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Research Article

Length-Weight Relationship and Condition Factor of Ethmalosa Fimbriata (Bowdich, 1825) from the Escravos Estuary, Delta State, Nigeria

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Abstract

Biometric data such as length-weight relationships and condition factor are veritable tools in fisheries management since it provide information about the growth of the fish, its general wellbeing, and fitness in an aquatic ecosystem. The length-weight relationship of *Ethmalosa fimbriata* collected from the Okerenkoko section of the Escravos estuary, Delta State, Nigeria was established, and its growth condition was evaluated using linear regression and Fulton's condition factor equation respectively. The logarithmic transformation equation of the length-weight relationship for *E. fimbriata* is given by the equation: Log TW=3.0588Log TL–2.1759 (r2=0.9045, n=182, P<0.05). The computed b value (3.0588) was not significantly different (p>0.05) from 3 and revealed that fish growth is isometric. Condition factor (K) ranged between 0.620 for fish with total length (14.0 cm) and total weight (17.0 g) to 0.88 for fish with total length (16.3 cm) and total weight (38.0 g) with a mean and standard deviation value of 0.792 ± 0.01. The K value of this species in the Okerenkoko estuary indicated that they were not in good condition (K<1). The poor condition of the fish may be attributed to occasional crude oil spillage in the area. This is first baseline data about LWRs and condition factor of fish species from the Escravos estuary. This data is therefore valuable for establishing a monitoring and management system of this fish species.

Keywords: Escravos; Fish biometrics; Growth; Regression coefficients

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Introduction

Organisms generally increase in size (length and weight) during development. The key factors that influence the growth of fish are the quantity of food available, the number of fish utilizing same food source, temperature, oxygen and other water quality factors besides the size, age and sexual maturity of the fish [1]. In fish, size is generally more biologically relevant than age, mainly because several ecological and physiological factors are more size-dependent than age-dependent. Consequently, variability in size has important implications for diverse aspects of fisheries science and population dynamics [2]. Biometric data such as Length-Weight Relationship (LWR) is a veritable tool in fisheries management because it is useful in the estimation of the average length and weight by establishing a mathematical relationship between the relative well-being of the fish population [3,4]. According to Pitcher and [5], LWRs has both applied basic uses in the practical assessment of fish stocks. Length and weight data are also useful standard results of fish sampling programs [6]. *Ethmalosa fimbriata*, a Clupeid fish popularly known as Bonga shad is found in fairly shallow coastal waters, lagoons and estuaries, and sometimes also in lower courses of coastal rivers, even more than 300 km up rivers [7,8]. It breeds throughout the year in waters of salinities 3.5-38 ppt, but with peaks in at least some areas; spawns in the sea, in estuaries and in rivers [9]. *E. fimbriata* is distributed in West African Atlantic waters from Mauritania to Angola [10], and despite its marine origin, is highly abundant in estuaries, deltas, and lagoons [11]. It is one of the most important fishes targeted by artisanal fisheries in Cameroon, Ivory Coast, Nigeria, and Senegal [12,13]. In Nigeria, information on the length-weight relationship and condition factor of *Ethmalosa fimbriata* have been documented in Epe lagoon [14], Cross River Estuary [15,16], New Calabar River [17] and Nkoro river [18]. However, no work has been documented on the length-weight relationship of *E. fimbrata* from the Escravos Estuary. Hence, this study aimed to provide information on the length-weight relationship and condition factor of *E. fimbriata* from the Escravos Estuary. Results from this research will therefore serve as baseline resource for deductions in fisheries management policy formulations, geared towards enhanced fisheries development of the estuary.

Materials and Methods

Study area

Fish samples were collected from the Okerenkoko section of the Escravos estuary (Figure 1). The Escravos estuary is located in Western Niger Delta, Southern Nigeria. The area is mainly mangrove swamps and coastal sand edges. Salinity ranges between 14 - 31‰ [19]. The main occupation of the residents is fishing, fish processing, design and manufacturing of artisanal fishing gear such as basket net, traps, gill net, drag net, hook and line, petty trading etc. Numerous activities such as oil exploration and production also go on in the region.

Collection of *E. fimbriata* samples

A total of 182 samples of *E. fimbriata* were randomly collected from notable fish landing points at Okerenkoko between July and

October, 2021 from the landings of artisanal fisher-folks. The fish was caught by gears such as gill net and dip net. The samples were immediately transported to the teaching and research laboratory of the Faculty of Marine Environmental Management, Nigeria Maritime University, Okerenkoko, for species identification and biometric measurements. *E. fimbriata* was identified using keys and descriptions provided by [7,9].

Measurement of biometric parameters of *E. fimbriata*

Total length was measured to the nearest 0.1cm using a measuring board. Total length (cm) of each fish was taken from the tip of the snout (mouth closed) to the extended tip of the caudal fin [20]. Body weight was measured to the nearest 0.1g using Metlar 5000D electronic weighing balance.

Length-Weight Relationship

The expression $W=aL^b$ was used in the determination of the Length (L) and Weight (W) relationship [21].

Where:

W= Weight of the fish (g),

L= Total length of the fish (cm),

a = Constant and,

b = Exponent of the length weight relationship.

The values of constant "a" and "b" were estimated from the log transformed values of length and weight i.e. log W=log a + b log L, via least square linear regression [21]. Departure from isometry (b = 3) for exponent of the length-weight relationship (b) was evaluated using a t-statistic function given by [22] as follows:

$$t = \frac{s.d.(x)}{s.d.(y)} \times \frac{/b - 3/}{\sqrt[2]{1 - r^2}} \times \sqrt[2]{n - 2}$$

Where:

s.d. (x) = Standard deviation of the Log L values,

s.d. (y) = Standard deviation of Log W values,

n = Number of samples collected,

b = Estimated exponent of the length-weight relationship,

r^2 = Correlation coefficient of the length-weight relationship.

According to [21], the value of b is significantly different from 3 if the value of t- calculated is greater than the value of t-tabulated for the degree of freedom (n–2).

Condition factor (K)

Condition factor (k) was using the equation: $K= 100\ W/L^3$ [21].

Where:

K = Condition factor,

W = Weight of fish (g) and

L = length of fish (cm).

Statistical analysis

Regression coefficient value 'b' coefficient of correlation 'r' and intercept 'a' in the Length-Weight Relationship (LWR) of *E. fimbriata* from the Escravos Estuary were determined by power and linear regressions using Microsoft Excel (Version 2013). Analysis of Variance (ANOVA) was used to analyze the monthly condition factor of *E. fimbriata* to check for significant difference at p = 0.05 using PASW Software (Version 17).

Results and Discussion

Length-weight relationship of *e. fimbriata* from the escravos estuary

The length-weight relationship of *E. fimbriata* from the Escravos Estuary (Figure 1) is given by the equation: $TW = 0.0067\ TL^{3.0588}$ (r^2 = 0.9045, n = 182, P<0.05). A significant linear relationship was recorded between total length and total weight of *E. fimbriata* from the Escravos Estuary. The value of b (3.0588) was not significantly different from 3. The slope of the regression line of length and weight (*b*) computed for *E. fimbriata* obtained from the Okerenkoko estuary revealed an isometric growth pattern. When *b*=3, the fish grows isometrically resulting in ideal shape. When the *b* value is less than 3.0, the fish experiences a negative allometric growth, but when the value is higher than 3, the fish grows following the positive allometric growth pattern [23]. Findings from this study agrees with the *b* values (3.0) reported by [15] in *E. fimbriata* from Cross River. Values obtained from this study were, however, lesser that *b* values (3.210±0.013) reported by [14] in *E. fimbriata* from Epe Lagoon. The variation in '*b*' value may be attributed to several factors such variations ecological conditions of the environment, habitat, season, body shape and amount of fat present, sex, maturity stage, temperature, salinity and available nutrient food [24, 3, 25, 16, 26]. It is noteworthy mentioning that the caught fish were not sexed, which could influence LWRs reported in the current study [27].

Figure 1: Map showing sample stations along the Escravos estuary.

The logarithmic transformation equation of the length-weight relationship (Figure 1) for the *E. fimbriata* is given by the equation: Log TW = 3.0588Log TL – 2.1759 (r^2 = 0.9045, n = 182, P<0.05).

Condition factor (K) of *e. fimbriata* from the escravos estuary

Condition factor (*K*) determined for one hundred and eighty two (182) specimens of *E. fimbriata* from the Okerenkoko estuary is presented in Table 1. Condition factor (K) ranged between 0.620 for fish

with total length (14.0 cm) and total weight (17.0 g) to 0.88 for fish with total length (16.3 cm) and total weight (38.0 g) with a mean and standard deviation value of 0.792 ± 0.01. The present study revealed that *K* value decreased as the fish grow older. These values were lesser than those (1.0 ± 0.16) documented by [14] for *E. fimbriata* in Epe Lagoon. [16] Have also reported a higher pooled *K* value (1.06 ± 0.84) in *E. fimbriata* from Cross River Estuary. The *K* value of this species in the Okerenkoko estuary indicated that they were not in good condition ($K < 1$). The poor condition of the fish may be attributed to occasional crude oil spillage in the area [28, 29]. *Ethmalosa fimbriata* feed mostly on food from plant origin [3] and crude oil has been found to reduce photosynthetic rate and density of aquatic plants [30,31] reported that the larger the condition factor, the better the condition of the fish [32]. Have documented that *K* values may vary according to seasons and environmental conditions. [33] Corroborated this view that variation in condition factor of fish may be due to the abundance of food, adaptation to the natural environment and development of the gonads. The mean condition factor did not vary significantly ($p > 0.05$) across the months of sampling collection Figure 2.

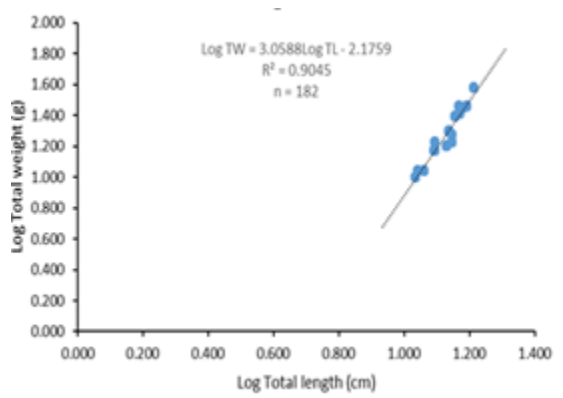

Figure 2: Log-Log transformation graph of length-weight relationship of *E. fimbriata* from the Okerenkoko estuary.

Month	Number of fish collected	Mean Condition factor (K)
July	43	0.813 ± 0.01[a]
August	50	0.802 ± 0.01[a]
September	40	0.786 ± 0.01[a]
October	49	0.765 ± 0.02[a]
Total	182	0.792 ± 0.01

Table 1: Fulton's Conditon Factor (K) of *E. fimbriata* from the Escravos Estuary.

*Means with the same superscript were not significantly different ($p > 0.05$).

Plate 1: Bonga Shad (*Ethmalosa fimbriata*) Source: Field survey.

Conclusion

This study provided the first data on the length-weight relationship and condition factor of fish collected from the Escravos estuary. Biometric data of *E. fimbriata* from the estuary showed an isometric growth pattern (increasing in all dimensions at the same rate). The *K* value of this species also revealed that they were not in good condition. This might be attributed to environmental conditions or linked to morphological characteristics specific to fish species of this estuary. Crude oil activities going on in the area was also implicated. This findings can be successfully applied for estimating the standing stock biomass and comparing ontogeny of fish population from different regions. This information can therefore form a baseline tool for enhanced fisheries management.

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