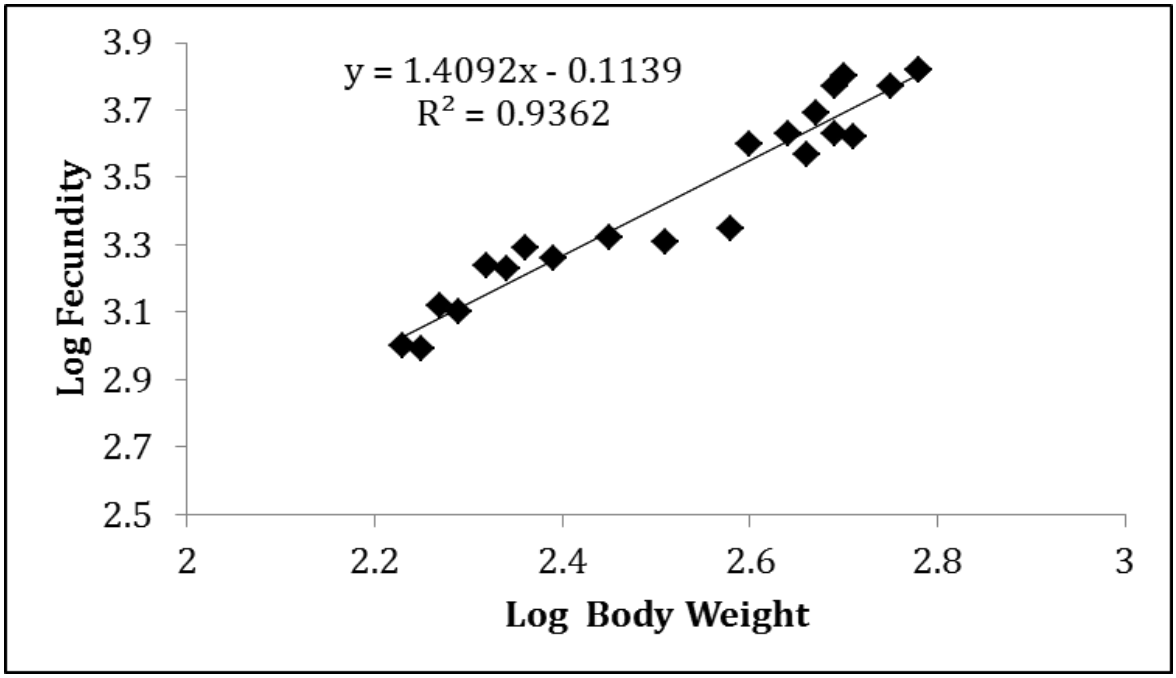


Figure 4: Fecundity-weight relationship of *Chrysichthys nigrodigitatus* from Ahaha, Cross River, Nigeria.

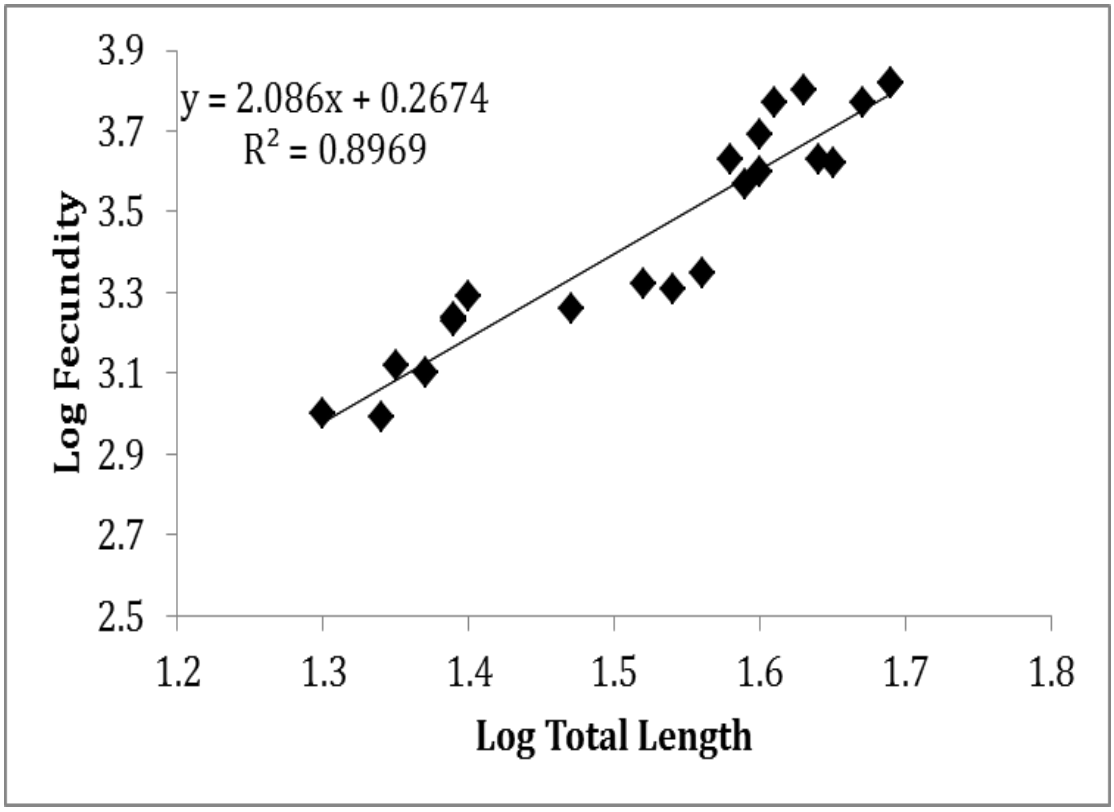


Figure 5: Fecundity-Length relationship of *Chrysichthys nigrodigitatus* from Ahaha, Cross River, Nigeria

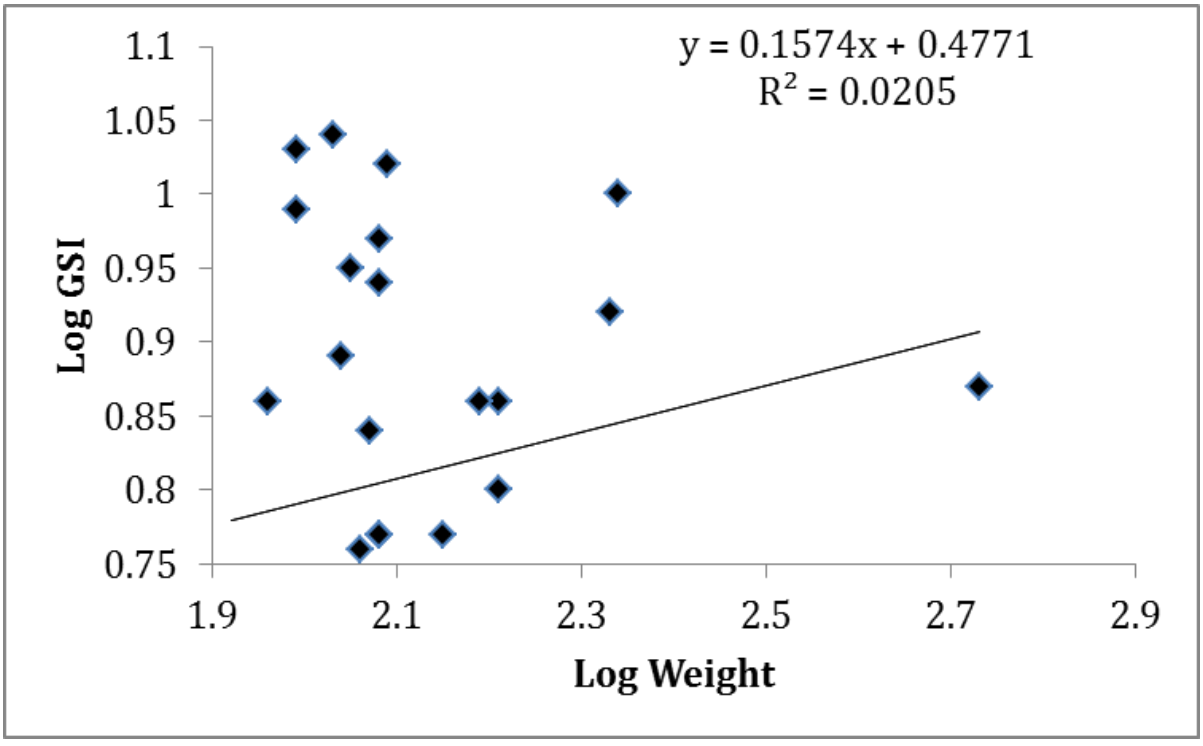


Figure 6: Gonado- somatic index-Weight relationship of *Chrysichthys nigrodigitatus* from Ahaha, Cross River, Nigeria

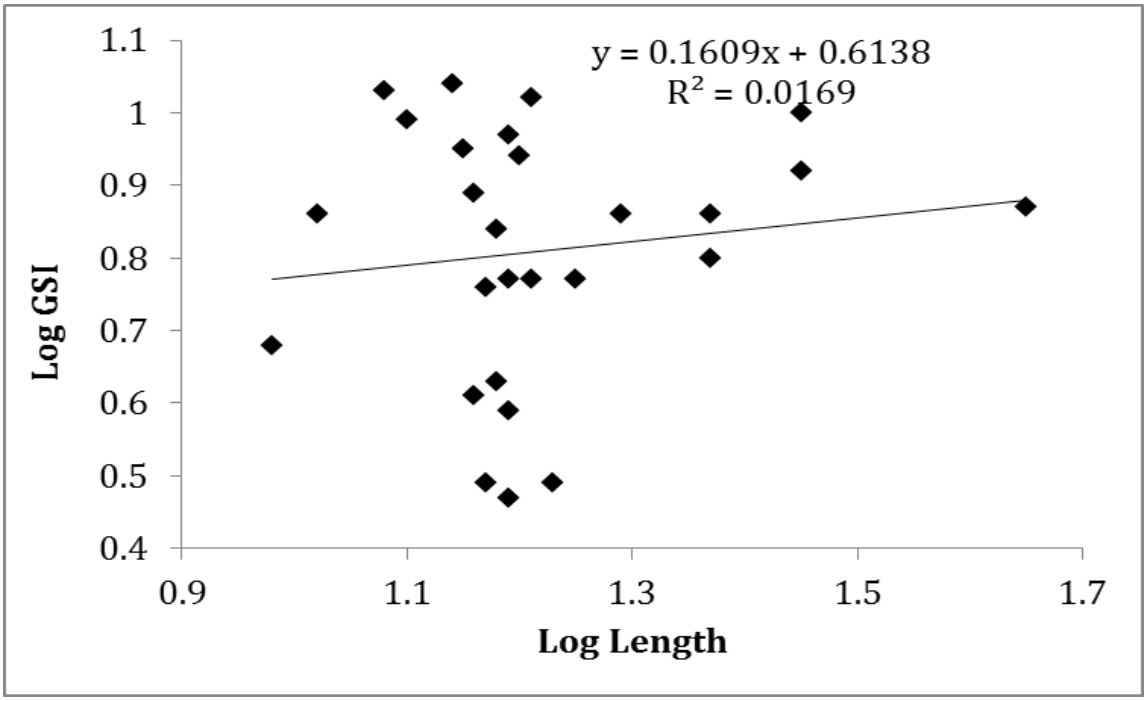


Figure 7: Gonado- somatic index-Length relationship of *Chrysichthys nigrodigitatus* from Ahaha, Cross River, Nigeria

Table 4: Regression model for different variables of Length, Weight, Gonado- somatic index and Fecundity of gravid *C. nigrodigitatus* of Cross River at Ahaha.

Variables	Regression Model	Range	Sample Size	R^2
L/F	LogF= 0.267 + 2.086LogL	19.8 – 56.10cm	64	0.90
W/F	LogF= -0.114 + 1.409LogW	168.60-605.30g	64	0.94
L/GSI	LogGSI= 0.614 + 0.161gL	19.8 – 56.10cm	64	0.017
W/GSI	LogGSI= 0.477+ 0.157Logw	168.60-605.30g	64	0.021

L = Total Length, W = Body Weight, F = Fecundity, GSI = Gonado- somatic index

DISCUSSION

Sex Ratio

The sex ratio for *C. nigrodigitatus* from Cross River at Ahaha is approximately one male to two females (1:1.93) as the deviation from the expected 1:1 (M:F) was significant (X^2 = 3.46, p< 0.05). This disagrees with sex ratios of 1:1.40 for *C. nigrodigitatus* reported by Imevbore (1970), 1:1.02 Ezenwa, (1981), 1:0.93 for *C. walkeri* Ikusemiju, (1976) and 1:0.98 for *C. auratus* reported by Ikomi and Odum (1998). In all these investigations, almost equal proportions of male and female numbers of these species were observed even though their abundance was in favour of female specimens. Wide disparities in findings exist in sex ratio among fishes. However the finding in this study compares favourably with those of Ikpi and Okey (2010) for *L. coubie* (1:1.67) and Onah, (2013) for *M. rume* (1:1.79) in Cross River at Ahaha were in each case the ratio is approximately one male to two females. According to Fagade *et al*. (1984). The preponderance of females over males, is a mechanism for population regulation. They have also been some reports of a much higher sex ratio than that recorded in this study for various freshwater fishes (Agbugui, 2013; Al-Ghais, 1995; Asebere- Ameyaw, 2001; Offem et al., 2008). However the dominance of males to females have also been reported by some

researchers (Adebiyi, 2003; Nzeh and Lawal, 2012; Fawole, 2002). The dominance of females especially between the months of July and September as recorded in this study may be due to migration of female specimens to breeding site or may be fishermen are setting their gears close to breeding ground. This situation may not be healthy for fishery conservation where more females are caught out of from their habitat. The preponderance of females in this study contradict the report by Fagade and Adebisi (1979) who reported that, in African water bodies, the population of males dominates because the generally present more growth than females.

Fecundity

The absolute fecundity ranged from 1,682 - 16,039 eggs reported in the present study was higher than 102 - 10180 eggs reported by Oboh and Omoigberale (2013) from Jamieson River, 1550 to 4300 eggs by Ajayi (1972) form Lake Kainji for *Chrysicthyes* species. However the highest value of 16,039 eggs recorded in this study was lower than 28086 eggs and 25,905 eggs reported by Ekanem (2000) and Offem *et al* (2008) for *C*. *nigrodigitatus* from Cross River respectively. Ekanem (2000) reported great disparity in the fecundities of *C. nigrodigitatus* from Cross River (3046 to 28086 eggs) and Lake Asejire (mean of 2884 eggs) and suggested that this could be due to the greater abundance of food in the river than in the lake or due to the free movement in search of food along the river, which is limited by area in the lake. The mean fecundity of 1009 eggs in the present study is low when compared to the 11, 745 eggs reported for *C*. *nigrodigitatus* by Ezenwa (1981) and 2084 eggs for *C. walkeri* reported by Ikusemiju (1976). Imevbore (1970) obtained a fecundity of 18,470 eggs for a female *C. nigrodigitatus* with total length of 47.5 cm. He also reported *C. auratus longifilis* as having a fecundity of 34200 eggs, the highest so far estimated for a *Chrysichthys* species. According to Gerkings (1978), fecundity of a fish depends on the fertility of the river, and rivers rich in nutrients produce more fecund fishes. The Cross River being a major channel flowing through forest and grass land collective from adjourning streams rich with both autothonus and allocthonus food substance is expected to produce fish with high fecundity. This agrees with Oboh and Omoigberale (2013) who stated that the lower fecundity recorded for *C*. *furcatus* from Jamieson River was because it is oligotrophic. The relative fecundity range of 3.71 - 8.68eggs/g and 48.26 to 104.32eggs/cm in this study indicating that the fecundity per unit length (48.26 to 104.32eggs/cm) is higher than fecundity per unit weight (3.71 - 8.68eggs/g). This corroborates with those of other researchers where fecundity per total length is higher than fecundity per body weight Ezenwa *et al* (1986), Ekanem (2000) and Offem *et al* (2008) for *C*. *nigodigitatus*. The relative fecundity range obtained in this study was lower than the 67 - 82eggs/g and 342 -432eggs/cm reported by Offem *et al* (2008) for *C*. *nigodigitatus* in the cross river. The difference in the relative fecundity of 14eggs/g obtained by Ezenwa *et al*. (1986), 13eggs/g recorded by Ekanem (2000) and high value of 82eggs /g reported by Offem *et al* (2008) for *C*. *nigrodigitatus* support the findings by Kings (1996 and 1997) that fecundity is size dependent. He further stated that the larger the fish, the higher its 'egg' number and this may be due to more available visceral volume for holding the eggs. Fecundity exhibited higher correlation with body weight (r=0.94) than total length (r=0.90) same observation was reported by Rheman *et al* (2002) for *Liza parsia*, by Oboh and Omoigberale (2013) *C*. *furcatus* and Ekanem (2000) for *C*. *nigrodigitatus*. The higher correlation value between fecundity is a suggestion that body weight was a better predictor of fecundity in this study than total length (Ikomi and Odum 1998; Shinkafi and Ipinjolu 2012) .The observed linear relationship between the number of eggs and the length and weight of the body and gonads agrees with the findings of Fagade and Adebisi (1979) and Ekanem (2000) for *C. nigrodigitatus.* Variations in the number of eggs in individuals of almost same length as observed in this study also corroborates the findings of Oboh and Omoigberale (2013) for *C.* furcat*us*, Ezenwa *et al*. (1986) and Ekanem (2000) for *C. nigrodigitatus*.

Gonado -somatic Index and Condition Factor

The gonado-somatic index (GSI) is the expression of the gonad weight as a percentage of the somatic weight (Oso *et al*., 2013). It gives an indication of the percentage of the fish weight that was used in eggs production of maturation stage. Maximum gonadosomatic index of 5.63 and 11.60 were obtained at the ripe and spawning stages respectively. The monthly gradual and progressive increase in the GSI is an indication that *C*. *nigrodigitatus* may reach a spawning period in September. The increase in GSI is an indication of fish maturity and reaches its maximum at the peak of gonad maturity. Similar findings were reported by Ikomi and Odum (1998) for *C. auratus* and Offem *et al.* (2008) for *C*. *nigrodigitatus*. This is also in agreement with so many researchers who reported that the breeding period of most fresh water fishes is between July and September (Ikomi and Odum 1998; Offem *et al.*2008; Araoye 1999; Idodo - Umeh, 2003). They also suggested that flood among other things provides expanded habitat and abundant food resources to ensure the survival of the huge number of young fishes produced. Olatunde (1978) observed also that most tropical fish breed during the rainy season, when water level is high to extend the nursery grounds. The June- August peak months of GSI values recorded in this study agrees with those earlier reported for most tropical freshwater fishes (Ikpi and Okey 2010; Onah, 2013; Oboh and Omoigberale, 2013). Increase in GSI was noted with a decrease in the condition factor and vice versa. Similar observation was

reported for *M*. *rume* and *L*. *coubie* at the same location (Ahaha) by Onah, (2013) and Ikpi and Okey (2010). This is an indication that small fishes have better and excellent condition than their larger counter part especially gravid fish. This may be because smaller fishes are more efficient in finding food than the bigger and gravid ones.

CONCLUSION

It is hoped that the present data will complement the limited information on the reproductive biology of *C. nigrodigitatus* in Nigerian water bodies, and prove useful in the management and conservation of this important commercial fish species.

REFERENCES

Adebiyi AM (2013). The sex ratio, gonadosomatic index, stages of gonadal development and fecundity of Sompat grunt, *Pomadasys jubelini* (Cuvier, 1830). *Pakistan J. Zool*., 45 (1) 41 – 46.

Agbugui MO (2013). The Sex Ratio, Gonadosomatic index, Stages of Gonadal Development and Fecundity of the Grunt, *Pomadasys jubelini* (Cuvier, 1830) in the New Calabar-Bonny River. Report and Opinion; 5(11):31 – 36

Ajayi C (1972). Biological studies on the family Bagridae in Lake Kainji, Nigeria. M. Phil thesis. University of Ile, Ife.

Al- Ghais SM (1995). Aspects of the biology of *Pomadasys stridens* Forskaal 1775 from the west coast of the United Arab Emirates. *Arab Gulf J. Sci. Res*. 13: 401 – 419.

Allison ME, Gabriel UU, Abowei JFN and Inko-Tariah MB (1998). Some aspects of the reproductive biology of *Cynoglossus canariensis* (STEIND) and *Cynoglossus goreensis* (STEIND) of Qua Iboe and Cross rivers Systems off South East Coast, Nigeria Parts I. Niger Delta Biologia 2(2):104-116.

Andem AB, George UU and Eyo VO (2013). Length Frequency Distribution of (*Chrysichthys nigrodigitatus)* (Lecepede, 1803) from Itu Head Brigde, in Akwa Ibom State, Nigeria. Int'l. J. Sci. Research, 2.(9): 258- 260.

Araoye PA (2001). Morphology of the gonads in the reproductive cycle of *Synodontis schall* (Pisces: Mochokidae) in Asa Lake, Ilorin, Nig. *J. Aqua. Sci.,* 16(2): 105-110

Asabere AA (2001). Observations on the reproductive biology and recruitment of the big eye grunt *Brachydeuterus auritus* (Pisces: Heamulidae) in Ghana. *J. Ghana Sc. Assoc*. 3: 14-21

Bagenal TB (1978). Aspects of fish fecundity, p. 75-101. *In* S.D. Gerking (ed.) Ecology of freshwater fish production. Blackwell Scientific Publications, Oxford.

Ekanem SB (2000). Some reproductive aspects of *Chrysichthys nigrodigitatus* (Lacépède) from Cross River, Nigeria. Naga, The ICLARM Quarterly 23(2):24-28.

Eldrige MB and Jarvis BM (1995). Temporal and spatial variation in fecundity of yellow tail rockfish. *Trans. Amer. Fish. Soc.* 124(1): 16-25.

Eyo JE and Mgbenka E (1992). Aspects of the biology of *Clarias gariepinus* in Anambra River basin. Oocyte Diameter, Fecundity and Sex Ratio*. J. Agric Sc Technol.* 2 (1): 47 – 51.

Ezenwa B (1981). A study of the reproductive biology of the catfish *Chrysichthys nigrodigitatus* (Lacépède) in Nigeria. Ph.D. Thesis, University of Lagos, Nigeria, pp. 178.

Ezenwa B, Ikusemiju L, Olaniyan CIO (1986). Comparative studies of the catfish, *Chysichthys nigrodigitatus* (Lacépède) in three isolated geographical areas in Nigeria for breeding purposes, pp. 258-262. In E.A. Huisman (ed) Aquaculture research in the Africa region. Wageningen, The Netherlands.

Fagade, S. O., Adebisi, A. A. and Atanda, A. N. 1984. The breeding cycle of *Sarotheondon galilaeus* in the IITA lake, Ibadan, Nigeria. *Arch. Hydrobiol*. 100: 493-500.

Fawole OO and Arawomo GAO (2009). Fecundity of *Sarotherodon galilaeus* (Pisces: Cichlidae) in the Opa Reservoir, Ile-Ife, Nigeria. *Revista de Biologia Tropical*, 48(1): 1-6.

Francis UE (2012). Aspect of the biology of trap caught *Chrysichthys nigrodigitatus* (Lecepedes 1802) from the New Calabar and Ikot Offiong River, Itu Bridge, Nigeria'', Int'l J. Fish. Aquac., 4(6), p. 9-104 (2012)

Hem S (1986). Premiers resultats sur la reproduction controlee de *Chrysichthys nigrodigitatus* on milieu d'elevage, p. 189-205. *In* E.A. Huisman (ed.) Aquaculture research in the Africa region. Wageningen, The Netherlands.

Howaida RG, Hanlon TH, Mahmoud HH and Eletreby SG (1998). Maturation, fecundity, seasonality and reproduction of two commercially valuable cuttlefish*, Sephia pharaonis* and *S. dollfusi* in Suez Canal. *J. Fish. Res.,* 36(23): 99-115.

Hunter JR and Macewicz BJ (2001). Improving the accuracy and precision of reproductive information used in fisheries: modern approaches to assess maturity and fecundity of warm- and cold-water fish squids. *Fishery bulletin*, 90(1): 101-128.

Idodo-Umeh G (2003). *Fresh water fishes in Nigeria*, (Taxonomy, Ecological notes, Diets and Utilization). Idodo-Umeh Publishers, Benin City. Nigeria. Pp 123- 124.

Ikom RB (1996). Studies on the growth pattern feeding habits and reproductive characteristics of the Momyrid *Brienomyrus longinalis* (Boulenger 1901). *Acta hydrobiology* 38: 381-399.

Ikomi RB and Odum O (1998). Studies on aspects of ecology of the catfish *Chrysichthys auratus* Geoffrey St. Hiliare (Osteichthyes: Bagridae) in the Benin River (Niger Delta, Nigeria). Fish. Res. 35:209-218.

Ikpi and Okey (2010). Estimation of Dietary Composition and Fecundity of African Carp, *Labeo Coubie*, Cross River, Nigeria. J. Appl. Sci. Environ. Manage. Vol. 14 (4) 19 – 24.

Ikusemiju K (1976). Distribution, reproduction and growth of the catfish, *Chrysichthys walker* (Gunther) in the Lekki Lagoon, Nigeria. J. Fish Biol. 8:453-458.

Imevbore AMA (1970). Some preliminary observations on the sex-ratio and fecundity of the fish in the River Niger. Kainjilake studies 1. Ecology. Ed. Visser, C.A. 87-98 Ibadan, N.I.E.S.R.

King RP (1996). Length – Fecundity relationship of Nigeria fish population. *Naga ICLARMQ* 20 (1): 29- 33.

King RP (1997). Weight-fecundity relationships of Nigerian fish populations. *NAGA, the ICLARM quarterly,* 22(1): 33-36.

LeCren ED (1951). The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). J. Anim. Ecol. 20:201-219.

Lowe – McConnel RH (1987). *Ecological Studies in Tropical Fish Communities*. 1st edtn Cambridge University Press.

Nzeh CG and Lawal A (2012). Condition Factor, Gonadosomatic Index and Sex Ratio of the Family Mormyridae from a Small Lake in Ilorin, Nigeria. World J. Zool. 7 (2): 102-105

Obiekezie AI and UK Enyenihi (1988). *Henneguya chrysichthyi* sp. Novv. (protozoa: Myxozoa) from the gills of estuarine catfish *Chrysichthys nigrodigitatus* (Lacépède). (Pisces: Bagridae) in Nigeria. J. Afr. Zool. 102:33-42.

Oboh IP and Omoigberale MO (2014). Fecundity and spawning frequency of *Chrysichthys furcatus* Gunther, 1864 (Osteichthyes: Bagridae) from Jamieson River, Nigeria. Peak J. Agric. Sci. 2(2), 21-29

Offem BO, Ayotunde EO and Ikpi GU (2008). Dynamics in the reproductive biology of *Heterobranchus longifilis* Val., (Pisces: 1840) in the wetlands of Cross River, Nigeria. *Res. J. Fish. Hydrobiol.,* 3(1): 22- 31.

Olatunde AA (1978). Sex, reproductive cycle and variations in the fecundity of the family Schilbeidae (Osteichthyes: Siluriformes) in Lake Kainji Nigeria. Hydrobiologia 57(2):125-142.

Onah (2014). Aspect of the biology of *Mormyrus rume* of Cross river as Ahaha. B.Sc. project, Cross River University of Technology

Oso JA, Ogunleye OA, Idowu EO and Majolagbe FA (2013). Gonado-Somatic Index, Sex Ratio and Fecundity of *Tilapia zilli* in a Tropical Reservoir, South West Nigeria. J. Biol. , Vol. 01, (2): 42-45

Rheman S, Islam ML, Shah MMR, Mondal S and Alam MJ (2002). Observation on the fecundity and gonadosomatic index (GSI) of Grey Mullet, *Liza parsia* (Ham.). *Online Journal of Biological Sciences,* 2(10): 690-693.

Saksena DN (1987). On the use of gonadosomatic index and volume of the gonads as indicators of gonadal state in India fresh water goby, *Glossogobius giuris* (Ham.) with a note on the role of temperature in fish reproduction. *Intl. J. Ichthyol.* 8(1): 1-8.

Saliu JK and Fagade SO (2003). The reproductive biology of *Brycinnus nurse* (Paugy, 1986). (*Pisces: Characidae*) in Asa Reservoir, Ilorin, Nigeria. *Turkish J. Fish. Aqua. Sci.*, 3: 5-9

Shinkafi BA and Ipinjolu JK (2012). Gonadosomatic Index, Fecundity and Egg Size of *Auchenoglanis occidentalis* (Cuvier and Valenciennes) in River Rima, North-Western Nigeria. Nig. J. Basic Appl. Sci. (September, 2012), 20(3): 217-224.

Steel GD and Torrie JH (1980). *Principles and Procedures of Statistics*. 2nd edition McGraw–Hill International Book. Co, New York, 633p.

Stiassny M (1981). The medium is the message: freshwater biodiversity in peril. In: Cracraft, J. and F. Griffo (Eds.). The living Planet in crisis: Biodiversity Science and Policy, Columbia University Press, New York p.; 53-71.

Vicentini RN and Araujo FG (2003). Sex ratio and size structure of *Micropogonias furneiri* (Desmaarest, 1823) Perciformes, Sciaenidae) in Sepetiba bay, Rio de Janeiro, Brazil. *Braz. J. Biol*. 3: 559-566.

Wooton RJ (1990). *Ecology of Teleost Fishes*. Ist edtn. Chapman and Hall, London. 344pp.