



Length-Weight Relationship and Condition Factor of Four Commercial Fish Species of Oyan Lake, Nigeria



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Abstract

This study evaluated the Length-Weight Relationship of four commercially available fish species (*Coptodon zillii*, *Oreochromis niloticus*, *Chrysichthys nigrodigitatus* and *Brycinus nurse*) of Oyan Lake. Eighty adult individuals of each fish species were procured from fishermen in Oyan Lake over a period of 4 months. The fish species were put in sterile polythene bags and taken in icebox to the laboratory. Weight and length of individual fish were measured using Metler balance and a measuring board respectively. Length-weight relationship was analyzed using the equation $W=aL^b$. The condition factor of the fish species was determined using the equation, $K=100W/L^3$. The female fish species recorded higher mean Total Length (TL) and mean weight (Wt) in all four fish species examined. However, there was no significant difference ($P>0.05$) in the mean total body length, mean standard length and mean body weight between the female and the male fish species. The length-weight relationship was observed to be significantly strong ($P=0.01$) in all the four fish species evaluated with Coefficient of determination (R^2) and the Correlation co-efficient (r) ranging from 0.893 to 0.991. The condition factor (K) was higher in *Coptodon zillii*, followed by *Oreochromis niloticus*, *Brycinus nurse* and *Chrysichthys nigrodigitatus*. The growth pattern of *Chrysichthys nigrodigitatus* was Positive Allometric while the growth pattern of *Coptodon zillii*, *Oreochromis niloticus* and *Brycinus nurse* were Negative Allometric.

Keywords: Fish; Length; Growth pattern; Bioaccumulation

Introduction

The knowledge of quantitative aspects such as length-weight relationship, condition factor, growth and mortality of fishes are important tools for studying fishing biology [1]. Length-weight relationships can be used to predict weight from length measurements made in the yield assessment [2]. As reported by Nehemia et al. [3] fish can attain either isometric growth, negative allometric growth or positive allometric growth. Isometric growth is associated with no change of body shape as an organism grows. Negative allometric growth implies that the fish becomes slenderer as it increases in weight while positive allometric growth implies the fish becomes relatively stouter or deeper-bodied as it increases in length [4]. In fish, the condition factor has been shown to reflect through its variations, information on the physiological state of the fish in relation to its welfare [5]. It also gives information when comparing two populations living in certain feeding, density, climate, and other conditions; when determining the period of gonadal maturation and when following up the degree of feeding activity of a species to verify whether it is making good use of its feeding source [6,7]. According to Lizama [1], the study of the condition factor is important to understand the life cycle of fish species and contributes to adequate management of the species. Hence, maintaining the equilibrium in the ecosystem [8]. As reported by Fafioye and Oluajo [9], the length-weight relationships data for fresh water and brackish water fish resources of Nigeria are limited. Such water body with limited data on its fish length-

weight relationship is the Oyan Lake, Nigeria. The lake is a tributary of the Ogun River used primarily to supply raw water to Lagos and Abeokuta. It is a significant source of fish for the people living in and around Abeokuta. Fish from the lake constitute a great proportion of both fresh and processed fish sold in major fish markets in Abeokuta. To study the condition of the available fish species of Oyan Lake, this study therefore evaluated the length-weight relationship, condition factor and growth patterns of four commercially available fish species (*Coptodon zillii*, *Oreochromis niloticus*, *Chrysichthys nigrodigitatus* and *Brycinus nurse*) of the Lake.

Study Area

This study was carried out at the Oyan River Lake located in Abeokuta North Local Government Area of Ogun State, south-west of Nigeria (7°15'N; 3°16'E). The lake is a tributary of the Ogun River used primarily to supply raw water to Lagos and Abeokuta.

Materials and Method

Sample collection

Eighty (80) adult fish specimens, twenty each of *Coptodon zillii*, *Oreochromis niloticus*, *Chrysichthys nigrodigitatus*, and *Brycinus nurse* were procured from fishermen in Oyan Lake over a period of 4 months. The fish species were put in sterile polythene bags and taken in icebox to the laboratory. The total length (cm) and the body

wet weight (g) of each of the fish samples were measured. Fish were mopped on a pile of filter paper before being weighed to remove excess water from their body in order to ensure accuracy. Weight and length of each individual fish were measured by using a Metler balance and a measuring board respectively. The total lengths (cm) were measured as distance from the snout with mouth closed to the tip of the caudal fin.

Length-weight relationship

The Length-weight relationship was analyzed by using the equation $W=aL^b$ [2]. Where W =weight of fish in gram; L =Length of fish in cm; a =describe the rate of change of weight with length (intercept); and b =weight at unit length (slope). The equation was log transformed to estimate the parameters 'a' and 'b'. When b is equal to three (3), isometric pattern of growth occurs but when b is not equal to 3, allometric pattern of growth occurs, which may be positive if >3 or negative if <3 [3]. The condition factor which shows the degree of well-being of the fish in their habitat was determined by using the equation, $K=100W/L^b$ [10]; whereby K =condition factor; W =the weight of the fish in gram (g); L =the total length of the fish in centimeters (cm); and b =the value obtained from the length-weight equation.

Table 1: Length weight parameters of both sexes of the fish species

	Sex	TL Range	Mean TL (cm)	Mean SL (cm)	Mean Wt (g)
<i>Chrysichthys nigrodigitatus</i>	Male	21.00-26.00	23.02±1.02	17.80±0.97	91.20±14.54
	Female	20.70-26.00	23.38±0.94	17.50±0.69	98.60±12.31
<i>Brycinus nurse</i>	Male	18.10-26.00	20.64±1.39	18.52±1.83	104.60±29.65
	Female	19.50-30.00	22.44±1.93	19.00±1.51	138.80±33.96
<i>Oreochromis niloticus</i>	Male	19.80-26.50	22.09±0.76	17.89±0.51	208.38±21.14
	Female	20.00-26.00	23.00±3.00	18.85±2.35	253.00±103.00
<i>Coptodon zillii</i>	Male	16.50-25.00	18.67±1.09	15.21±0.78	141.43±23.42
	Female	17.50-23.00	19.90±1.63	16.00±1.32	166.00±39.40

Mean significant between the male and the female at $P<0.05$ (Independent sample T-test); TL=Total length; SL=Standard length; Wt=Weight

Length-weight relationship of the fish species

Table 2: Length-weight relationship of the fish species of Oyan Lake

Fish spp	Total length (cm) (±SE)	Weight (g) (±SE)	a	B	r	R ²	P-Value
<i>Coptodon zillii</i>	19.04±0.87	148.80±19.33	-1.101	2.545	0.991	0.982	0.01*
<i>Oreochromis niloticus</i>	22.27±0.76	217.30±23.44	-1.44	2.793	0.954	0.91	0.01*
<i>Chrisichthys nigrodigitatus</i>	23.20±0.66	94.90±9.06	-2.694	3.411	0.975	0.951	0.01*
<i>Brycinus nurse</i>	21.54±1.16	121.70±22.00	-1.828	2.908	0.945	0.893	0.01*

*Significant relationship exists; SE=Standard error; R²=Coefficient of determination; r=Correlation co-efficient; a=Rate of change of weight with length (intercept); b=weight at unit length (slope)

The Length-Weight relationship of *Coptodon zillii*, *Oreochromis niloticus*, *Brycinus nurse* and *Chrysichthys nigrodigitatus* from Oyan Lake is presented in Table 2. The length-weight relationship was observed to be significant ($P=0.01$) in all the four fish species evaluated. Similarly, the Length-Weight relationship was very

Data analysis

Data were subjected to statistical analyses using the Statistical Package for Social Sciences (SPSS) version 20.0 [11]. Analysis of Variance (ANOVA) and descriptive statistics were used to compare the condition factor (K) between the fish species. Means were presented as Mean±Standard error of mean. Means were separated using the Student-Newman-Keuls (SNK). Independent Sample -Test was also used to compare length and weight parameters between the male and the female fish. P-value was set at 0.05. The regression of weight against length was also computed from the logarithmic formula: $\log a + b \log L$.

Results

Length weight parameters of the fish species

Table 1 represents the length weight parameters of both sexes of the fish species of the Oyan Lake. The female fish species recorded higher mean Total Length (TL) and mean weight (Wt) in all the four fish species examined. However, there was no significant difference ($p>0.05$) in the mean total body length, mean standard length and mean body weight between the female and the male fish species.

strong in the fish species with the Coefficient of determination and the Correlation co-efficient ranging from 0.893 to 0.991 (Table 2). The graphical representation of the Length-Weight relationship of the fish species is represented in Figure 1.

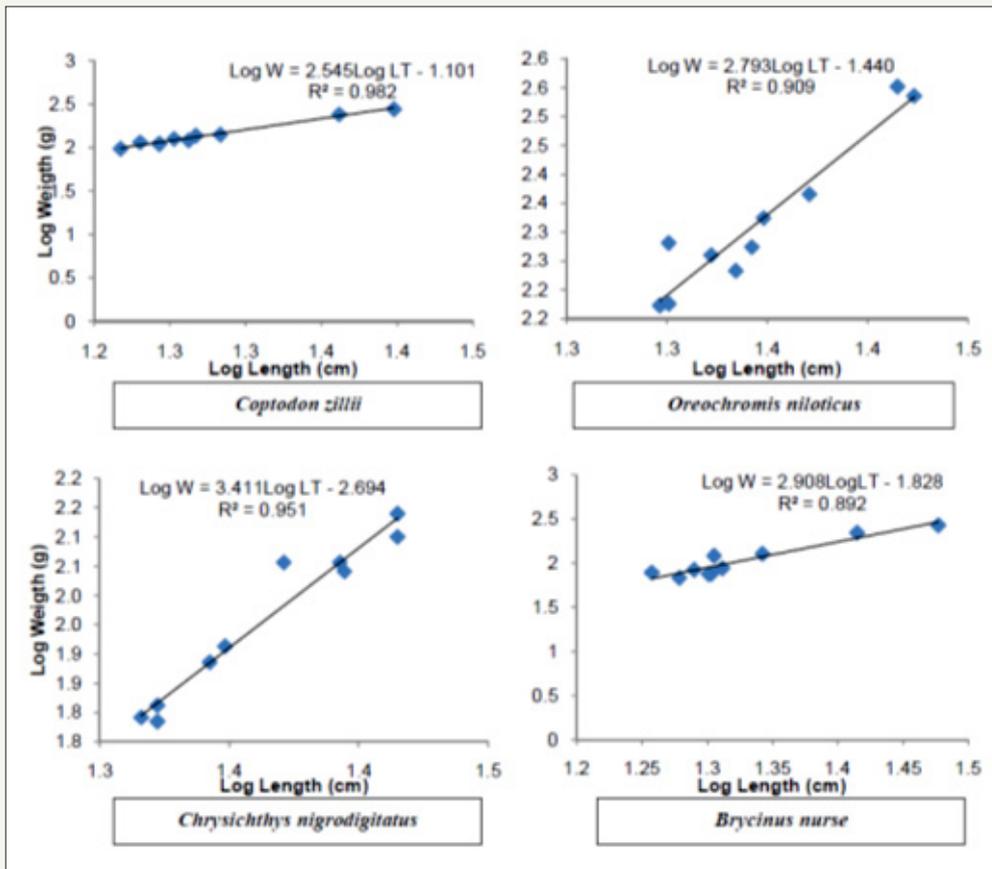


Figure 1: Length-weight relationships of *Coptodon zillii*, *Oreochromis niloticus*, *Chrysichthys nigrodigitatus* and *Brycinus nurse*.

Condition factor, growth pattern and exponential equation

The condition factor, growth pattern and exponential equation of the fish species of Oyan Lake are represented in Table 3. The condition factor (K) was significantly ($p < 0.05$) different between the different fish species. This was higher in the *Coptodon zillii* and

followed by *Oreochromis niloticus*, *Brycinus nurse* and *Chrysichthys nigrodigitatus* respectively. The growth pattern of *Chrysichthys nigrodigitatus* was identified as Positive Allometric (b value greater than 3.0) while the growth pattern of *Coptodon zillii*, *Oreochromis niloticus* and *Brycinus nurse* were identified as Negative Allometric (b value less than 3.0). The length-weight equation obtained for each of the fish species is also presented in Table 3.

Table 3: Condition factor, growth pattern and exponential equation of the fish species of Oyan Lake.

	Condition Factor (K)	B	Growth Type	Exponential Equation
<i>Coptodon zillii</i>	2.09±0.05 ^a	2.793	Negative Allometric	Wt=1.101(TL) ^{2.55}
<i>Oreochromis niloticus</i>	1.92±0.06 ^b	2.545	Negative Allometric	Wt=1.440(TL) ^{2.79}
<i>Chrysichthys nigrodigitatus</i>	0.74±0.02 ^d	3.411	Positive Allometric	Wt=2.694(TL) ^{3.41}
<i>Brycinus nurse</i>	1.14±0.06 ^c	2.908	Negative Allometric	Wt=1.828(TL) ^{2.91}

^{abc}Mean (±Standard error) having similar superscript is significantly different at $P < 0.05$. Wt=Weight; TL=Total Length

Discussion

This present study has demonstrated the variations in the condition factor, growth pattern and the length-weight relationship of the commercially available fish species of Oyan Lake, Nigeria (*Coptodon zillii*, *Oreochromis niloticus*, *Chrysichthys nigrodigitatus*, and *Brycinus nurse*). *C. zillii* was highest in condition factor (K) than the other fish species of Oyan Lake evaluated. In fisheries science, the condition factor is used in order to compare the condition, fatness or wellbeing of fish [5]. Condition factor is also a useful index for monitoring of feeding intensity, age and growth

rates in fish [12]. As reported by Abobi and Ekau [13], condition factor defines the state of wellbeing of the fish and reflects through variations, some information on the physiology of the fish, and it is assumed that the higher the value of condition factor, the better the state of wellbeing. Hence, it could be suggested that the condition of Oyan Lake is more favourable to *C. zillii* than the other fish species evaluated. Condition factor (K) recorded in *C. zillii*, *B. nurse* and *O. niloticus* were greater than one (>1). Nehemia et al. [3] earlier reported that K-value which is greater than one signifies that a fish is in good condition. K-values greater than one as recorded for *C.*

zillii, *B. nurse* and *O. niloticus* in this study could therefore be an indication that Oyan Lake provide a good habitat for these fishes to thrive. On the other hand, K-value less than one as recorded for *C. nigrodigitatus* suggested that the conditions of Oyan Lake might not be completely favourable for the well-being of the fish. Fafioye and Oluajo [9] also reported a K-value less than one for *Chrysichthys nigrodigitatus* in Epe Lagoon, Nigeria.

The length-weight relationship (LWR) is an important tool that provides information on growth patterns and growth of animals [5]. The b values in length-weight relationships have been used to determine the growth pattern of fish species. According to Alam et al. [14], the value of b is an exponent indicating an isometric growth when equal to 3 and indicating an allometric growth when significantly different from 3. From this study, *C. zillii*, *B. nurse* and *O. niloticus* were observed to have a negative allometric growth pattern with b value less than 3.0. Earlier researches reported that negative allometric growth pattern with b value less than 3.0 exist in *C. zillii* [8,3,15,16], in *B. nurse* [17] and in *O. niloticus* [8,16]. However, *C. nigrodigitatus* had a positive allometric growth pattern with b value greater than 3.0. A similar result was reported for *C. nigrodigitatus* of Epe Lagoon, Nigeria [9]. The values of R² ranged from 0.893 to 0.982 in *B. nurse*, *O. niloticus*, *C. zillii* and *C. nigrodigitatus* and all regressions were highly significant (P = 0.01). This was an indication that the body weight of the fish species could be estimated with a high degree of accuracy from known standard lengths [17,18].

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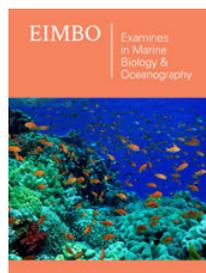
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