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RESEARCH PAPER

Some aspects of the biology of *Synodontis clarias* (LINNAEUS, 1758) from Epe axis of Lagos lagoon, Lagos Nigeria

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Abstract

A total of 1006 randomly selected specimens of *Synodontis clarias* from Epe axis Lagos lagoon was examined over a period of 6 months; June – November, 2019 for morphometric and meristic features, stomach contents and sex data. 717 were males and 289 females. Length ranged from 5.27 – 52.2cm and weight range from 4.6 – 186.28g. The intercept 'a' and slope 'b' of the LWR (LogW = a + bLogL) were W= 10.83+ 0.119 L (r= 0.862) for combined sexes, Log W= 10.67+ 0.121 log L (r= 0.911) for males and Log W= 10.83+ 0.119 log L (r=0.710) for females. The mean K-factor was 1.09. The fish fed predominantly on plankton (87.03%), green plants (2.33%) and small fishes (10.54%) using frequency of occurrence method, which indicated that the species is an omnivore. Mean Gonadosomatic index (GSI) was 6.22, sex ratio of the population was 1: 0.24 males to females and Chi-square test revealed that there were significant differences at P<0.05. The study revealed that the males were more than the females and showed better growth and the adults had more complex feeding habit in the environment. However, feeding versatility of combined sexes coupled with the high fecundity as reported by other researchers enables this species to overcome perturbations, natural or human induced, in the Epe axis of Lagos lagoon.

Keywords: Growth pattern (LWR), gonadosomatic index (GSI), *Synodontis clarias,* Epe lagoon, Lagos

Introduction

Synodontis clarias (LINNAEUS, 1758) belong to the family Mochokidae and the genus Synodontis to which *S. clarias* belong is the most common and of great commercial importance. Synodontis species only occur in Africa and apart from those species present in River Nile they are restricted to water systems within the tropics. *S. clarias* (squeaker or upside-down catfish) is benthopelagic potamodrous fresh water fish (Reids, 2004). This fish is generally classified as an omnivore feeding mainly on insect larva, mollusc and detritus. All members of Synodontis have a structure called a premaxillary toothpad, which is located on the front of the upper jaw of the mouth. This structure contains several rows of short (chisel-shaped). The number of teeth on the mandible is used to differentiate between species; in *Synodontis clarias*, there are about 6 to 9 teeth on the mandible. (John *et al.* 2009). The fins are greyish white and the tail is often tipped with red. Juveniles may have small dark marbling patterns on the body and round dark spots on the ventral, anal, and caudal fins. The maximum standard length of the species is 36cm. Generally, females in the genus Synodontis tend to be slightly larger than males of the same age.

In the wild, the species are known to occur from Senegal to Ethiopia, and along the entire length of the Nile River. The species is harvested for human consumption. Its habitat is threatened by dams, water depletion, and water pollution. In its natural environment, it is a bottom feeder, feeding on insect larvae, plants, and detritus. The reproductive habits of most of the species of Synodontis are not known, beyond some instances of obtaining egg counts from gravid females. Spawning likely occurs during the flooding season between July and October, and pairs swim in unison during spawning. The growth rate is rapid in the first year, and then slows down as the fish age. *(Koblmüller et al., 2006).*

Synodontis is among the most favoured edible fish in Northern Nigeria, owing to their overwhelming abundance in the artisanal fisheries. It contributes a large proportion to the annual fish landings in the region. The genus consists of many species, some of which are commercially more important. *Synodontis membranaceus* is generally preferred by fishermen and consumers because of their relatively large sizes. They command a higher market value than other species of the genus (Owolabi 2005).

Synodontis is highly relished either fresh or smoke-dried. There is dearth of information on the study of dietary habits of fishes based on stomach content analysis which is widely used in fish biology and ecology to indicate the position of a species within a food web and to provide information on the contribution of different prey items to the diet. Information about the food habits of fishes is useful in defining predator-prey relationships, estimation of trophic level and in the creation of trophic models as a tool to understanding complex ecosystems (Lopez-Peralta and Arcila 2002). The species has been found to be a typical example of fish without strict feeding habit. It is regarded as an omnivore, because of its ability to use just any food material present in its habitat. Several researchers have reported diverse food types ranging from insects, planktons, molluscs to fish and crustaceans have been observed in the stomachs in different waters. They also feed on plant materials and mud deposits (Fagade 1983).

This species has a wide distribution, with no known major widespread threats. It is therefore listed as least concern. It has also been assessed regionally as Least Concern for north eastern and western Africa. The species is now rare in the Egyptian Lower Nile, where it is assessed as Vulnerable. Also the species has been noted to be reducing in the Epe axis of Lagos lagoon, Nigeria where it has always been known to be abundant for decades. Potential threats has been observed in the study area, which includes: water pollution from agricultural, domestic and commercial/industrial sources, groundwater extraction and sand mining currently ongoing pose possible threats. While Conservation actions are required, no information is available. More research is needed into this species population numbers and range, biology and ecology, habitat status and threats, as well as monitoring and potential conservation measures. This study therefore attempts to provide some answers to the afore-mentioned problems by focusing on the growth pattern, stomach content analysis and sexual dimorphism (reproductive biology i.e. sex ratio, gonadosomatic index) with the hope that these data and scientific information can be useful in the ecological and biological management of the species and other trado-cultural importance and eventually open up range of research potential areas e.g Haematology, Hepatology, Microbial load, Omega H3 oil content, etc.

Materials and Methods

Study Area

Specimens of *Synodontis clarias* were obtained from well monitored fishermen at Epe Lagoon, Epe for a period of 5 months about 110.5 km away from Lagos State University. The specimens were then preserved in the fish laboratory in a freezer. After which morphometric and meristic data were taken. The sample collection area was Epe lagoon, Epe Local Government with the coordinates 6.6055^{o}N, 3.9470^{o}E in the northern side of the Lekki Lagoon. This is shown in figure 1 below.

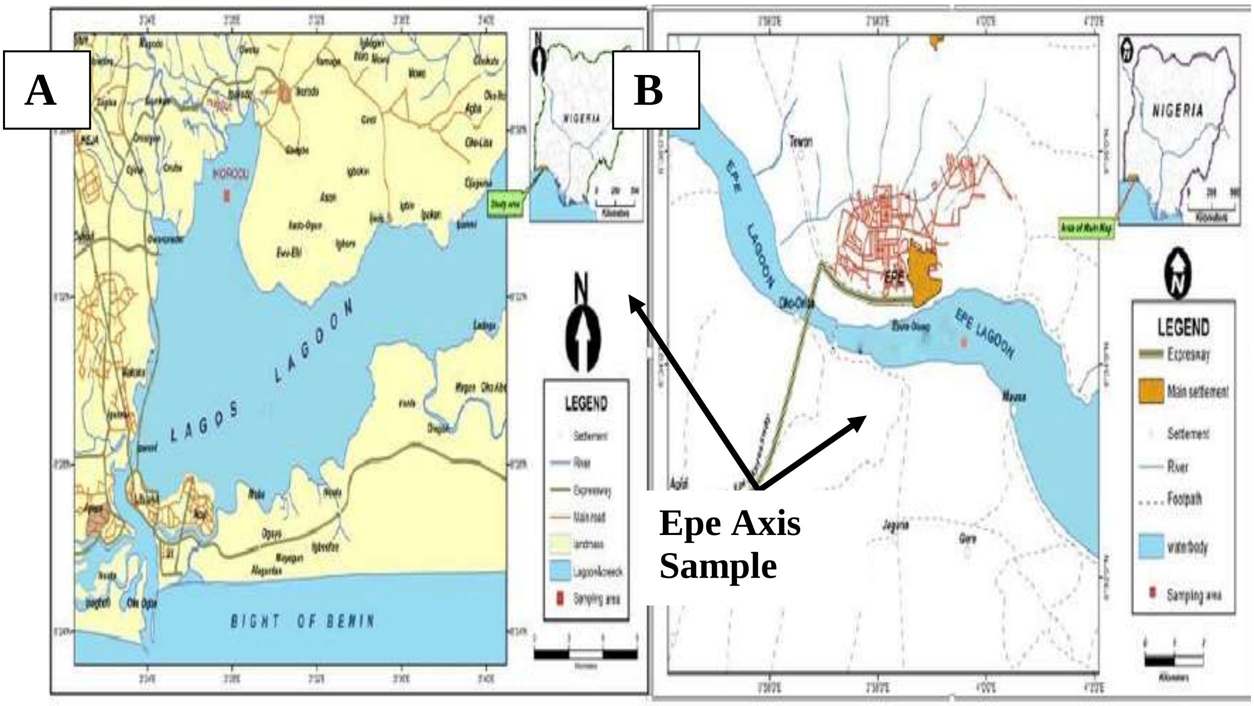

Figure 1: Map showing Lagos lagoon (A), and Epe Axis (B) of the Lagos Lagoon

Sample Collection

The samples were collected in the morning after the fishermen had caught them and were bought and placed in the basket. This was done for over a period of five months in which samples were collected once a month with an average of 200 samples gotten monthly. After samples were collected, they were stored in the laboratory's freezer for preservative purposes before analysis were carried out on them. At subsequent times, samples will be taken out of the freezer and have the analysis carried out on them.

Figure 2: Laboratory assessment of *Synodontis clarias* collected from Study area

Length Weight Relationship

The length weight relationships were obtained from the linear regression analysis

Intercept: $a = [\frac{\sum Y}{N} - (b.\frac{\sum X)}{n}]$

The slope ('b') as: $b = \frac{\sum XY - \frac{(\sum X)(\sum Y)}{n}}{\sum X - \frac{(\sum X)2}{n}}$

And the correlation Coefficient ('r') as:

$$|r| = \frac{[\sum XY - \frac{(\sum X)(\sum Y)}{n}]}{[\sum X - \frac{(\sum X)2}{n}][\sum Y2 - \frac{(\sum Y2)}{n}]}$$

Where: X= Lengths of fish, Y= Weights of fish, and n= number of specimens.

The length-weight relationships for males and female specimens were obtained and a scattered diagram was drawn to determine the statistical relationships. The relationship was expressed as: W= a + bL. The same data was converted to logarithms and a straight line graph was drawn and the relative slope (b) was obtained from the relationship:

$\text{Log}_{10}W = a + b \log_{10} L$.

Length-Frequency Method (Petersen method)

The method currently in use for the analysis of length-frequency data; all finds their origin from the work of Petersen (Petersen methods). With this method, the assumptions were made as to the time interval separating the various peaks of one length frequency sample. These peaks were assumed to represent distinct age groups in a year class.

Condition Factor (K)

Fulton's condition factor (K) obtained for both sexes was expressed as; $K = 100W/L^3$

Where W = weight of fish (g), L= Length of fish (mm). Therefore, the condition factor (K) was used to compare the condition, fatness or well being of both sexes of the fish.

Food and feeding habits

Each specimen was opened with scissors and forceps by making a slit from the anus to the throat. The stomach was examined microscopically and thus, awarded an index of fullness before opening. Thus, Empty stomach = 0, One quarter filled stomach = 1/5, Half filled = 2/5, Three quarter filled =3/5, Distended = 5/5 and Filled stomach = 4/5. The food items of the specie were enumerated using the presence of food items and was expressed as a percentage of all non-empty stomach examined. This figure estimated the proportion of the population that fed on that particular item and it is referred to as Percentage Frequency of Occurrence.

$$\% \text{ Freq of Occurrence} = \frac{\text{Number of stomach}}{\text{All non-empty stomach}} \times 100$$

Sex Ratio

The differentia in sex distribution of the pollution of *Synodontis clarias* was determined from the separation of sexes in to males and females. The chi-square technique was used where the observed (X^{2tab}) was measured against the chi-square calculated (X^{2cal}) as expressed below:

$X^2 = (O - E)^2 / E$

Gonadosomatic Index (GSI)

The gonadosomatic index (GSI) was determined or calculated based on the formula suggested by Lagler (1971) which is expressed as:

$$GSI = \frac{\text{Gonad weight (g)}}{\text{Total body weight (g)}} \times 100$$

Results

Length-Weight Relationships, Condition Factor

The total length and weight of *Synodontis* caught during the 6-month sampling period is shown in Table 1. The results in the table also show the values of the condition factors in the combined sexes, males and females. The length-weight relationships as shown figure 3 – 5, was described for the combined sexes, males and females based on the linear equations:

Combined sexes*:* Log TW = 10.76 + 0.12 Log TL (r = 0.799)
Females*:* Log TW = 11.71 + 0.115 Log TL (r = 0.489)
Males: Log TW = 10.65 + 0.122 Log TL (r = 0.659)

No significant difference in L-W relationship ($P > 0.05$) was obtained between these males and female species. In both sexes, the constant b, which describes the slope of the regression line, is smaller than 3 ($p < 0.05$). This implies that the tendency of the two sexes is to increase more in size than in mass.

The mean condition factor (K-factor) values obtained was 1.0 ± 0.05 (0.1 – 6.9) for combined sexes of *S. Clarias*, while 1.0 ± 0.2 (0.0 – 6.9)in males and 0.9±0.1(0.1 – 4.9) in females of the species. Significant difference in average K-factor values was observed between species ($P < 0.05$). Peak of condition factor occurred during the flooding season which falls in June to July.

Table 1: Summary of Regression Analysis, Morphometric Features and Condition factor of Synodontis clarias from Epe axis of Lagos lagoon, Nigeria

Parameters	Combined sexes	Males	Females
Regression Constant (a)	10.76	10.65	11.71
Regression Coefficient (b) Slope	0.12	0.122	0.115
Correlation Coefficient (r)	0.799	0.659	0.489
Total Weight (g) [Mean±(SD)Range]	71.6±1.2 (4.5 – 186.3)	65.0±2.5 (4.6 – 183.9)	87.8±2.3 (4.6 – 186.3)
Total Length (cm) [Mean±(SD)Range]	19.4±4.3 (9.6 – 60.0)	18.6±4.2 (9.6 – 60.0)	21.9±1.5 (10.5 – 52.7)
Condition Factors (K) [Mean±(SD)Range]	1.0±0.2 (0.1 – 6.9)	1.0±0.2 (0.0 – 6.9)	0.9±0.1 (0.1 – 4.9)
Gonadosomatic Index (GSI) [Mean±(SD)Range]	-	-	3.5±0.1 (0.0 – 19.4)
TOTAL	1006	717	289

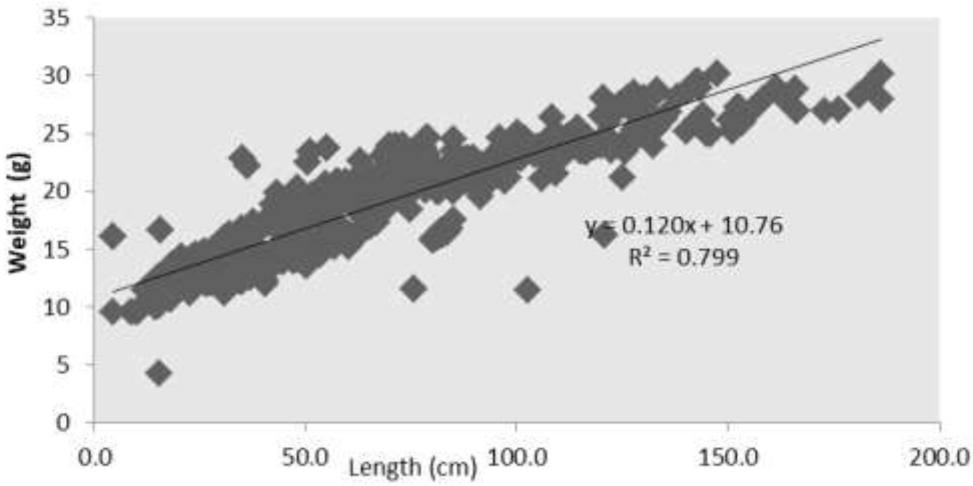

Figure 3: Length-Weight Relationships in Combined sexes of *Synodontis clarias* from Epe axis of Lagos lagoon

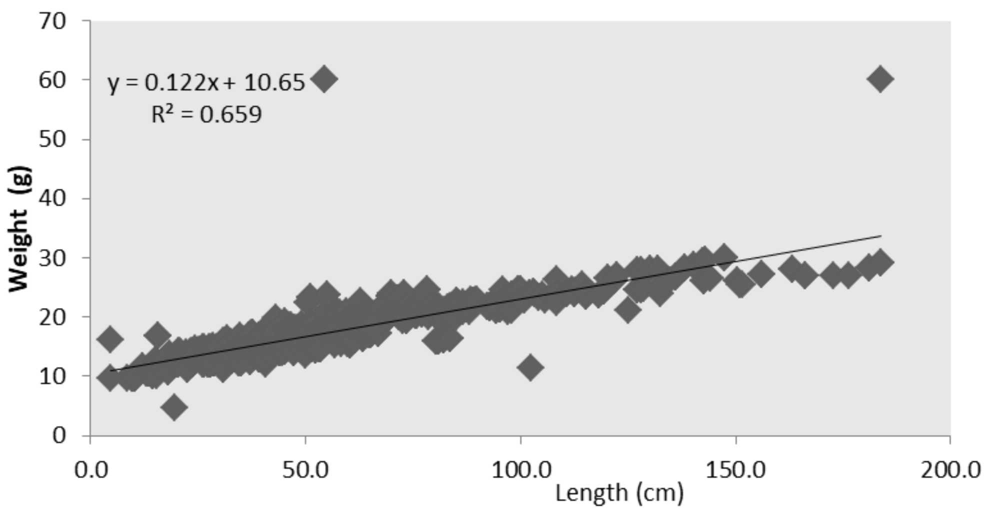

Figure 4: Length-Weight Relationships in Males of *Synodontis clarias* from Epe axis of Lagos lagoon.

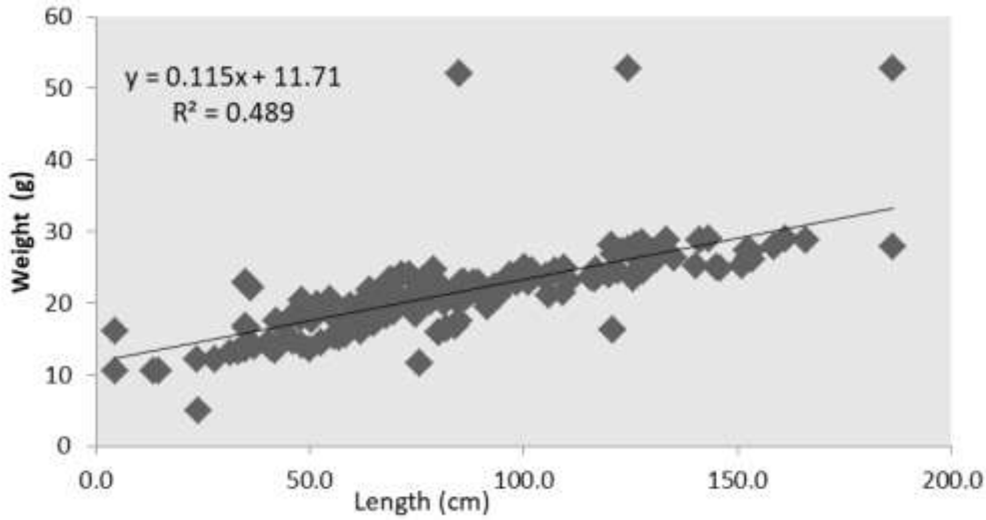

Figure 5: Length-Weight Relationships in Females of *Synodontis clarias* from Epe axis of Lagos lagoon

Trophic Biology

Of the 1006 stomachs of *Synodontis clarias* (9.6 - 60.0 cm TL) and (4.5 – 186.3 g BW) combine sexes examined, about 1.8% (19) was observed empty, while 98.11% (987) were filled. From the data given in Table 2, the fish feeds mainly on plankton (87.03%), and 2.33% fed on green plants and just 10.54% feed on small fish, while 1.82% stomachs are empty. Hence *S. clarias* caught from Epe axis of Lagos lagoon can be referred to as are omnivores in nature. In general, both sexes had a constant level of feeding activities in the species. Highest index value of stomach content was observed in June for both sexes which indicates availability of food washed in from by rain and reproductive activities. Macrophytes and algae were the most frequent food items observed in the stomachs making up to 87.03% (frequency of occurrence). Green plants 2.33 % and animal prey types are larvae and small fishes and crustaceans added up to 10.54 %. Mud and some unidentified particles were also observed.

Table 2: Percentage frequency of occurrence of different Plants and Animal species identified in the stomach of *Synodontis clarias* from Epe axis of Lagos lagoon

Food Category	No of stomachs	Frequency of occurrence (%)	Species
Plankton	859	87.03	*Actinocyclus sp, Amphora commutate, Closterium acutum, Anemoeoneis sphaerophora, Euglena proxima Microcystis sp, Cymbella caespitose* etc.
Green plants	23	2.33	Macrophytes, e.g. maize, *Azolla sp.* Leaves etc.
Small fishes and Crustaceans	104	10.54	*Macrobrachium sp.,* Copepoda, and Cladocera
Empty stomachs	19	1.82	
Total	1006		

Sex Ratio (Chi square)

Randomized sampling of fish species from difference fishing spots in Epe axis of Lagos lagoon, Lagos Nigeria ensured a representative distribution of males and females species. In general, males were observed to be numerically dominant than females ($P < 0.05$). The chi-square test was used to determine if a population contains equal proportions of males and females and it is a test of how well a model fits the observed data. The null Hypothesis: H_o= means that the male and females were distributed on 50% basis (i.e. no significant difference in sex distribution). The results however revealed that the calculated value (X^{2cal}) of 182.03 is higher than tabulated value (X^{2tab}) of 3.481 at degree of freedom of $P<0.05$. As shown in Table 3, the males are 71.27% (717) in the population, while the females are 28.43% (289) giving rise to ratio 1: 0.24 males to females distribution in favour of the males, an indication that a significant difference existed in their sexes.

Table 3: Chi-square test analysis and Gonadosomatic Index (GSI) of *Synodontis clarias* Epe axis of Lagos lagoon

Sexes	Observed (O)	Expected (E)	Chi-Square $[X^2 = (O - E)^2/E]$	Ratio (%)
Male	717	503	91.04	71.27
Female	289	503	91.04	28.73
Total	1006		182.08	100

Gonado-somatic index (GSI) and spawning period

GSI values varied from 5.18% ± 0.1 to 6.99% ± 1.4 with mean value of 6.22%. GSI values for the species was found to vary considerably with time, and this variation was at its maximum during October – November, 2019 (Figure. 6). Peak values occurred in mid- November which coincided with the high rain/ water period for the year (late rain).

Table 4: Gonado-somatic index (*GSI*) and spawning period of S. clarias from Epe axis of Lagos lagoon

Month	NUMBER OF FEMALES	GSI (%)
June	39	6.022
July	76	5.577
August	21	5.178
September	43	6.814
October	45	6.974
November	55	6.99
		6.26

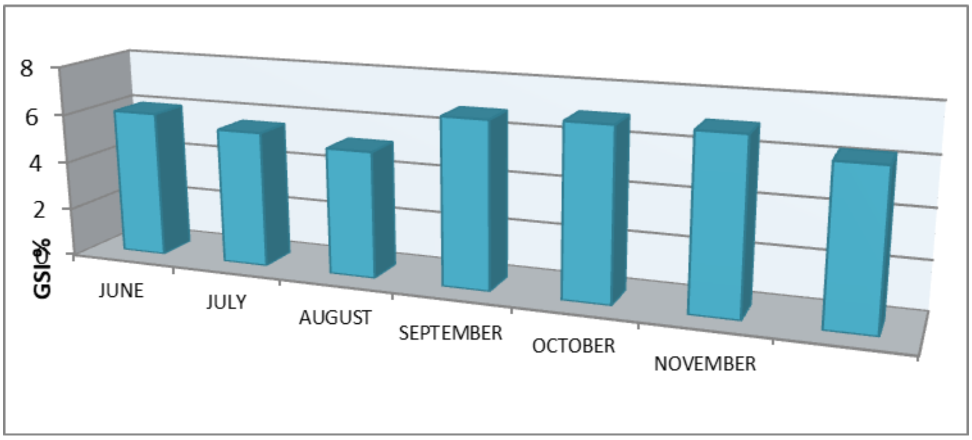

Figure 6: Seasonal variation in gonadosomatic index of females of *S. clarias*

Discussion and Conclusion

Length-Weight Relationships and Condition Factor

Fish living strategies are the result of natural selection that aims to produce the biggest number of specimens that will survive until maturity under the conditions imposed by the biotope. Therefore, the fact that *Synodontis clarias* is one of the most abundant fish species in Epe axis of the Lagos lagoon complex is an indicator of its biological success, reflecting an adjustment among the species demands and the environmental characteristics.

The length-weight relationships of the males, females and combined sexes of *Synodontis clarias* were significantly correlated ($P<0.05$) with a relatively high positive correlation coefficient (r). The values of regression coefficient (b) observed in this study were significantly below 3.0, which indicated that both male and female species of *Synodontis clarias* exhibited weak positive allometric growth pattern. The b values of 0.12, 0.115 and 0.12 were observed for male, female and combined sexes respectively in Epe Lagoon of the Lagoon complex. The observations in this study are in agreement with four species of *Synodontis* in Lower Benue

River, (Akombo, *et al.* 2011); for *S. schall* in River Nile at Assiut (Hassan, 2007); and *S. nigrita* in Ouèmè River Benin (Lalèyè *et al.,* 2006). The high positive correlation in the length-weight relationship of *Synodontis clarias* in the Epe Lagoon of the Lagos lagoon complex agrees with other researchers on length-weight relationships, such as Ayuba (1997) on *Synodontis species* in River Benue at Yola; Abubakar and Ishaya (2000) on *O. niloticus* in Geriyo lake, Yola; Abubakar and Edward (2002) on the catfish *Synodontis* in upper Benue River basin Yola.

The Length-weight relationship of fish also known as growth index is an important fishery management tool. It is vital in estimating the average weight at a given length group (Abowei and Davies, 2009; Abowei, 2010). Jomabo *et al*., (2009) reported that LWRs of fishes are important in fisheries biology and population dynamics where many stock assessment models require the use of LWR parameters. The b values observed in this study (Table 1) were significantly below 3 which reflected that the species under study became thinner as they grew longer. Apochi *et al.,* (2017) worked on Length-weight relationship, food and feeding habit and condition factors of *Synodontis melanoptera* and *Synodontis courtetti* from Lower River Benue and reported weak positive allometric growth just as was exhibited by the fish samples used for this work, the length of the fish increased with corresponding increase in body weight. They concluded that this could be attributed to the presence of quality and quantity of food and plankton yield from the water body where the fish samples inhabited. These observations are also in agreement with those of Midhat *et al*., (2012). This result gives a great insight to the availability of food and other environmental inconveniences e.g. domestic dumping of refuse in the lagoon and gross sand mining activities currently ongoing in the Epe lagoon. The condition factor (k-factor) has varying results on *S. clarias* from Epe lagoon. The combined sexes ranged from 1.0 – 6.9, males sex ranged from 1.0 – 6.9, while the females had a lower condition factor range from 0.9 – 4.9 (Table 1). The males were in better condition of well-being than the females as indicated by the results. This thus showed that there is opportunistic feeding in the population, coupled with aggression and predatory activities (survival of the fittest).

The high positive correlation in the length-weight relationship of *Synodontis clarias* in the Epe Lagoon of the Lagos lagoon complex agrees with many researchers of length-weight relationships such as Ayuba (1997) on Synodontis species in River Benue at Yola; Abubakar and Ishaya (2000)] on *O. niloticus* in Geriyo lake, Yola; Abubakar and Edward (2002) on the catfish *Synodontis* in upper Benue River basin Yola; Abowei and Hart (2009) on ten finfish species from the lower Num River, Delta State and Akombo *et al*., (2011) on four species of *Synodontis* from Lower Benue River at Makurdi..

Trophic Biology

The food items in the stomach of both *Synodontis clarias* suggest that they are omnivorous feeders as the diet covers a wide spectrum of food ranging from various types of plankton e.g. *Actinocyclus sp, Amphora commutate, Closterium acutum, Anemoeoneis sphaerophora, Euglena proxima Microcystis sp, Cymbella caespitose* etc to invertebrates e.g. *Macrobrachium sp.,* Copepoda, and Cladocera and green plants e.g. Macrophytes, e.g. maize*, Azolla sp.* Leaves etc. As shown in table 2. This is in agreement with the finding of Lauzanne (1988) who inferred that the *Synodontis* genus are eclectic. The same feeding habit was observed in *S. nigrita* from the Osun River (Nigeria) according to Olojo *et al.* (2003). This high diversity of the food composition in both *Synodontis* sexes indicates an adaptive radiation of great relativity to the habitats in which they live. Many catfishes, such as the *Chrysichthys* spp, are benthic omnivores with a strong tendency to predation (Baras & Lalèyè, 2003).

Olojo *et al.*, (2003) also opined that this is an important strategy for survival and an advantage over the fish species competing for a specific food item. A clear morphological explanation for its feeding versatility may be due to the ventral location of the mouth of both *Synodontis* species which encourages a detritivorous mode of feeding while the simple horny structures around the mouth enable it to adapt to filter feeding (These structures also help *Synodontis* to gnaw at any hard plant tissue which form part of its rich diet. The results in this study revealed that S. clarias from Epe lagoon preferred Macrophytes and Algae as these were the most frequent food items observed in the stomachs making up to 87.03% (table 2). Laleye, (2006) indicated interspecific differences in the feeding pattern of *Synodontis schall* in Ouémé River, and concluded that the most frequent food items in the stomachs of the species were macrophytes and algae. The diversity of algae consumed by both species is high (more than 100 species).

However, the juveniles show more indignation towards phytoplankton, diatoms, leaves and insect larvae, while the adults exhibit more versatile and complex feeding habit. This fish explore food items of aquatic and terrestrial origin depending on availability as influenced by season and water hydrology.

Sex Ratio (Chi square), Gonado-somatic index (GSI) and Spawning period

The results sex ratio analysis (Chi-square) revealed that the calculated value (X^{2cal}) is 182.03 higher than tabulated value (X^{2tab}) of 3.481 at P<0.05. As shown in Table 3, the males are 71.27% in the population, while the females are 28.43% giving rise to ratio 1: 0.24 males to female's distribution in favour of the males, an indication that a significant difference existed in their sexes from the expected 1:1 ratio. The sex ratio obtained is highly desirable for hatchery operations of *Synodontis clarias* because the males are bigger and had better condition factors than the females.

In this report, it was observed that the highest Gonadosomatic index (GSI) was recorded in October (6.9) and lowest in August, 2019 as shown in table 4 and figure 6. Thus means the ovum mature during this period. This agrees with the findings of Olaleye (2006), who reported that highest GSI in *S. schall* and *S. nigrita* in the Ouémé River occurred from August to October which coincides with the flooding period of the river. This, however, is also in agreement with other observations on fish reproduction ecology in other floodplain environments. Baras & Lalèyè (2003) indicated that the majority of floodplain fish species initiate spawning after horizontal flooding has begun, i.e. well into the rainy season. In Lake Chad, the spawning activity for *S. schall* occurs from mid-July through September. The different environmental and climatic conditions in the habitats could explain the discrepancies observed.

Conclusion

Conclusively, the feeding versatility of combined sexes of *S. clarias (males and females)* coupled with the high fecundity as reported by other researchers enables this species to overcome perturbations, natural or human induced, in the Epe axis of Lagos lagoon, Lagos Nigeria. Life-history of species is influenced by varying ecological conditions and highly tolerant species, such as the catfishes, are promising candidates for commercial exploitations and aquaculture.

References

Abowei, J.F.N, and Davies O.A. (2009). Some Population Parameters of *Clarotes laticeps* (Rüppell, 1829) from the Fresh Water Reaches of Lower Nun River, Niger Delta, Nigeria. *American Journal of Scientific Research*; 2:10-19. 2.

Abowei, J.F.N., George, A.D.I. and Davies, O.A. (2010). Mortality, Exploitation rate and Recruitment pattern of (De Rochebrune, 1883) from Okpoka Creek, Niger Delta, Nigeria. *Asian Journal of Agricultural Sciences* 2(1):27-34. 5.

Abowei, J.F.N. and Hart, A.I. (2009). Some Morphometric Parameters of Ten Finfish species from the Lower Nun River, Delta, Nigeria. *Research Journal of Biological sciences* 4(3):282–288. 3.

Abowei, J.F.N. (2010). The condition factor, Length-Weight Relationship and Abundance of *Elops senegalensis* (Regan, 1909) from Nkoro River, Niger Delta, Nigeria. *Advance J. Food sci Tech* 2(1):16-21. 4.

Abubakar, K.A. and Edward, A. (2002). Food and Condition Factor of Catfish *Synodontis* in Upper Benue River Basin, Yola Area, Nigeria. *Journal of Aquatic Sciences* 17(2):105-108. 6.

Abubakar, K.A. and Ishaya, R.M. (2002). Some Biological Aspects of *Oreochromis niloticus* in Lake Geriyo, Yola, Adamawa state. Nigeria. *Journal of Education and technology.* 2:50-56.

Adeyemi, S. O. (2004). Food and feeding habits of *Synodontis resupinatus* (BOULENGER, 1904) at Idah Area of River Niger, Kogi State, Nigeria *Journal of Education and technology.* 4:75-86.

Apochi, J. O., Omeji, S. Adadu, M.O., and Kever, A. (2017)Length weight relationship, food and feeding habits and condition factor of *Synodontis melanoptera* and *Synodontis courtetti* from lower River Benue, Benue state, Nigeria *Mar. Biol*., 50, 263-273

Brown, K.J., Rüber, L. Bills, R., and Day, J.J. (2010). Mastacembelid eels support Lake Tanganyika as an evolutionary hotspot of diversification *Hydrobiologia* 31:193–202.

Chapman, L.J., L. Kaufman, and Chapman, C.A. (1994). Why swim upside-down - a comparative study of 2 Mochokid catfishes. *Copeia* 4:130–135.

Day, J.J., and M. Wilkinson. (2006). On the origin of the *Synodontis* catfish species flock from Lake Tanganyika. *Biology Letters* 2:548–552.

DeWeirdt, D., Vreven, E. and Fermon, Y. (2008). *Synodontis gouniensis*, a new species (Siluriformes: Mochikidae) from Ngounié and Nyanga basins, Gabon and Republic of Congo. *Ichthyological Exploration of Freshwaters* 19(2):121–128.

Ferraris, C.J., Jr. (2007). Checklist of catfishes, recent and fossil (Osteichthyes: Siluriformes), and catalogue of siluriform primary types. *Zootaxa* 1418:1–628.

Fischer ,W. and Branchi G. (1984) FAO Species Identification Sheets for Fishery Area, *FAO Report* 34, 47.

Friel, J.P. and T.R. Vigliotta. (2006). *Synodontis acanthoperca*, a new species from the Ogôoué River system, Gabon with comments on spiny ornamentation and sexual dimorphism in mochokid catfishes (Siluriformes: Mochokidae). *Zootaxa* 1125:45–56.

Friel,, J.P. and T.R. Vigliotta. (2008). *Atopodontus adriaensi*, a new genus and species of African sucker-mouth catfish from the Ogôoué and Nyanga River systems of Gabon (Siluriformes Mochokidae). *Proceedings of the Academy of Natural Sciences of Philadelphia* 157:13–23.

Friel,, J.P., and J.P. Sullivan. (2008). *Synodontis woleuensis* (Siluriformes: Mochokidae), a new species of catfish from Gabon and Equatorial Guinea, Africa. *Proceedings of the Academy of Natural Sciences of Philadelphia* 157:3–12.

Froese, R. and Pauly, D. (2014*).* Species of Synodontis in FishBase. *June 2014* version*.*

Gayanilo, F.C., Sparre P. and Pauly D. (2005*) FAO-ICLARM Stock Assessment Tools, FAO, Rome, Italia, 2(8), 268.*

Gulland, J.A. and Rosenberg P.O. (1983) Food Agriculture*, UK, 123.*

John, P. F. and Thomas, R. V. (2009). Mochokidae African squeaker and sucker-mouth catfishes*. Tree of Life Web Project.* Retrieved December 4, 2012*.*

Lagler, K.F., Bardach, J.E., Miller, R.R. and Passion, D.R.M. (1962) Ichthyologia, *Willey,* New York, 506-520.

Lalèyè, P. Chikou, A. Gnohossou, P. Vandewalle, P. Philippart, J. C. And Teugels, G. (2006). Studies on the biology of two species of catfish *Synodontis schall* and *Synodontis nigrita* (Ostariophysi : Mochokidae) from the Ouémé River, Bénin *Belg. J. Zool.*, 136 (2) : 193-201.

Moreau, J., Bamboni C. and Pauly D. (1986). The First Asian Fisheries Forum, Asian Fisheries Society, *Manila, Philippines.* 201-206.

Vidotto-Magnoni, A.P. and Carvalho E.D. (2009*)* Neotrop. *Ichthyol*., 7, 701-709.

West, G. (1990). Methods of assessing ovarian development in fishes, *Australian Journal of Marine and Freshwater Research*, 6: 124-138