Journal of Biology and Genetic Research Vol. 10 No. 2 2024 E-ISSN 2545-5710
P-ISSN 2695-222X www.iiardjournals.org Online version

# Length-Weight Relationships and Condition Factors of Selected *Synodontis Species* from the Lower Benue River, Makurdi, Nigeria

**Iorchor,S.I, Deekae, S.N, Amachree, D and Otene, B.B**
[1]Department of Fisheries Technology, Akpera Oshi Polytechnic, Yandev, Gboko, Benue State.
[2-4]Department of Fisheries and Aquatic Environment, Rivers State University, Nkpolu-Oroworukwo, Port Harcourt
Correspondence Authors: benjaminotene56@yahoo.com
DOI: 10.56201/jbgr.v10.no2.2024.pg38.48

***Abstract***

*Length-weight relationships (LWRs) and conditions factors of selected Synodontis species from the Lower Benue River, Makurdi, Nigeria was studied from January -December 2023. A total of one thousand, one hundred and three (1,103) individuals from three species S. membranaceus, S. courteti and S. batensoda were obtained monthly from four sampling locations with the help of fishers.. The length and weight measurements were taken using a measuring board and an electronic balance respectively to determine Fulton's growth patterns and condition factors. The length ranged between 5 and 42.5cm (S.batensoda), 5-47 and 510cm(S.courteti) and 10 and 65.4cm (S. membranaceus). The weight ranged from 70 to 489g (S.batensoda), 98 to 776g (S.courteti) and 150-1500g (S. membranaceus). The growth coefficient (K) were respectively 1.902 ± 0.0388, 2.100±0.065 and 2.235 ±0.051 for S. batensoda, S. courteti and S.membranaceus showing that all the fish species exhibited negative allometry since the values were less than 3 (<3) such that the growth favours length against the weight. The coefficient of determination/regression ($r^2$) showed strong and positive correlation with S. batensoda but weak correlation with both S. membranaceus and S. courteti. These findings suggest that conservation measures need to be taken to improve the fish health and physiological condition in the area.*

***Key words:*** *Length-Weight Relationship*

## Introduction

Fish has been reported to be good source of animal protein accounting for 20% of all animal protein (Seiyabo *et al.,* 2016) for a proper understanding of species performance in the aquatic ecosystem. It has become imperative among biologists and environmentalists to assess the fish stock in their natural environment (Falaye *et al.*, 2015). Length – weight relationship of fish has become an essential tool used in revealing essential details about their habitats as well as important hints about climatic and environmental changes and shifts in human subsistence practices. Moslen and Miebaka (2017) opined that length – weight relationship (LWR) evaluation is a crucial component of fish ecology while Bashir *et al* (1993) disclosed that length-weight ratio of fish change with the condition of life in the environment. Length-weight relationship study also important since it helps to comprehend the general health and growth patterns of a fish population. According to Guarrizzo

*et al.*, (2015) fish body length and body weight are two essential empirical variables in stock evaluation, population biology, community and ecosystem ecological studies.

Condition factor is considered as an index illustrating how biotic and abiotic factors interact to affect the fish physiological state. Condition factor just like length-weight relationship is widely used as morphometric parameter which provides insights into the growth patterns; body shape and overall health of fish populations (Froese, 2006, Kumolu-Johnson and Ndimele, 2010). The duo is useful in fisheries science because the length-weight relationship (LWR) describes the mathematical relationship between the length and fish weight while the condition factor (CF) is an indicator of the well-being and fitness of the fish (Bolger and Connoly, 1989).

Comparative studies in Abakaliki river (Nwankwo, & Nnaji, 2012) Ologe Lagoon (Ogunye Akintola, 2015) and Niger State (Mokogwu & Ofoezie, 2013) on the LWR and CF of different *Synodontis species* within the same geographical region revealed important differences in their body and ecology. This information could be useful for fish management stock assessment and conservation efforts targeting these commercially and ecologically important catfishes. This research therefore is aimed at assessing the length-weight relationship and condition factor of three species of *Synodontis* from the lower Benue River, Makurdi, Nigeria.

## MATERIALS AND METHODS

### Study Area

The research was carried out in the Lower Benue River at Makurdi, Nigeria. It is an area located downstream of the Benue confluence which is contained within the Federal Republic of Nigeria and lies on the coordinates; 8º 31'N and 7º 35'E River Reid and Sydenham (1979) (Figures 1). The Benue River strongly flows through an extensive alluvial plain which stretch for approximately 1,160 kilometres along the river route. The lower Benue River is contained within Benue and Kogi States of Nigeria (Reid and Sydenhan, (1979). River Benue originates from the Adamawa Mountains of Cameroun and flows west across East-Central Nigeria (NEDECO, 1959). It is the largest tributary of the Niger which it joins at Lokoja in Kogi State, Nigeria.

Makurdi is the capital city of Benue State, Nigeria. It is situated on the banks of the Benue River on which serves as a commercial and administrative center for the state and is known for its agricultural activities, particularly in the production of yams, cassava, and rice. Katsina-Ala is is a town in the Katsina-Ala Local Government Area of Benue State and known for its agricultural output, particularly yams and cassava. It also has cultural significance, with various festivals celebrated by the local communities. Abinsi is a town in the Gwer East Local Government Area of Benue State, located northeast of Makurdi which plays an important role in local agriculture and trade. It is characterized by its rural communities and farming activities. Buruku is a town in the Buruku Local Government Area of Benue State, situated northwest of Makurdi and known for its agricultural activities, particularly in the cultivation of crops like maize and soybeans. The town also has a growing market for local goods and services.

**Sample Collection**

Fish samples were collected from various sampling sites along the Lower Benue River which include Makurdi, Katsina-Ala, Abinsi and Buruku located on the coordinates,7.1935° N, 9.3007° E, 7.1935° N, 9.3007° E,7.7463° N, 8.7282° E and 7.2924° N, 9.3126° E respectively (Nwosu *et al.,*2014), Adetunji and Okwu, 2018). Specimens were identified to the species level using taxonomic keys and relevant literature (Olaosebikan & Raji, 1998; Idodo-Umeh, 2003).

The total length (TL) and body weight (W) of each individual fish was measured, and the length-weight relationship was determined using the power function equation:

W = a * L^b

where

W is the body weight (g)

L was the total length (cm)

a and b are the regression coefficients.

The condition factor (CF) was calculated using the formula:

CF = (W / L^3) * 100 (Pauly,1980, 1983)

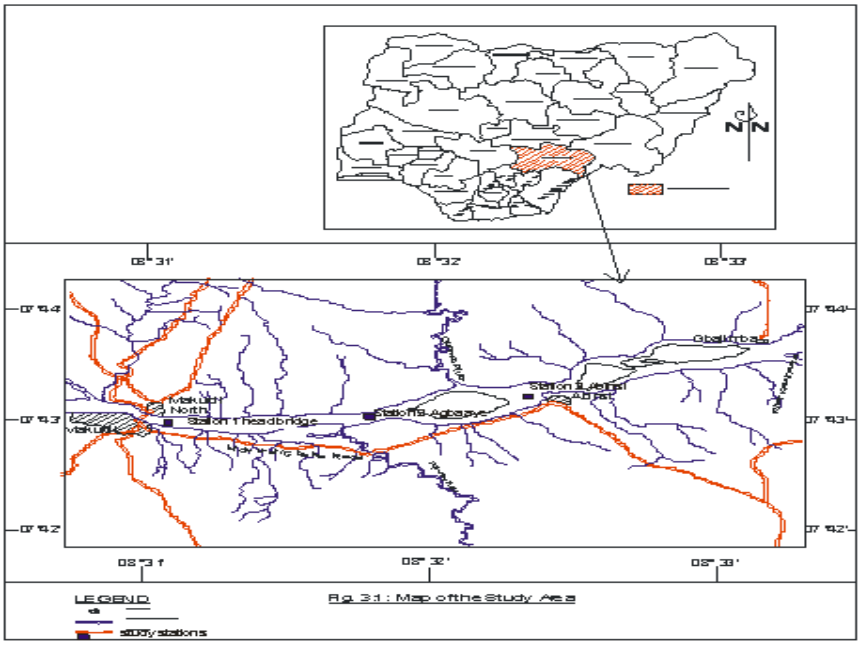
where

W is the body weight (g)

L is the total length (cm).

**STATISTICAL ANALYSIS**

All statistical analyses were performed using appropriate software, such as R or FISAT II while comparisons of growth parameters and mortality rates among the three *Synodontis species* were conducted using statistical tests, such as ANOVA or Kruskal-Wallis test.




## RESULTS

Table I shows the length-weight relationship of the Mochokids in the lower Benue River. The length ranged between 5 and 42.5cm (*S. batensoda*), 5 and 47.5cm (*S.courteti*) and from 10 to 65.4cm (*S. membranaceus*). The weight ranged from 70 to 489g (*S.batensoda*), 98 to 776g (*S.courteti*) and 150 to 1500g (*S. membranaceus*). The growth coefficients (K) were respectively, 1.902 ± 0.0388, 2.100±0.065 and 2.235 ±0.051 for *S. batensoda, S.courteti* and *S. membranaceus* for combined sex, then 1.9302±0.0468( *S. batensoda*) to 2.044±0.054 *(S. membranaceus*) for the male and 1.931±0.0451 (*S.batensoda*) to 2.150±0.052 (*S.membranaceus*) for the female showing that all the fish species exhibited negative allometry since the values were all less than 3 (<3) such that the growth favours length against the weight (Table 2 and Figures 2-4). The growth coefficient (K) for the male and female species are as presented on the Table 1 and 2). The condition factor (K) for the Mochokids is as on Table 2 and Figures 5-7. The value ranged between 0.7045 (*S. batensoda*) and 0.8535 (*S. courteti*) with all the values less than unity (<1). The monthly condition factor for the various species showed that *S. membranaceus* had the highest condition factor of 1.2, followed by *S. courteti* (1.150) while *S. batensoda* was 0.77cm in February, July and June respectively. Table 4.5 showed that entire fish species from the lower Benue river were not in good condition of health since their k – values were all less than one (<1).The coefficient of determination/regression ($r^2$) showed strong and positive correlation with both *S. membranaceus and S. courteti but weak correlation with S. batensoda* as in Table 1 and 2 below.

Table 1: Length -weight Parameters of mochokids in the Lower Benue River

| Parameters | *S. membranaceus* | *S. courteti* | *S. batensoda* |
|---|---|---|---|
| Length(cm) | 10-65.4 | 5-47.5 | 5-42.5 |
| Weight (g) | 150-1500 | 98-776 | 70-489 |
| Intercept (a) | 0.6924±0.0792 | 1.766±0.096 | 0.3558±0.0575 |
| Growth Coefficient (b) | 2.235±0.0511 | 2.100±0.065 | 1.902±0.0388 |
| Correlation Coefficient($r^2$) | 0.3817 | 0.185 | 0.5806 |

Table 2: Length-weight Relationship of Mochokids in the Study Area

| Regression Index | | *S. membranaceus* | *S. courteti* | *S. batensoda* |
|---|---|---|---|---|
| a | Combined | 0.692±0.079 | 1.1766±0.0959 | 0.3555±0.0575 |
| | Male | 1.0278±0.086 | 0.7344±0.0906 | 0.4658±0.0706 |
| | Female | 1.0178±0.083 | 1.0081±0.0868 | 0.5245±0.0678 |
| b | Combined | 2.235±0.051 | 2.10±0.0645 | 1.902±0.0388 |
| | Male | 2.044±0.054 | 1.988±0.0625 | 1.9302±0.0468 |
| | Female | 2.150±0.052 | 2.0094±0.0598 | 1.931±0.0451 |
| r | Combined | 0.6178 | 0.4296 | 0.7620 |
| | Male | 0.5954 | 0.6848 | 0.7629 |
| | Female | 0.5999 | 0.5975 | 0.7523 |
| $r^2$ | Combined | 0.3817 | 0.1846 | 0.8806 |
| | Male | 0.3544 | 0.4659 | 0.5820 |
| | Female | 0.3599 | 0.3570 | 0.5660 |

a=Intercept, b=Slope, r=Coefficient of Regression, $r^2$=Coefficient of determination

Table 3 : Condition Factor (K) for *Synodontis species* in the Lower Benue River

| Species | Condition Factor |
|---|---|
| *S. Membranaceus* | 0.806469±0.3223 |
| *S. courteti* | 0.853509±0.3233 |
| *S. batensoda* | 0.70455±0.1039 |

Key: S=*Synodontis*

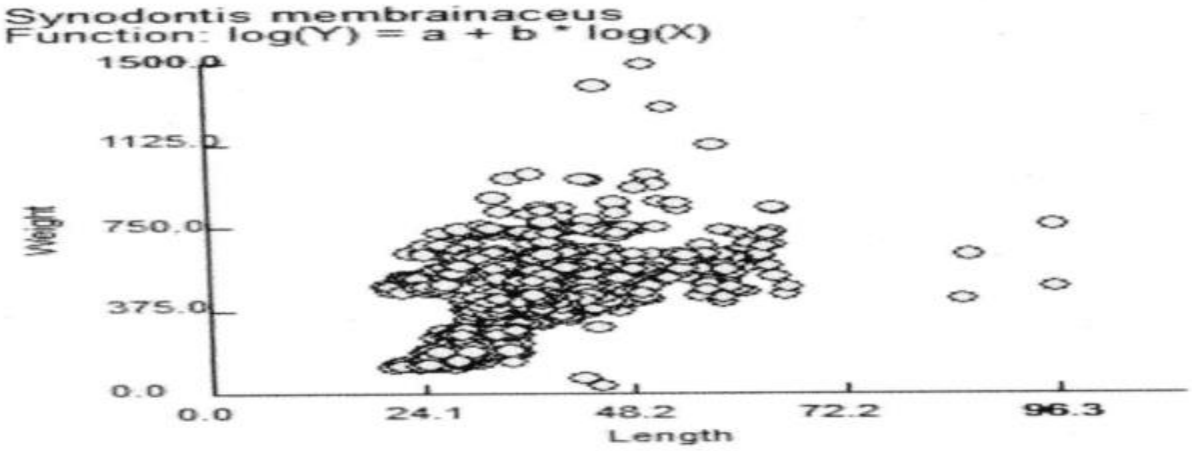



Figure 2: Length(cm) -Weight(g) Relationship (*Synodontis membranaceus*)

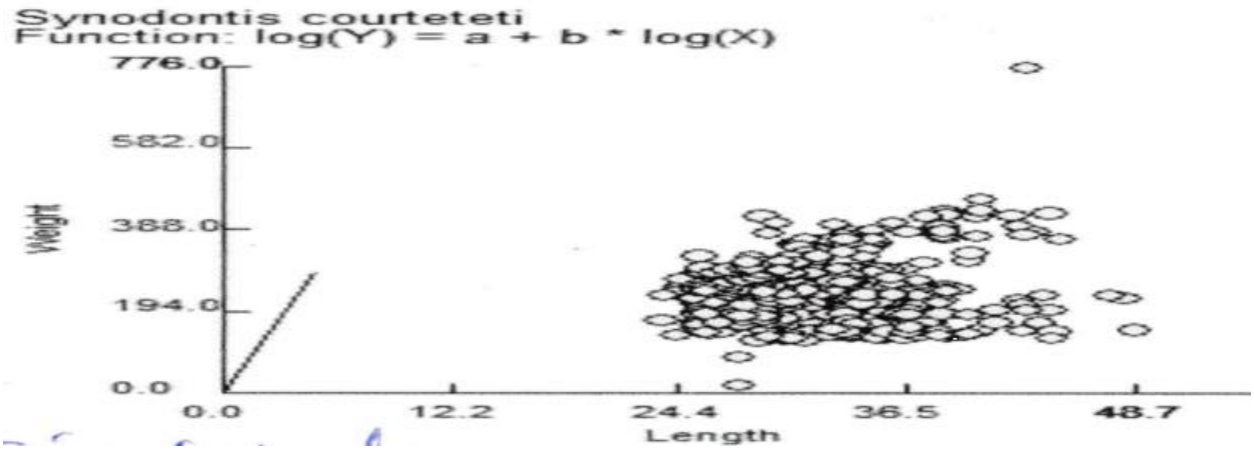



Figure 3: Length(cm) -Weight(g) Relationship (*Synodontis courteti)*

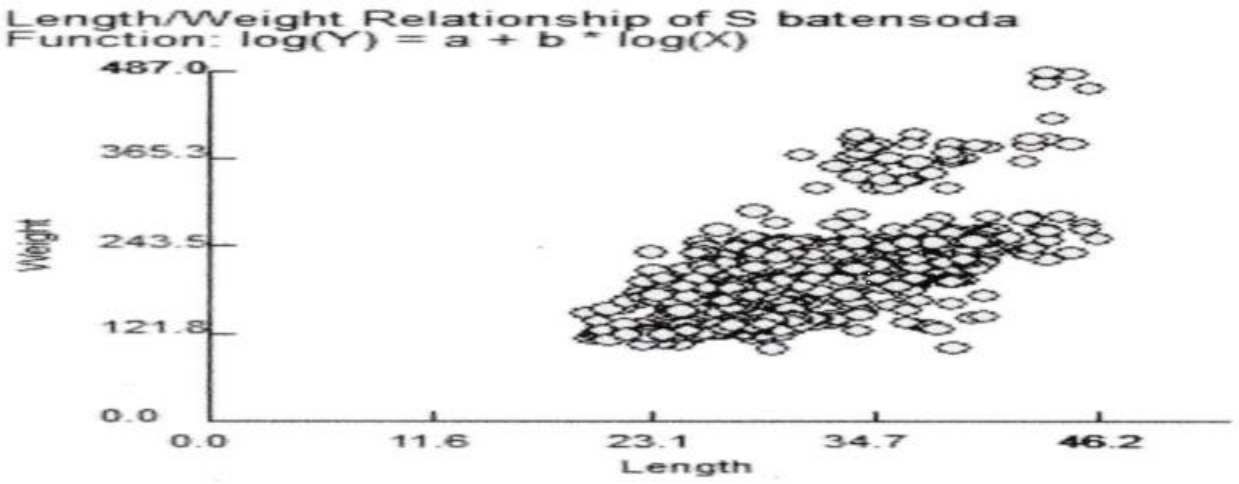



Figure 4: Length(cm) -Weight(g) Relationship (*Synodontis batensoda)*

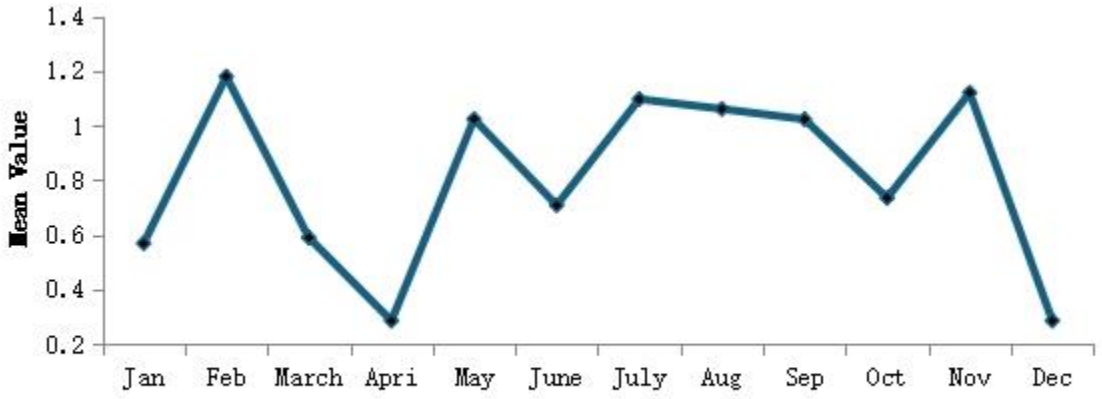



**Figure 5: Monthly condition factor for *S membranaceus***

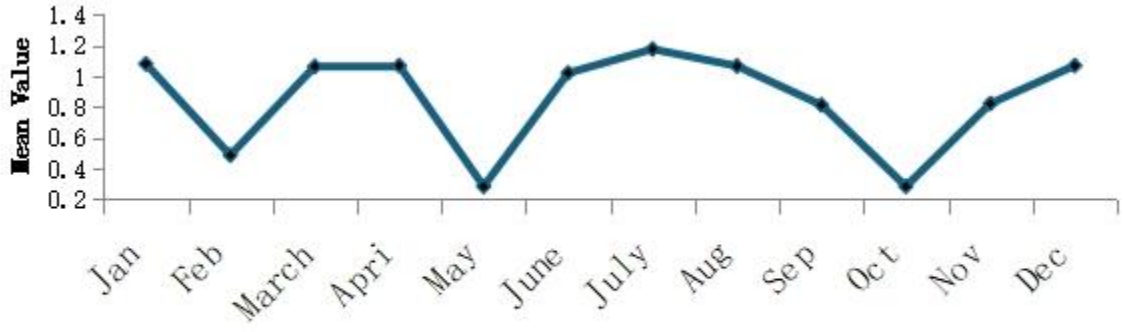



**Figure 6: Monthly condition factor for *S courteti***

**Title**


**Figure 7: Monthly Condition Factor *for S. batensoda***

## DISCUSSION

According to Igwela *et al* (2011) length-weight relationship (LWR) is considered as a crucial tool for learning about the growth trends of different fish species in the aquatic environment. The range of length and weight obtained in this study is contrary to the 7.60 to 20cm and 13.12 to 607.30g reported by Akombo *et al* (2014) from the lower Benue River at Makurdi, Nigeria for *Synnodontis clarais*. The low / weak positive correlation in the length-weight relationship of some species (*S. membranaceus* and *S. courteti*) in this study is contrary to some researches on length-weight relationships like Ayuba (1997) on *Synodontis species* in River Benue at Yola, Abubakar and Edward (2002) on the catfish, Synodontis in the upper Benue River Basin, Yola.It was also different from the report of Akombo *et al* (2011) on the four species of *Synodontis S. nigrita, S. schoutedeni, S.euptera and S. membranaceus* where most species indicated varying growth patterns with most exhibiting positive allometric growth pattern(b>3) and were attributed to environmental influences such as water parameters and habitat availability which significantly affected their growth and health status.

The observed negative allometric growth pattern in this study is in agreement with the findings of Midhat *et al* (2012) who reported values less than 3 for *S. Schall* male and female in River Nile at Gizza. Lalaye *et al.,* (2006) also reported negative allometric growth for *S. Schall and S. nigrita* in Oueme River, Benin. Adeyemi (2010) reported negative allometric growth in River Niger at Idah, Kogi State for *S. robbianus*. Ogamba *et al.,* (2014) reported similar result of negative allometric growth for silver catfish from Odi River, Niger Delta. Asuquo *et al.,* (2015) opined that when a species of fish exhibits negative allometric growth pattern, some conventional population dynamic models which assume isometry in fish growth (b=3) cannot be useful in analysing the population of such species. This result also tallied with the finding of Abowei and Hart (2009) who reported negative allomtric growth pattern from Amassoma River flood plains.

Conditions factor of a fish reflects the well-being of the fish and also gives information when comparing two populations living in certain feeding, density, climates and other conditions when determining the period of gonad maturation and when following up the degree of feeding activity of species to verify whether it is making good use of its source (Abowei 2010, Ighwela *et al.*, 2014). Ighwela *et al.,* (2011) opined that condition factor of a fish could be influenced strongly by both biotic and abiotic environmental conditions and can be used as an index of assessing the status

of the aquatic ecosystem. It could also be influenced by sex, season, age and maturity stages of fish (Edah, *et al.*, 2010).

The ranged of values obtained in this study is in disagreement with the figures (3.3667, 2.6868 and 2.9954) reported by Akombo *et al.,* (2014) for the male, females and combined sexes of *S. clarias* from Benue River. Bagenal and Teschi (1978) earlier recommended range of 2 to 4 condition factor to be suitable for freshwater fishes. This result is also contrary to the range of 2.34 to 4.50 for male and 2.50 to 4.03 for females in *S. resupinatus* at Idah area of River Niger. Baijot *et al* (1997) documented 2.65 to 3.32 while offem *et al.,* (2013) reported the mean range of 0.32 which is less than unity (one) and considered poor.

## CONCLUSION AND RECOMMENDATION

From this result there is correlation between the length and weight of both sexes, but the condition factor showed that the species are extremely in poor condition. During the study, *Synodontis species* and other carnivores were noticed to be readily available and harvested abundantly by the fishers. On this premise, a predator-prey dynamism study should be carried out to ascertain the level of natural mortality caused by predators, so as to monitor predator abundance and the disappearance of prey using mochokids as the object of focus.

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