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ARTICLE

Length-weight Relationship and Condition Factor of Sarotherodon Melanotheron (Perciformes: cichlidae) from Forcados River Estuary, Niger Delta, Nigeria

Efe Ogidiaka* **John Atadiose** **Betty O. Bekederemo**

Department of Science and Technology, Fisheries and Fisheries Technology, Delta State School of Marine Technology, Burutu, Delta State, Nigeria

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ABSTRACT

Length-weight relationship (LWR), condition factor (k) of the black chin tilapia, *Sarotherodon melanotheron* (Rüppel, 1852) from Forcados River estuary Nigeria was investigated. The fish were collected monthly from fishermen for a period of 24 months (between April 2012 and March 2014). 699 specimens of the fish species were collected. The Length-weight relationship (LWR) of the fish was evaluated using the equation: $W = a L^b$ while the condition factor of the fish was determined using the equation; $K = 100W L^b$. The standard length of sampled *S. melanotheron* ranged from 4.15 to 18.92 cm, total length 6.01 and 22.5 cm while the weight ranged from 7.85 - 286.71 g. The b value 2.1299 was less than 3 indicating that the growth pattern of the fish was allometric. The correlation co-efficient (r) value for *S. melanotheron* was 0.7528. The condition factor for the combined sexes fluctuated monthly. The length-weight relationships and condition factor of *S. melanotheron* in Forcados river estuary indicated that the fish were above average condition.

1. Introduction

Cichlids are important ecological and commercial inexpensive food fishes of tropical fresh and brackish water bodies (King and Etim 2004; Abdul 2009) [1.2]. With *Sarotherodon melanotheron* commonly called "Black chin tilapia" reported as one of the most important brackish water species in the Niger Delta region of Nigeria (Ayoade and Ikulala, 2007) [3]. *S. melanotheron* has also been found in Central Africa lagoons and estuaries (Amoussou et al., 2018) [4].

This fish, is highly valued for its edible flesh, low cost and availability for local populations (Guissé and Niass, 2021) [5]. However, information on its growth characteristics in Forcados River estuary seems to be scarce, hence this study. According to Egborge (1994) [6], *S.*

*Corresponding Author:
Efe Ogidiaka,
Department of Science and Technology, Fisheries and Fisheries Technology, Delta State School of Marine Technology, Burutu, Delta State, Nigeria;
Email: efeogis@yahoo.com

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melanotheron is recognised by the possession of truncate caudal fin, moderate pectoral fin, and an anal fin which has long rays which project over half the caudal fin.

Length weight relationship (LWR) and condition factor ("K") are used for assessing the general health of a fish population and are important tools for fish biology study(Le Cren 1951) [7] Lizama et al., (2002) [8]. This is done by drawing a mathematical relation between the length and weight of the aquatic species (Beyer 1987) [9]. Thereby changing growth-in-length calculations to growth-in-weight used in stock evaluation models (Pauly 1993) [10].

Morey et al. [11] stated that the mathematical relationships between length and weight are a very potent tool which can be used in predicting weight of fish from length measurements taken in the course of stock assessment and monitoring.

Growth is a basic characteristic of living things and the growth rates and pattern are species-specific (Olopade *et al*. [12]) and vary from one water body to another even within the same species.

Anene (2005) [13] reported that, in fish biology, condition factor gives an overview of the "condition" of fish founded on hypothesis that fish that have more weight of a certain length are in a healthier physiological state (Begenal 1978) [14].

Condition factor can give details on the physiological situation of the fish as well as its variations in relation to its welfare (Ighwela *et al*., 2011) [15] It is also used in comparing different populations of fish living in certain grazing, climate, and certain other conditions; during the determination of the period of coming into full development and when measuring up the rate of grazing activity of a species to determine if it is making meaningful use of its feeding source (Anyanwu et al. (2007), Wootton (1990) [16,17].

According to Lizama et al., 2002 [8], condition factor determination enables the understanding of the life cycle of fish species easier and also contributes to the adequate management of these species. Therefore, balancing the ecosystem [8].

Previous studies have been documented on the LWR and condition factors of fishes in Nigeria, West Africa. Ayoade and Ikulala (2007) [3] worked on the biology of *Hemichromis bimaculatus, S. melanotheron* and *Chromidotilapia guenthsi* in Eleiyele Lake, Nigeria. Oribhabor *et al*. (2009) [18] studied the length-weight relationship of *S. melantheron* and *Tilapia guineensis* in a Niger Delta Mangrove Creek, Nigeria. Fafioye and Oluajo (2005) [19] worked on five different fish species in Epe Lagoon.

Reports from other places in the world on *S. melanotheron* includes works by Guissé and Niass, (2021) [5] on the length relationship and condition factor of the fish in the special wildlife reserve of Gueumbeul in Senegal. Mireku et al., [20] reported on aspects of the biology of the cichlid in Brimsu Reservoir, Ghana while Chikou, 2019 [21] worked on the growth characteristics of *S. melanotheron* in Benin Republic.

The study was carried out to assess the length-weight relationship and condition factor of *S. melanotheron* in Forcados River estuary. The result will be useful in managing and conserving this tilapia in the estuary.

2. Materials and Methods

The study area lies between latitude 5º 357' - 5º354'N and longitude 5º 501' - 5º370' E and enjoys a tropical climate, with two defined seasons; rainy and dry seasons. The dry season commences from November to April while the rainy season is mainly from May to October (Opute 2000) [22]. The vegetation covers include *Eichhornia crassippes, Fern, Pistia, Cenchrus ciliaris, Nymphaea spp, Trapa spp, Lemna spp, Ceratophyllum spp*. Human activities here include fishing, bathing, swimming and transportation.

S. melanotheron samples were obtained between April 2012 and March 2014 on a monthly bases from artisanal fishermen and immediately transported for analysis and identification in the laboratory. Keys used for identification includes that of Fischer et al. (1981) [23]; Schneider (1990) [24]; Paugy et al. (2003) [25]; Tesch, 1971 [26]; Thomas et al. 2003 [27]. The weights of the fish was measured with the aid of a sensitive Sartorius top loading balance and the lengths (standard and total) were measured using a measuring board.

The length-weight relationship was estimated using the least square regression on log transformation given the equation, cited as Equation 1:

$$\log W = \log a + b \log L \quad (1)$$

Where,

$W = weight\ (g)$,
$TL = total\ lenght\ (cm)$,
$a = constant\ (intercept)$,
$b = exponent\ (slope)$.

The condition factor, was evaluated using this formula, cited as Equation 2:

$$K=100W/Lb \quad (2)$$

Where,

$K = condition\ factor,$
$W = total\ weight\ (g),$
$L = total\ length$ () and
$b = the\ regression\ coefficient.$

3. Results and Discussion

A total of 699 *S. melanotheron* (combined sexes) were captured. The standard length of sampled *S. melanotheron* in this study ranged from 4.15 to 18.92 cm, total length varied from 6.01 to 22.5 cm while the weight ranged from 7.85 to 286.71 g. The b value was 2.1299 which was less than 3 indicating that the growth pattern of the fish was allometric. That is, as the fish increased in length so it increased slightly in weight. The correlation co-efficient (r) value for *S. melanotheron* was 0.7528 which is quite high depicting that there was a strong positive relationship between weight and total length of *S. melanotheron* in the estuary.

This result (negative allometry) is in line with results reported by Guissé and Niass, [5] who recorded 2.77 and 2.69 values for the regression coefficient for females and males respectively, and 2.76 and 2.72 for the wet and dry seasons in Gueumbeul (RSFG) in Senegal). Chikou [28] in multiple water reservoirs in Benin (b values ranged from 2.55 to 2.76), and those recorded by Ecoutin and Albaret [29] in the Ebrié lagoons in Côte d'Ivoire (b = 2.78) and Sine Saloum in Senegal (b = 2.81). These outcomes are unlike those established by Mireku et al. [30] in Brimsu reservoir, Ghana with b values that ranged from 4.08 to 4.99 for females and 3.95 to 4.94 for males by Lalèyè [31] in the Ouémé River in Benin where the b values (3.07) were not significantly different from 3 and those obtained by Ndimele et al. [32] for similar species (*S. melanotheron*) in Ologe lagoon, Nigeria with b values spanning from 3.09 to 3.12.

Le Cren (1951) [7] stated that change in growth rate of the same species of fish throughout different months are subjected to many factors such as food supply, environmental factors as well as ecological state of the habitats.

The growth pattern of fish can be greatly influenced by season, population, food availability, sex or physiology (Silva et al. 2015; Cella-Ribeiro et al. 2015; Dieb-Magalhães et al. 2015; Giarrizzo et al. 2015; Freitas et al. 2017) [33-37].

In such cases exponential value must be exactly '3' but owing to fluctuating environmental conditions of the fish, the real relationship between the variables usually does not follow cube law (Le Cren, 1951) [7]. According to Wootton (1990) [17], if fish growth is isometric the exponential value recorded will be exactly 3.0. On the contrary, a value significantly larger or smaller than the given standard indicates an allometric growth pattern.

In a related statement, Froese (2006) [38] reaffirmed that for isometric growth to be recorded, the exponential value must read between 2.5 and 3.5. A lesser value shows a negative allometric growth indicating that a fish becomes lighter with increase in its size whereas a positive allometric is seen when values are higher which indicates that the fish obtained a heavier weight for a particular length. That is, as the fish increased in length so it increased slightly in weight. The correlation co-efficient value for *S. melanotheron* was 0.7528 which is quite high portraying that there was a great positive relationship existing between weight and total length of *S. melanotheron* in the estuary.

The monthly changes in condition factor of *S. melanotheron* showed that there was an increase in value from April 2012 to May 2012. A peak was recorded in June 2012 and a decrease in value recorded to August 2012. Other sharp decreases recorded were in the months of December 2012 and November 2013. This shows that the fish were in better condition during the raining season months.

Furthermore, the result showed that the condition factor was not size dependent, a rise in K value was recorded from size 4.1-5.0 cm to size 6.1-7.0 cm, while gradual drop was recorded from size 6.1-7.0 cm to 9.1-10.0 cm (Figure 2). A sharp rise was then recorded in value in size 10.1-11.0 cm and a gradual drop in value recorded from 11.1-12.0 cm to 13.1-14.0 cm. There was an increase thereafter to size class 18.1-19.0 cm.

The total length recorded in this study was within the range recorded by Ayoade and Ikulala 2007 [3] and Oribhabor *et al.* 2009 [10]. The value reported on the growth equations for the fish species was within the bounds of 2 and 4 described by Tesch (1971) [26] for most fish. Most aquatic organisms change shape as they increase in size, thus deviating from isometric growth (Thomas *et al*., 2003) [27]. This changes is usually influenced to a larger extent by the productivity of environment of such organism (Abdul *et al.* 2010) [39]. This is similar to the report of Laléyé (2006) [31], Ayoade and Ikulala, 2007 [3] for *S. melanotheron*. The correlation coefficient (R^2) of 0.7528 for *S. melanotheron* indicates increase in length with increase in weight. This findings is in agreement with earlier studies which has to do with fish species from unrelated water bodies (Laléyé 2006; Ayoade and Ikuala 2007) [31,3].

The correlation coefficient (R^2) values of 0.7528 reflects that there is a robust correlation linking the length and weight of *S. melanotheron* species in Forcados

River estuary. This result was in line with reports from Gueumbeul basin for this cichlid species.

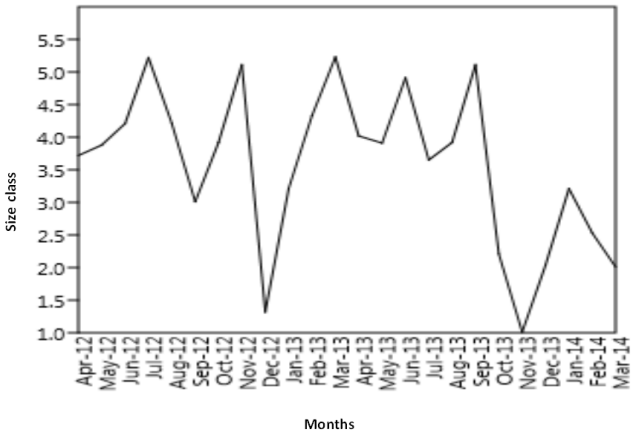

Figure 1. Monthly variation in condition factor (K) of *S. melanotheron* (A)

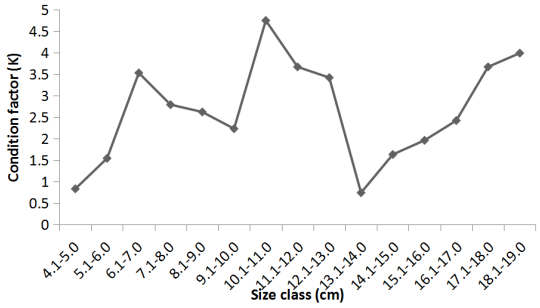

Figure 2. Variation in condition factor (K) of S. melanotheron according to size

The condition factor for the combined sexes fluctuated monthly in the estuary. According to Abdul (2009) [2], condition factor of fish is a function of phosphate availability in water. Possible sources capable of influencing high phosphate concentration in the estuary include leaching of dead macrophytes, precipitation, surface run off and domestic sewage containing human feaces (Ekhator *et al*. 2015) [40]. The condition factor of fish species in this study was not size specific. This agreed with previous observation by Arawomo (1982) [41] and Fagade (1983) [42] in their studies. Pauly (1983) [43] reported that the differences in weight for the sampled size could be attributed to individual condition factor in relation to the degree of fatness and well-being.

According to Le Cren (1951) [7] fluctuations in the condition factor of a fish is associated to the maturity cycle of the fishes. It is also worthy of note that full development of digestive system can be linked to the 'K' factor. Kund et al. (2011) [44] reported that condition factor of smaller fishes are higher when compared to the large ones due to their edacious feeding nature. Bakare (1970) and Fagade (1979) [42] postulated that the condition factor relatively reduces due to the gradual increase in length.

4. Conclusions

The length-weight relationships and condition factor of *S. melanotheron* in Forcados river estuary indicated that the fish were above average condition. The condition factor for the combined sexes fluctuated monthly in the estuary. The condition factor of fish species in this study was not size specific. Information obtained from the study can be used for better management of *S. melanotheron* in the water body.

Authors' Contribution

Efe Ogidiaka conceptualize the research work, conducted part of the laboratory analysis and drafted the manuscript. John Atadiose did part of the laboratory analysis while Betty O. Bekederemo sourced for literature material used and also reviewed the write up.

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