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LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR OF SOME COMMERCIAL FISH SPECIES IN LEKKI LAGOON, SOUTHWEST NIGERIA.

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ABSTRACT

A study on Length-Weight Relationship (LWR) and condition factor was carried out on 3 commercial fish species: Chrysichthys nigrodigitatus, Coptodon zillii and Ethmalosa fimbriata species in the Lekki Lagoon, Nigeria. Samples were collected between January and July 2022. A total of I, 386 fish were randomly collected from commercial fishermen selected in both dry and wet seasons from all landing sites around Lekki Lagoon. The total length and total weight of fish samples were measured using standard methods to the nearest 0.01 cm and 0.01 g. The average mean length ranged from 11.07±0.90 cm to 20.15±7.23 cm, and the average mean weight ranged from 13.51±3.17g to 205.97±146.48 g. Average length and weight were lower in the wet season than in the dry season. The 'b' value of C. nigrodigitatus showed a negative allometric growth pattern, and the total length was positively correlated with the total weight of the fish (r^2=0.98 and 0.93) in both seasons. The 'b' value in C. zillii were 2.94 and 3.00 for both dry and wet seasons. LWR was positively correlated (r^2=0.9861 and 0.9905) while the growth pattern was isometric. The value of 'b' for E. fimbriata during the study for both dry and wet seasons were 2.33 and 2.56 and r^2=0.745 and 0.77 respectively. Respective condition factors 'k', dry and wet seasons, were: 0.97g/cm³ and 0.83g/cm³ for C. nigrodigitatus, 2.19g/cm³ and 1.87g/cm³ for C. zillii and 0.95g/cm³ and 0.99g/cm³ for E. fimbriata. The study showed that the condition factor was highest in C. zillii in both seasons in the water body. Therefore, efforts should be directed towards the sustainable management of the fisheries.

Keywords: ***Length-weight relationship, Lekki lagoon, condition factor, fish stock assessment.***

INTRODUCTION

Estuaries are dynamic habitats marked by considerable swings in environmental conditions because they are the meeting location of freshwater from rivers and saltwater from the sea (James *et al*., 2007). The unique feature of this water, in combination with other factors (such as food availability), usually influences the growth rate and abundance of fish.

Assessing the Length-weight relationship (LWR) and condition factor (k) of fish is an important aspect of useful information for fish stock assessment. Adedeji and Araoye (2005) summarized growth as a function of fish size. Growth can be referred to as a change in absolute weight (energy content) or length of fish over time which could be as a result of various factors such as availability of food necessary for growth, population of the habitat and water quality (Bake and Sadiku, 2004; Kuriakose, 2017). Growth is also described as any change in size or amount of body material, whether positive or negative, temporary or permanent (Busacker *et al.,* 1990). As a result of their importance in age and growth investigations, LWRs, or connections between the sizes of scales or other calcified tissues and body length, have been used to analyze growth trends in fish (Adeyemi *et al.*, 2009; Murua *et al.*, 2017). According to Abowei and Hart (2009) and

Dar *et al*., (2012), the LWR of fish, also known as the growth index, is an important management measure used in predicting the average weight at a particular length of growth.

Length and weight data are relevant and are required to calculate growth rates, lengths, and age structures. LWRs assist fisheries scientists to transform length-based growth into weight-based growth in stock assessment models. The condition factor indicates the state of the health and wellbeing of the fish in their environment. Fish condition is influenced by a variety of factors including stress, sex, season, feed availability, and other water quality elements (Kuriakose, 2017). Understanding the life cycle of fish and maintaining ecosystem equilibrium necessitates the research of condition factor Haruna and Bichi (2005).

Various research on the LWR and condition variables of fish have been conducted in Nigeria. Bolarinwa and Popoola (2013) studied the LWRs of various economically important fish in Ibeshe Waterside in the Lagos Lagoon, Nigeria. Obasohan *et al.*, (2012) investigated the LWRs and condition factor of five fish species from the Ibiekuma stream in Edo State, Nigeria.

The purpose of this study is to assess the length and weight relationship and condition factor of *Chrysichthys nigrodigitatus*, *Coptodon zilli* and *Ethmalosa fimbriata* in Lekki Lagoon in view of the fact that there is dearth of data needed for fisheries population studies, management and conservation. The findings will aid in decision-making about fisheries management and conservation in the estuary.

MATERIALS AND METHODS

Description of the Study Area

Lekki lagoon, a large expanse of shallow freshwater, is in Lagos Nigeria, where the alternation of the dry and wet seasons are phenomenal (Adesalu and Nwankwo 2009). It covers an area of nearly 247km². A greater part of the lagoon is shallow (<3.0m), while some areas are up to 6.0m deep. It lies between $4^0 15^1 E - 4^0 30^1\ E$ and $6^0 20^1 N - 6^0 45^1 N$ (Abdul *et al.*, 2016). It is essentially considered a freshwater system as it has no direct connection with the Atlantic Ocean and its main discharge channels are from River Osun, Mosafejo and Oni (Abdul *et al.*, 2010). Fishing activities are commonly carried out using fishing gears such as seine net, cast net, gill net and bamboo traps. Fisheries resources found in the water body include: *Chrysichthys sp, Tilapia sp, Elops lacerta, Scomber japonicus, Ethmalosa fimbriata, Lutjanus agennes, Caranx senegallu, Sarotherodon galilaeus, Hepsetus odoe, Sardinella sp, Synodontis sp* (Abdul *et al.*, 2010, Ajagbe *et al.*, 2011)

Sample Collection

A total of 1,386 fish samples were randomly collected between February – July 2021 across dry and wet seasons (February – April being the dry season and May – July being the raining season). Fish were collected from fisher folks at purposively selected landing sites of the estuary. A total of 473 samples of *Chrysichthys nigrodigitatus* (101), *Coptodon zillii* (99) and *Ethmalosa fimbriata* (273) were captured during the dry season and 913 samples of *Chrysichthys nigrodigitatus* (331), *Coptodon zillii* (198) and *Ethmalosa fimbriata* (384) during the wet season. Samples consisted of a combination of various sizes and sexes in indiscriminate proportions. Fish were collected using fishing gear such as seine net, gill net, cast nets and traps. Sampling locations were identified with a hand-held global positioning system (GPS 12 Garmin model).

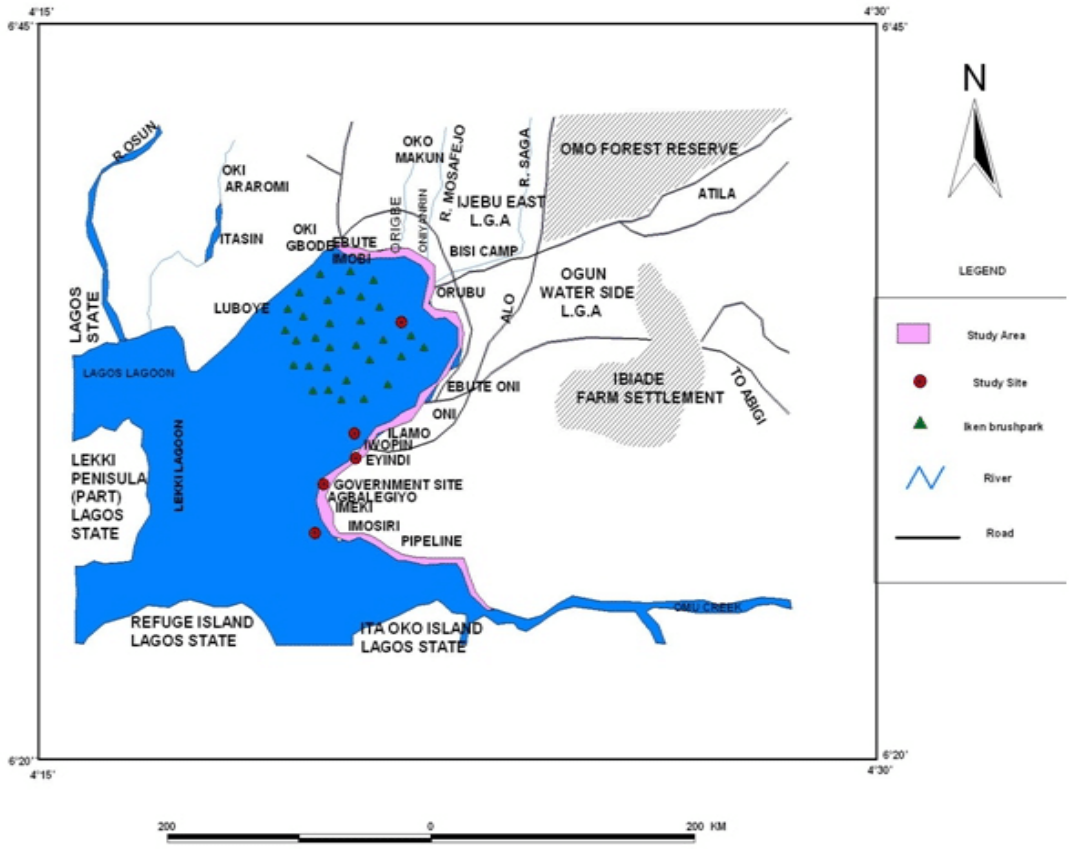

Figure 1: Map showing Lekki Lagoon Source: Abowei *et al* (2017)

Collection was carried out between 9am and 5pm GMT+1 across all commercial landing sites around the Lekki Lagoon. Length of the fishes were measured using the standard Ichthyoboard and recorded to the nearest 0.01cm. Weight was taken using the Mettler Toledo analytical balance (Include Model) to the nearest 1g. Fish were identified using fish identification guide (Olaosebikan and Raji, 1998).

Length-Weight Relationship

The length-weight relationship (LWR) was calculated using the following formula (Froese, 2006).

$$W = aL^b$$

Where;
W= weight (g)
L= Total length (cm)
a= Constant
b= Growth exponent

Condition factor

The value of the complied growth exponent was used to calculate the condition factor,

$$k = \frac{100w}{L^3}$$

Where K= Condition factor
W= Total body weight (g)
TL= Total length (cm)
b = Growth exponent

Statistical Analysis were carried out using FISAT II - FAO-ICLARM Stock Assessment Tool.

RESULTS

The length and weight frequency of 3 fish species; *Chrysichthys nigrodigitatus*, *Coptodon zillii* and *Ethmalosa fimbriata* sampled in Lekki Lagoon are presented in tables 1, 2 and 3. The mean length and weight for *C. nigrodigitatus* was 20.15±7.23cm and 107.31±139.1g during the dry season and 16.40±4.06 cm and 42.97±51.18g during the wet season. The 'b' values were 2.83 and 2.72 in dry and wet seasons respectively while, condition 'k' for both dry and wet seasons were 0.97 and 0.831 respectively (Table 4)

Also, *C. zillii* had the mean length and weight of 20.04±4.85cm and 205.97±146.48g in dry season and 17.24±5.08cm and 124.01±132.97g in wet season. The 'b' values were 2.94 and 3 respectively while, condition 'k' for both dry and wet seasons were 2.19 and 1.87 respectively (Table 4). For *E. fimbriata*, the mean length and weight was 11.99±1.32cm and 16.60±5.12g during the dry season and 11.07±0.90cm and 13.51±3.17 g during the wet season. The 'b' values were 2.94 and 3 respectively while, condition 'k' for both dry and wet seasons were 2.19 and 1.87 respectively.

The 'b' values estimated for *C. nigrodigitatus* and *E. fimbriata* were significantly different from 3 at 95% confidence limit while that of *C. zillii* were not significantly different from 3.

Table 1: seasonal frequency distribution and mean weight of *Chrysichthys nigrodigitatus* in Lekki Lagoon

	Dry Season			Wet season		
Length class	Frequency	Total weight (g)	Mean weight	Frequency	Total weight (g)	Mean weight
5-9.9	0	0	0.00	1	4	4.00
10-14.9	21	445	22.25	131	2751	21.49
15-19.9	44	2178	49.50	160	6021	39.10
20-24.9	12	1341	111.75	26	2074	79.77
25-29.9	15	2862	190.80	8	1173	146.63
30-34.9	6	1747	291.17	2	530	265.00
35-39.9	0	0	0.00	2	713	356.50
40-44.9	2	1666	833.00	1	604	604.00
45-49.9	1	590	590.00	0	0	0.00
Total	101	10829		331	13870	1516.49
Mean length (cm)	20.15± 7.23			16.40±4.06		
Mean weight (g)		107.31±139.1			42.97±51.18	

Table 2: Seasonal length frequency distribution and mean weight of *Coptodon zillii* in Lekki Lagoon

	Dry Season			Wet season		
Length class	Frequency	Total weight (g)	Mean weight	Frequency	Total weight (g)	Mean weight
5-9.9	0	0	0.00	11	126	11.45
10-14.9	14	822	58.71	38	1356	35.68
15-19.9	42	5056	120.38	106	10085	94.89
20-24.9	23	5663	246.22	28	4977	191.42
25-29.9	17	7087	416.88	11	4653	423.00
30-34.9	3	1853	617.67	3	2027	675.67
35-39.9	0	0	0.00	1	997	997.00
Total	99	20481		198	24221	
Mean length (cm)	20.04± 4.85			17.24±5.08		
Mean weight (g)		205.97± 146.48			124.01±132.97	

Table 3: Seasonal length frequency distribution and mean weight of *Ethmalosa fimbriata* in Lekki Lagoon.

	Dry Season			Wet season		
Length class	Frequency	Total weight (g)	Mean weight	Frequency	Total weight (g)	Mean weight
5-5.9	0	0	0.00	0	0	0.00
6-6.9	0	0	0.00	1	6	6.00
7-7.9	0	0	0.00	1	9	9.00
8-8.9	3	26	8.67	6	38	6.33
9-9.9	5	50	10.00	25	221	8.84
10-10.9	46	540	11.74	111	1277	11.50
11-11.9	80	1140	14.25	189	2695	14.26
12-12.9	83	1426	17.18	43	732	17.02
13-13.9	39	835	21.41	8	184	23.00
14-14.9	10	257	25.70	0	0	0.00
15-15.9	2	62	31.00	0	0	0.00
16-16.9	3	99	33.00	0	0	0.00
17-17.9	2	40	20.00	0	0	0.00
Total	273	4475		348	5162	
Mean length (cm)	11.99±1.32			11.07±0.90		
Mean weight (g)		16.60±5.12			13.51±3.17	

Table 4: Length-weight relationships and condition factors of *Chrysichthys nigrodigitatus, Coptodon zillii* and *Ethmalosa fimbriata.*

	Dry Season				Wet season			
Species	A	b	r^2	k	a	b	r^2	k
Chrysichthys nigrodigitatus	0.0161	2.82	0.98	0.97	0.015	2.77	0.926	0.831
Coptodon zillii	0.27	2.94	0.9861	2.19	0.0185	3	0.9905	1.87
Ethmalosa fimbriata.	0.041	2.33	0.745	0.95	0.0284	2.56	0.77	0.99

Where a – intercept, b – exponent, k – condition factor, and r^2- coefficient of determination

DISCUSSION

The length-weight relationship is used in fisheries sciences for the estimation of age, general health and habitat condition, population dynamics and ecological studies (Froese, 2006; Koffi *et al.,* 2014). The length-weight relationship reflects the condition and growth pattern of the fish. 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 at a 95% confidence limit (Paraskevi *et al.,* 2012)

The 'b' values in this study ranged from 2.33 (*E. fimbriata*, dry season) and 3 (*C. zillii*, wet season). *C. nigrodigitatus* showed a negative allometric growth pattern in both dry and wet seasons with a b-value of 2.82 and 2.77 respectively, as well as *Ethmalosa fimbriata* with b-values of 2.33 and 2.56 respectively. However, *Coptodon zillii* revealed a negative allometric growth pattern with a b value of 2.94 during the dry season and isometric growth with a b value of 3 in the wet season. The b value recorded for *C. nigrodigitatus* showed a negative allometric growth pattern ($p<0.05$), which is in accordance with the studies of Abdul *et al.,* (2016) in the Ogun State coastal estuary and Famoofo and Abdul (2020) in Lekki Lagoon. Contrary to these studies, *C. zillii* in the present study showed isometric growth pattern. The 'b' value recorded for *E. fimbriata* showed negative allometric growth, contrary to the study of Ama-Abasi (2004) in the Cross River estuary where the growth pattern was isometric. In the same vein, Famoofo and Abdul (2020) report negative allometric growth patterns as well as low condition factors in the fishes sampled in the Iwopin freshwater ecotype of Lekki Lagoon. The disparity in the exponent in length-weight relationships and the differences in the b values may be due to the environmental condition in the system as well as a change in seasons (Hossain *et al.,* 2006). According to Obasohan *et al.,* (2012) fish species particularly those from tropical regions are said to have varying growth which could be a result of environmental parameters peculiar to this region. Sex, food availability, and habitat preservation practices have also been said to influence length-weight relationships in fish (Yilmaz *et al.,* 2012).

Condition factor can be used as an indicator to determine the fitness of the fish in a system and can, therefore, be used to determine the state of fish wellbeing, whether they are feeding properly or are being deprived of food as well as their breeding state (Busacker *et al.,* 1990). Condition factor 'k' above one indicates that the environment is able to support the growth of the fish (Olopade and Tarawallie 2014). According to Busacker *et*

al., (1990), the condition factor with a value ≥ 0.5 indicates that the fish is in good condition. Condition factors in this study ranged from 0.831 (*C. nigrodigitatus* - wet season) to 2.19 (*C. zillii* - dry season), indicating that the fishes under study are in good condition (Bagenal and Tesch 1978 as cited by Abdul *et al*., 2016). Condition factor varies with the seasons of the year; high condition factor might be a result of high fat utilization in preparation for breeding and low condition can be attributed to lack of feeding activity and degeneration of the ovary (Abdul *et al.,* 2016). Oni *et al.,* (1983) and Saliu (2001) also reported that condition factors vary among populations with time and could be attributed to varying biotic and abiotic conditions. Fish condition factor as observed in this study was greatly influenced by seasons of the year.

The r^2 value of all the species of fish examined ranged from 0.77 to 0.9905. This indicates that there is a strong degree of positive correlation between the length and weight of the fish. As the length of the fish increases, so also the weight increases, however, there is a negative allometric growth pattern. Thus, the weight of the fish can be accurately estimated from their respective standard lengths as the linearized models are reliable (Gomez and Gomez 1984 as cited by Abdul *et al*., 2016).

CONCLUSION

The study detailed that the three fish species exhibited allometric growth patterns which have implications for the food populations. The condition factor was higher in the dry season in *Chrysichthys nigrodigitatus and Coptodon zillii* than in the wet season in contrast to observation in *Ethmalosa fimbriata*. Fishes in this study exhibited negative allometric growth apart from *Coptodon zillii* which had an isometric growth pattern during both the wet and dry seasons.

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