

Length-Weight Relationship and Condition Factors of Ichthyofauna Species of Okamini Stream, New Calabar River Segment, Rivers State, Nigeria

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Abstract

This study investigated the length–weight relationship and condition factors of ichthyofauna species in Okamini Stream, a segment of the New Calabar River, Rivers State, Nigeria. Fish samples were assessed for length, weight, length–weight relationships and condition factors across sampling Stations and Months and analysed following standard method using identification keys and measuring instruments. Clarias angularis recorded the highest mean length and weight (29.226 cm; 224.632 g), while Coptodon zillii had the lowest size range. Significant spatial differences ($P < 0.05$) occurred in Labeo falcipinnis, Mugil cephalus and Chrysichthys nigrodigitatus, whereas C. zillii and C. angularis showed no significant differences. Length–weight relationships were strong ($R^2 = 0.92–0.98$), with b -values ranging from 2.80 to 3.10. C. zillii and Sarotherodon galilaeus exhibited isometric growth, S. melanotheron positive allometric growth, while the remaining species showed negative allometry. Condition factors ranged from 0.90 to 3.77, with C. zillii recording the highest values and C. angularis the lowest. Overall, most species exhibited favourable conditions.

Keywords: Length-weight relationship, Condition Factor, Ichthyofauna, Okamini Stream, New Calabar Rivers

Introduction

Fish are important components of aquatic ecosystems and valuable sources of food, employment, income and livelihoods, particularly in fishing-dependent communities. The Food and Agriculture Organization emphasizes the importance of reliable biological information for sustainable management of aquatic food systems and conservation of fisheries resources (FAO, 2026). Fish populations are influenced by food availability, reproduction, age, sex, predation, competition, fishing pressure, water quality and seasonal changes. Consequently, biometric parameters such as length-frequency distribution, length-weight relationship (LWR) and condition factor are useful for assessing growth, productivity, population characteristics and general biological condition. The length-weight relationship is expressed as $W = aL^b$, where W is body weight, L is fish length, a is the intercept and b is the growth exponent. A value of b approximately equal to 3 indicates isometric growth, while values below and above 3 indicate negative and positive allometric growth, respectively. LWR is useful for estimating weight from length, comparing growth patterns among populations and supporting fisheries assessment (Froese, 2006; Dienye & Olopade, 2019).

Similarly, Fulton's condition factor ($K = 100W/L^3$) provides an indication of the relative robustness or well-being of fish. However, condition factor can vary with species, age, sex, maturity, feeding, season and environmental conditions and should therefore be interpreted alongside other biological and environmental information. The New Calabar River is an important aquatic system in the Niger Delta, supporting freshwater and brackish-water habitats, fisheries, transportation and local livelihoods. Previous investigations have documented considerable fish diversity, including 61 species belonging to 54 genera, 41 families and 15 orders, with variations in abundance associated with environmental conditions, food availability, fishing pressure and anthropogenic activities (Ibim *et al.*, 2016, Dienye *et al.*, 2025, Ekwueme *et al.*, 2025). The river is also exposed to domestic waste disposal, agriculture, dredging, transportation, industrial discharges and petroleum-related activities, which may alter water quality and fish habitat. Studies have reported the presence of metals in water, sediments and fish tissues, while Stanley *et al.*, (2017) reported elevated cadmium and lead at sampled locations, together with substantial bacterial and coliform counts. Environmental changes can influence fish feeding, growth, reproduction and survival, making LWR and condition factor useful biological indicators when interpreted with ecological information. Assessing these parameters in a defined segment of the New Calabar River can therefore provide updated information on species-specific growth patterns and fish condition, while establishing baseline data for future comparisons. Such information will complement existing studies on fish diversity and environmental conditions and contribute to sustainable fisheries management and conservation of the river's aquatic resources. Although previous studies have examined fish composition and biometric characteristics in the New Calabar River, information remains fragmented across species, locations, fishing gears and sampling periods. Consequently, updated information is needed on the length-weight relationships and condition factors of ichthyofauna within defined river segments to determine current growth patterns and biological condition. Therefore, this study aims to determine the length-weight relationship and condition factors of ichthyofauna inhabiting a selected segment of the New Calabar River, Rivers State, Nigeria, thereby providing current information on their growth patterns and general biological condition.

Materials and Methods

The Okamini River is a tributary of New Calabar River, Rivers State South of Choba, and flows into the Atlantic Ocean (Figure 1). Adjacent to the river are industrial estates, dredging sites and weekly markets in addition to sustenance and commercial fishing, as well as numerous other human activities. The Nun River unlike region has an annual rainfall between 2000 - 3000 mm (Abowei, 2000) and is a rare tidal freshwater body. The highest tidal registration New Calabar river was 2.62m while the lowest was 0.31m with the mean tidal level of 1.52m and mean velocity in a vertical at the reference cross-section on a spring tide of 0.34m/s (Ekpete, 2012).

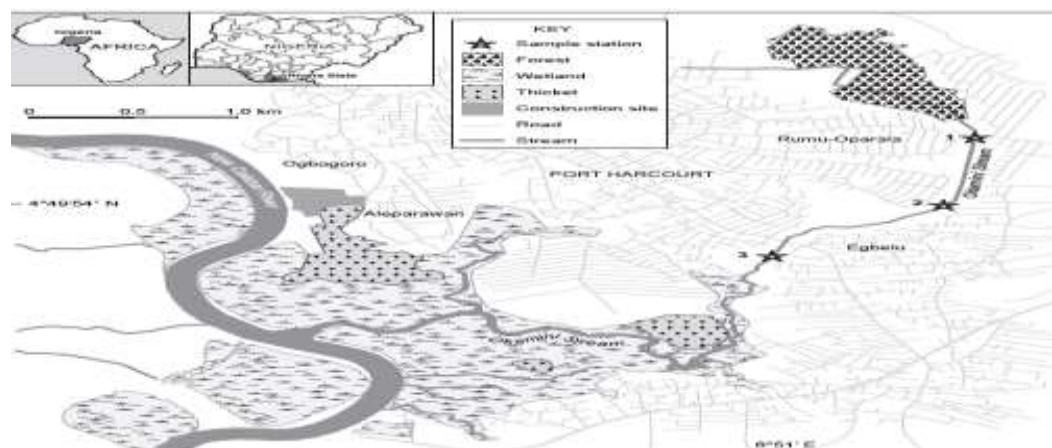


Figure 1: Map of the Study Area Showing the Sampling Stations

Sampling Procedure

The fish samples were collected in an ice pack container from the fish landing sites based on previous arrangements with the fishermen. 10% formalin was used for sample preservation before been transported to fishery laboratory where the fish identification to species level was performed with the aid of reference materials such as Balogun (2006), Idodo-umeh (2003).

3.3. Biometric Data

Fish weight determination

The weights of the fish were determined using electronic weighing balance with the capacity of 10,000g (model: SF-400) (Wang *et al.*,2012).

Length determination

The standard and total length of each fish was determined using a measuring board. The total length was measured from the tip of snout to the longest lobe of the filament of the caudal fin. The margin of lobes was pressed together before measurement. The standard length was measured from the tip of the snout to the point of attachment of the caudal rays ((Wang *et al.*,2012).

Determination of Length-weight relationship

The length-weight relationship for more occurring fish species was determined using the formula described by Le cren (1951) in Wang *et al.* (2012) and Kahraman *et al.* (2014) as follow: $W = aL^b$ and were transformed into logarithms before calculation and therefore becomes:

$$\text{Log } W = a + b \text{ Log } L$$

Where

W = weight in grams, L = total length in centimeter, a = constant/intercept , b = an exponent/slope.

The 95% confidence interval (CI) of b was computed using the equation:

$$CI = b \pm (1.96 \times SE)$$

Where SE is the standard error of b

3.3.4 Determination of Condition factor (K)

The condition factors (K) were estimated for individual fish species using the formula by Pauly (1993) and Froese (2006) as follow:

$K = 100W/L^3$ Where W = weight, L = total length

Results

Tables 1–2 and Figure 4.1 showed the length and weight of ichthyofauna in Okamini Stream. *Clarias angularis* had the highest mean length and weight (29.226 cm; 224.632 g), with ranges of 18.00–41.00 cm and 120.00–360 g, followed by *Mugil cephalus* (22.424 ± 5.45 cm; 148.298 ± 48.396 g). *Coptodon zillia* had the lowest ranges (12.00–18.00 cm; 99.18–139 g). No significant spatial differences occurred in *C. zillia* and *C. angularis*, while *L. falcipinnis*, *M. cephalus* and *C. nigrodigitatus* differed significantly ($P < 0.05$). Mean values were highest at Station 2. Table 3 showed that b-values ranged from 2.80 ± 0.613 (*C. nigrodigitatus*) to 3.10 ± 0.331 (*S. melanotheron*), while a-values ranged from 0.009 (*C. angularis*) to 0.27 (*C. zillia*). R^2 ranged from 0.92 to 0.98. *C. zillia* and *S. galileus* showed isometric growth, *S. melanotheron* positive allometry, while the remaining species showed negative allometry. Tables 4–6 showed overall condition factors of 0.90 ± 0.06 – 3.77 ± 0.82 , with the highest in *C. zillia* and lowest in *C. angularis*. Monthly values ranged from 3.565–3.910 (*C. zillia*) to 0.793–1.048 (*C. angularis*). Most species remained above unity, while *C. angularis* was below 1 from August to November before increasing above 1. Spatially, *C. zillia*, *S. galileus* and *S. melanotheron* recorded values of 2–4, with *C. zillia* highest (4.110) at Station 3. *C. angularis* had the lowest spatial range (0.850–0.974), while most species recorded their highest values at Station 3

Table 1: Overall Mean Values of ICTHYOFAUNA Species in the Study Area

Fish Species	Mean	Std Dev	Minimum	Maximum
<i>Coptodon zillia</i> (LA)cm	14.598	2.232	12.000	18.000
Weight(g)(WA)	117.073	18.837	99.8.000	139.000
<i>Sarotherodon galileus</i> (LB)cm	17.438	4.9664	9.0	26.0
Weight(WB)g	136.131	74.8789	53.0	236.0
<i>S. melano</i> (LC)cm	20.264	3.307	14.000	25.000
Weight(WC)g	206.987	33.0098	150.0	245.9
<i>Clarias angularis</i> (LD)cm	29.226	6.708	18.000	41.000
Weight(WD)g	224.632	62.069	120.000	360.00
<i>Liza falcipinnis</i> (LE)cm	20.750	6.4348	16.0	27.0
Weight(WE)g	154.828	55.1998	98.8.0	270.0
<i>Mugil cephalus</i> (LF)cm	22.424	5.4583	16.0	30.6
Weight(WF)g	148.298	48.396	110.000	245.00
<i>Chrysichtys nigrodigitatus</i> (LG)cm	19.167	5.566	16.000	25.500
Weight(WG)g	99.945	33.0245	60.0	146.0

Table 2: Spatial Mean Length-Weight of Ichthyofauna (Fishes) Species in the Study Area

	Length(cm)/ weight(g)	STN 1	STN 2	STN 3
<i>Coptodon zillia</i>	L	14.876±1.50 ^a	14.745±1.37a	14.15±3.32a
	W	116.40±9.91 ^a	118.27±9.509a	116.43±30.23a
<i>Sarotherodon galileus</i>	L	16.914±4.59 ^a	17.818±4.302a	17.551±5.943 ^a
	W	125.675±74.03 ^b	139.988± 71.944a	142.494±78.750a
<i>S. melanotheron</i>	L	19.731±2.712a	20.859±1.993a	20.141±4.669a

	W	201.442±27.425a	212.240±19.919a	206.831±46.522a
<i>Clarias angularis</i>	L	29.561±5.728a	29.505±5.935a	28.577±8.294a
	W	219.757±58.575b	226.706±57.147a	227.294±70.723a
<i>Liza falcipinnis</i>	L	22.366±2.465a	22.394±2.128a	17.304±10.066a
	W	163.861±33.906a	168.014±32.000a	131.161±80.263b
<i>Mugil cephalus</i>	L	22.906±5.332a	23.323±3.365a	20.947±7.002b
	W	149.58±48.014b	155.33±41.754a	139.25±54.473b
<i>Chrysichtys nigrodigitatus</i>	L	19.738±4.673a	20.766±1.917a	16.827±7.904b
	W	99.348±29.158b	109.626±18.547a	89.901±44.511b

Key: Means with similar superscript across the row are not significantly different at P<0.05, L=Length, W=Weight.

Table 3: Growth Parameters of the Ichthyofauna Species in Okamini Stream

<u>Species</u>	<u>Length (cm)</u>	<u>Weight (g)</u>	<u>a</u>	<u>b</u>	<u>R²</u>	<u>Growth Type</u>
<i>Coptodon zillia</i>	14.598	117.073	0.027±0.10	3.00±0.06	0.98	Isometric
<i>Sarotherodon galileus</i>	17.438	136.131	0.025±0.21	3.00±0.07	0.97	Isometric
<i>S. melanotheron</i>	20.264	206.987	0.025±0.21	3.10±0.05	0.96	Positive allometric
<i>Clarias angularis</i>	29.226	224.632	0.009±0.25	2.70±0.31	0.94	Negative allometric
<i>Liza falcipinnis</i>	20.750	154.828	0.017±0.27	2.90±0.04	0.95	Negative allometric
<i>Mugil cephalus</i>	22.424	148.298	0.013±0.26	2.85±0.03	0.93	Negative allometric
<i>Chrysichtys nigrodigitatus</i>	19.167	99.945	0.014±0.27	2.80±0.04	0.92	Negative allometric

Table 4: Mean Condition Factors of Ichthyofauna Species in the Area

<u>Species</u>	<u>Length (cm)</u>	<u>Weight (g)</u>	<u>Condition Factor (K)</u>	<u>Interpretation</u>
<i>Coptodon zillia</i>	14.598	117.073	3.77±0.82	Very robust; excellent health and food availability
<i>Sarotherodon galileus</i>	17.438	136.131	2.57±0.67	Good condition; healthy and well-fed
<i>S. melanotheron</i>	20.264	206.987	2.49±0.62	Good condition; typical for balanced populations
<i>Clarias angularis</i>	29.226	224.632	0.90±0.06	Poor condition; underweight, possible stress or low food
<i>Liza falcipinnis</i>	20.750	154.828	1.74±0.83	Moderate condition; adequate but not optimal
<i>Mugil cephalus</i>	22.424	148.298	1.32±0.62	Fair condition; slightly lean, may face resource limits

<u>Species</u>	<u>Length (cm)</u>	<u>Weight (g)</u>	<u>Condition Factor (K)</u>	<u>Interpretation</u>
<i>Chrysichtys nigrodigitatus</i>	19.167	99.945	1.42±0.55	Fair condition; below average, potential habitat issues

Table 5: Monthly Values of Condition Factors Itchyofauna Species in the Study Area

	<u>August</u>	<u>September</u>	<u>October</u>	<u>November</u>	<u>December</u>	<u>January</u>
<i>Coptodon zillia</i>	3.818	3.565	3.889	3.91	3.662	3.686
<i>Sarotherodon galileus</i>	4.406	2.469	2.329	2.453	2.269	2.683
<i>S. melanotheron</i>	3.069	2.284	2.352	2.37	2.383	2.631
<i>Clarias angularis</i>	0.868	0.846	0.793	0.879	1.047	1.048
<i>Liza falcipinnis</i>	1.560	1.668	1.495	1.421	2.619	2.182
<i>Mugil cephalus</i>	1.157	1.000	1.164	1.269	1.541	1.843
<i>Chrysichtys nigrodigitatus</i>	1.055	1.410	1.265	1.317	2.052	1.379

Table 6: Spatial Values of Condition Factors of Itchyofauna Species in the Study Area

	<u>ST 1</u>	<u>ST 2</u>	<u>ST3</u>
<i>Coptodon zillia</i>	3.536	3.689	4.110
<i>Sarotherodon galileus</i>	2.557	2.475	2.636
<i>S. melanotheron</i>	2.622	2.339	2.530
<i>Clarias angularis</i>	0.850	0.883	0.974
<i>Liza falcipinnus</i>	1.465	1.496	2.531
<i>Mugil cephalus</i>	1.244	1.224	1.515
<i>Chrysichtys nigrodigitatus</i>	1.292	1.224	2.014

Discussion

The marked differences in body size among species indicate variation in growth potential, age composition, body morphology, feeding strategy and habitat utilization. The relatively large size of *C. angularis* in Okamini Stream may be associated with its ecological characteristics and ability to exploit available food resources. Species of *Clarias* are adapted to diverse aquatic habitats and food resources, which can support substantial growth under favourable conditions (de Graaf and Janssen, 1996). However, body size is influenced not only by environmental conditions but also by age, sex, maturity, reproductive status, fishing pressure and gear selectivity. The size range recorded in Okamini Stream is comparable with observations from other Niger Delta systems. Dienye and Olopade (2019), who studied 26 fish species in the New Calabar River, reported mean total lengths ranging from 8.79 ± 0.25 cm in *Caranx hippos* to 31.48 ± 4.93 cm in *Sphyrna barracuda*, demonstrating substantial interspecific size variation. The mean length of *C. angularis* in the present study therefore falls within the broad size spectrum reported for Niger Delta fishes. However, comparisons should be made cautiously because fishing gear, mesh size, season and habitat can influence size distributions. Dienye and Olopade (2019) used cast nets with 1.5 and 2.5 cm mesh sizes, highlighting the importance of sampling methodology. Significant spatial differences in *Labeo falcipinnis*, *Mugil cephalus* and *Chrysichthys nigrodigitatus* ($P < 0.05$),

together with non-significant differences in *C. zillii* and *C. angularis*, indicate variation in population structure among stations. The greater mean length and weight at Station 2 may reflect more favourable conditions, including food availability and shelter. Such spatial heterogeneity may result from differences in depth, current velocity, substrate, vegetation, nutrients and anthropogenic influence. Similar variation in fish size has been documented in the New Calabar River (Olopade *et al.*, 2018). The relatively smaller size range of *C. zillii* in Okamini Stream may reflect differences in population structure or recruitment. Olopade *et al.* (2018) reported total lengths of approximately 13–17 cm among cichlids in the New Calabar River, while Oladimeji *et al.* (2025) found population-specific differences in the size and condition of *C. zillii* among Aiba Reservoir, Asejire Reservoir and Igbokoda River. These findings emphasize the influence of local waterbody characteristics on fish growth and population structure.

Length–weight relationship

The length–weight relationship provides useful information on fish growth, biomass and population structure. In the present study, the exponent (b) ranged from 2.80 ± 0.613 in *C. nigrodigitatus* to 3.10 ± 0.331 in *Sarotherodon melanotheron*, while intercept (a) values ranged from 0.009 in *C. angularis* to 0.27 in *C. zillii*. The high coefficients of determination ($R^2 = 0.92–0.98$) indicate strong relationships between length and weight, showing that changes in body length were closely associated with changes in body weight (Balogun *et al.*, 2026). The occurrence of different growth patterns within the same assemblage agrees with findings from the New Calabar River. Dienye and Olopade (2019) reported b values ranging from 2.13 in *Ethmalosa fimbriata* to 3.53 in *Pelmatolapia mariae*, indicating negative, isometric and positive allometric growth within the same river. Similarly, Olopade *et al.* (2018) recorded an isometric b value of 3.00 for *S. galilaeus*, with $R^2 = 0.98$, closely corresponding to the present result for the species. These similarities suggest some consistency in length–weight relationships among populations in the Niger Delta.

The b value of 2.80 recorded for *C. nigrodigitatus* indicates negative allometric growth and is higher than the mean value of 2.080 reported by Godwin and Agarin (2016) for the lower New Calabar River. Differences between the populations may reflect variation in food availability, environmental conditions, size range, maturity, sex composition, seasonality and fishing pressure. Likewise, Oladimeji *et al.* (2025) reported negative allometric growth for *C. zillii* in Aiba Reservoir, Asejire Reservoir and Igbokoda River, contrasting with the isometric growth observed in the present study. For *S. melanotheron*, the positive allometric growth recorded in Okamini Stream ($b = 3.10 \pm 0.331$) differs from the negative allometry reported by Ajibare and Loto (2022) in Lagos Lagoon ($b = 2.36$) and Ogidiaka *et al.* (2021) in the Forcados River Estuary ($b = 2.1299$). However, Kumolu-Johnson and Ndimele, (2011) reported isometric growth for the species in Ologe Lagoon. Similarly, Moslen and Miebaka (2017) documented both positive and negative allometric growth in *M. cephalus* from a Niger Delta tidal creek, including an approximately isometric value of 3.003 during one sampling period.

Coefficient of determination and strength of the length–weight relationship

The R^2 values of 0.92–0.98 obtained in the present study indicate strong relationships between length and weight in all the species examined. This implies that a substantial proportion of the variation in body weight can be explained by variation in body length. The results compare favorably with those of Olopade *et al.* (2018), who obtained R^2 values ranging from 0.82 to 0.98 among cichlid species in the New Calabar River. The highest value of 0.98 was recorded for *S.*

galilaeus, which is identical to the upper R^2 value obtained in the present study. Dienye and Olopade (2019) also reported strong positive relationships between length and weight for most fish species sampled from the New Calabar River. The high R^2 values obtained in Okamini Stream therefore indicate that the sampled populations had relatively consistent length–weight relationships. However, the strength of the regression does not necessarily imply that all individuals were in identical physiological condition. Body weight can be influenced by gonadal development, gut fullness, fat reserves, parasites and other biological factors that are not directly captured by the length–weight regression.

Condition factor of the fish species

The high condition factor recorded for *C. zillii* is consistent with observations from the New Calabar River. Dienye and Olopade (2019) reported a mean value of about 2.20 for *C. zillii*, while Olopade *et al.* (2018) recorded 1.95 ± 0.06 – 2.22 ± 0.11 among cichlids, indicating generally favourable conditions. However, the values in Okamini Stream were higher than those reported by Oladimeji *et al.* (2025), who recorded 1.92–2.03 for *C. zillii* in three Southwest Nigerian water bodies. Such differences may reflect variation in food availability, environmental productivity, body size, reproductive status, season and methodology. Comparable values have been reported in other Nigerian coastal waters, with Ajibare and Ayeku (2024) recording 2.04–2.53 for *S. melanotheron* and *T. guineensis* and Ajibare and Loto (2022) reporting mean values of 1.64 and 2.04, respectively, in Lagos Lagoon. Temporal variation in condition factor may result from changes in food availability, hydrological conditions, reproductive activity and energy expenditure. The decline in *C. angularis* condition between August and November may therefore reflect reduced food availability or increased energetic demands. Seasonal variation has also been reported by Moslen and Miebaka (2017) for *M. cephalus* and *O. niloticus* in a Niger Delta tidal creek, and by Ayoade and Ikulala (2007) for *H. bimaculatus*, *S. melanotheron* and *C. guentheri* in Eleiyele Lake. The subsequent recovery of *C. angularis* condition above 1 may indicate improved feeding conditions or reduced energetic demands. Similar monthly fluctuations have been documented for *S. melanotheron* in the Forcados River Estuary (Ogidiaka *et al.*, 2021). Spatially, *C. zillii*, *S. galilaeus* and *S. melanotheron* recorded condition factors between 2 and 4, with *C. zillii* reaching 4.110 at Station 3, whereas *C. angularis* recorded the lowest range (0.850–0.974). Most species had their highest values at Station 3, suggesting differences in food availability, habitat quality or environmental stress among stations. Although Station 2 had the highest mean length and weight, Station 3 generally had the highest condition factors, indicating that body size and relative robustness may respond differently to environmental conditions. Similar spatial variation was reported by Dienye and Olopade (2019) in the New Calabar River. The high condition of *C. zillii* at Station 3 may also reflect its ability to exploit diverse food resources, while Oladimeji *et al.* (2025) similarly found differences in *C. zillii* condition among Nigerian water bodies.

Conclusion

The study revealed variation in fish size, growth and condition. *Clarias angularis* had the highest mean length and weight, while *Coptodon zillii* recorded the lowest size range. Length–weight relationships were strong ($R^2 = 0.92$ – 0.98), with species showing isometric, positive and negative allometric growth. Most fishes were in favourable condition, although the low condition of *C. angularis* from August to November suggests possible seasonal effects of food availability, reproduction or environmental conditions.

The

Recommendations

Based on the findings of the study, it was recommended that fish length, weight, length–weight relationship and condition factor should be monitored periodically to establish long-term trends in the health and population structure of the fish community while domestic, agricultural and industrial waste entering Okamini Stream should be properly controlled by routine environmental monitoring of the study area.

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