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LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR OF *Chrysichthys nigrodigitatus* FROM LEKKI LAGOON, SOUTH-WEST, NIGERIA

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ABSTRACT

Length-weight relationships are crucial in fishery stock assessments and when combined with the relative condition factor, may yield an estimate of the possible prevailing environmental factors. This study assessed the length-weight relation and condition factor of *Chrysichthys nigrodigitatus* from Lekki Lagoon, Southwest, Nigeria for a duration of 12 months between January and December, 2022. The lagoon was randomly stratified into five landing sites: Whaf, Ebute-Oni, Agbalegiyo, Ilumofin and Luboye. A total number of 6,123 fish samples were taken from the local commercial fishers immediately after harvesting using assorted fish gears and were identified using identification keys. Mean length was 18.53±7.41 cm and weight was 106.32±171.97 g in the wet season but 16.16±5.72 cm and 69.26±104.40 g, respectively in the dry season. The length-weight relationship revealed a mean 'b' value of 2.73±0.17 (r = 0.91±0.02) which was significantly (P<0.05) lower than the isomeric value 3. Mean condition factor (k) ranged from 1.18 in April to 2.07 in September with a mean value of 1.61±0.26. It is concluded that *C. nigrodigitatus* species exhibited negative allometric growth pattern in the lagoon and they are in a good physiological state.

Keywords: Growth index, Cubic law, Silver Catfish, Brackish Water

INTRODUCTION

In Nigeria's lagoon systems, the silver catfish (*Chrysichthys nigrodigitatus*, Family: Bagridae) is a significant fish species (Abdul, 2015). *C. nigrodigitatus* is a demersal and potamodromous species of freshwater fish. Adults live over fine sand and mud on the bottom of lakes with shallow waters (less than 4 m). As an omnivore, *C. nigrodigitatus* consumes detritus, seeds, insects, and bivalves. As fish get older and bigger, their diets become more specialized; larger fish may eat fish and decapods (Vreven *et. al.*, 2013). The fish is used in traditional and continental dishes and is highly valued for its flavour and meat quality, primarily when it is smoked (Eyo *et al.,* 2013). According to Offem *et al.* (2009), the fish is a highly prized food fish that is one of the most commonly harvested commercial species in major Afri-

can rivers. It is also the most common fish caught in Nigerian lagoons (Eyo *et al.*, 2013).

In order to evaluate fisheries, the relationships between length and weight are essential. When paired with the relative condition factor, these studies are crucial for evaluating the dynamics of fish populations and could aid in estimating potential prevailing environmental conditions (Ferraz *et al.*, 2021). Fish have been evaluated for their weight based on their length using length-weight relationships (Froese, 2006; Abdul *et al.*, 2023). The condition factor is a helpful indicator for determining fish age, growth rates, and degree of feeding. It is also frequently utilized as an indicator to evaluate the condition of the aquatic habitat that the fish lives in. The fatness, condition, and general well-being of fish from similar or different habitats can occasionally be compared between and within species using this method. Condition factor provides information on the current state of the fish which is strongly influenced by biotic and abiotic environmental variables and fluctuates due to interactions among feeding habits, parasitic load, and fish physiological conditions (Le Cren, 1951; Dar *et al.*, 2012; Rao *et al.*, 2024). An increase in length decreases the condition factor and controls the reproductive cycle in fish (Welcome, 1979; Ekpemikoghene *et al.*, 2024).

Many studies on the length-weight relationships and condition factors of different fish species have been conducted in Nigerian waters. These studies include those conducted by Saliu (2001) on the condition factor of *Brycinus nurse* from Asa Reservoir in Ilorin, Kwara State, Nigeria. In Nigeria's Epe Lagoon, Fafioye and Olubanjo (2005) investigated the length-weight relationships of five distinct fish species while Hart and Abowei (2007) carried out a study on the length-weight relationship, condition factor and age of ten different fish species from the lower Nun River in the Niger Delta region of Nigeria. Agboola *et al.* (2008), studied the Length-weight relationships of thirty-five (35) species of fish from Badagry Creek, Lagos, Nigeria and Abowei *et al.* (2009), studied the length-weight relationship, condition factor of five (5) fish species from Nkoro River, Niger Delta, Nigeria. Kumolu-Johnson and Ndimele (2010) studied length-weight relationships and condition factor of twenty-one (21) fish species in Ologe Lagoon, Lagos, Nigeria while Atama *et al.* (2013) studied the Length-weight relationship and condition factor of six cichlid (Cichlidae: Perciformes) species of Anambra River, Nigeria.

Famoofo and Abdul (2020) in their work titled Biometry, condition factors and length-weight relationships of 16 fish species in Iwopin freshwater ecotype of Lekki Lagoon, Ogun State, Southwest Nigeria reported that the Fulton condition factor (k) values significantly ranged between 0.08 and 1.28 while b values ranged between 1.067 and 3.41. The values of b indicated negative and positive allometric growth patterns. Among the fish samples studied were *Chryscichthys nigrodigitatus* which was the most abundant species out of sixteen species while *Polypterus senegalus, Sphyraena barracuda* and *Dagetichthys lakdoensis* formed the least groups of populations. Other fish species sampled included *Sarotherodon galilaeus* and *Sarotherodon barracuda.*

Various factors such as eutrophication, overfishing, pollution, and habitat degradation, are adversely affecting the coastal ecosystems (Abdul *et al.*, 2023). These factors have contributed to a decline in the productivity of

coastal water bodies. Therefore, it is generally accepted that inadequate management of these ecosystems is to blame for the demise of numerous coastal fisheries (Callisto *et al.*, 2002). Thus, improving fish yields, biodiversity, and ecosystem quality can be achieved through sustainable management of coastal ecosystems and their resources.

This study therefore seeks to provide updated information on the growth status of *C. nigrodigitatus* from Lekki lagoon by evaluating the species' length-weight relationship and condition factor.

MATERIALS AND METHODS

Study Area

This study was done in Lekki Lagoon located between Lagos and Ogun States, Southwestern Nigeria. The area is found on latitude 6^0 20' N – 6^0 45' N and longitude 4^0 15' – 4^0 30' E. It is bounded down South by the Bight of Benin and in the East by Lekki Lagoon (Famoofo and Abdul, 2020). Lekki Lagoon is estimated to cover an area of about 26 km^2 (Sentengo and Larkin, 1973). Although the Lagoon is mostly freshwater, saltwater intrusion is possible occasionally. Large tracts of fertile soil, rocks, and mineral deposits are among the natural resources that define the Lekki Lagoon (Adekoya, 1995). With semi-diurnal offshore tides, the lagoon hydrologically empties into the western littoral region. Seasonal upwelling combined with summertime intensification and windy conditions results in rip currents, which typically occur from July to September. It appears that the two air masses—the southwestern and northeastern harmattan—along with the Intern Tropical Discontinuity (ITD) oscillations cause heavy precipitation. According to Famoofo and Abdul (2020), Lekki Lagoon has a tropical climate with rainy (April–November) and dry (December –March) seasons. Fishing is the primary occupation of the people.

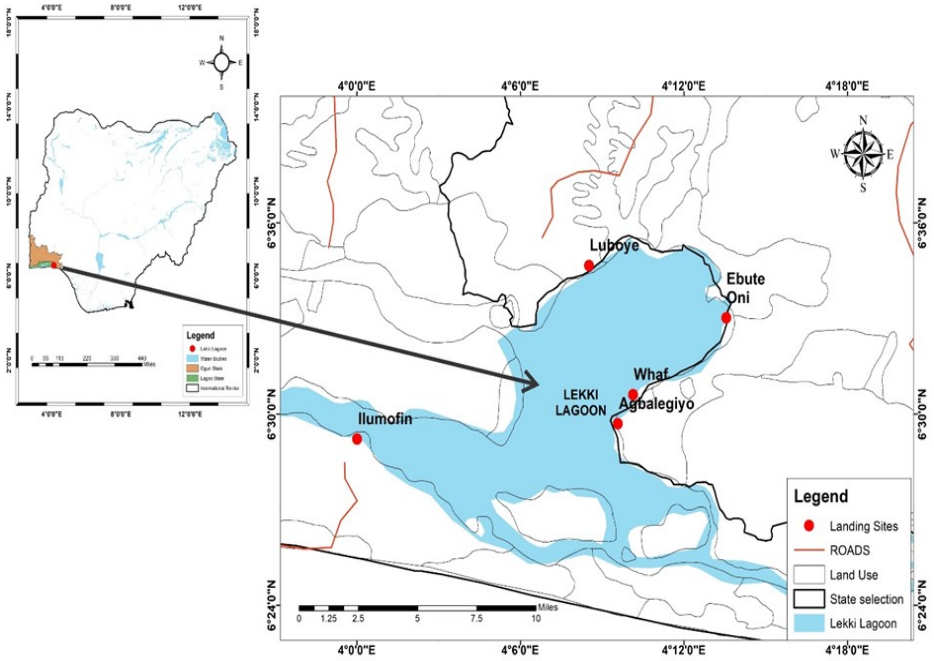

Fig. 1: Study area showing sampling sites
Source: Field Survey (2022).

Sampling Procedures

Data were collected for twelve months, covering both the dry (November – April) and wet (May – October) seasons. The lagoon was randomly stratified into 5 different landing sites: Wharf, Agbalegiyo, Ebute-Oni, Ilumofin and Luboye. Proportional sampling which depended on the level of fishing activities was used for sample collection at each landing site. Fish samples adding up to 6,123 were collected from the local commercial fishers immediately after harvesting using various fishing gear types which were seine nets, gillnets, cast nets and traps. The samples were identified using fish identification keys (Olaosebikan and Raji, 2013). The total length (TL) was measured (from the tip of the snout to the tip of the caudal fin) using an ichthyoboard to the nearest ±0.1 cm, as well as the weight measured to the nearest ±0.01 g was taken using an electronic weighing balance (MH-999) according to Dienye *et al.* (2021).

Data Analyses

The length-weight relationship (LWR) of the selected fish species was estimated using the equation adopted by Abdul (2009):

$$W = aL^b \quad (1)$$

Where,
W = body weight of fish in grammes (g)
L = total length of fish in centimetres (cm)
a = regression constant (y-intercept).
b = regression coefficient

After the logarithmic transformation of this relation (log W = log a + b logL), parameters a and b were determined using least–square linear regression method (Zar, 1999). To check if the value of b was significantly different from 3, the method described by Sparre and Venema (1992) and Abdul *et al.* (2015) was used. The value of b gives information on the kind of growth pattern of fish: the growth is isometric if b= 3 and the growth is allometric if $b \neq 3$ (negative allometric if $b < 3$ and positive allometric if $b > 3$).

Condition factor (CF) an estimate of the general well-being of the fish sampled, was analyzed to size and it was estimated using the Fulton's equation as adopted by Famoofo and Abdul (2020):

$$K = 100W/L^3 \quad (2)$$

Where:
K = condition factor
W = weight in grammes (g)
L = total length in centimetres (cm)

The regression analysis for length-weight data was carried out using the FAO-ICLARM Stock Assessment Tool (FiSAT II) Version 2.3 while the condition factor was calculated using Microsoft Excel (2019).

RESULTS

A total of 6,123 fish specimens were sampled. The total length of *Chrysichthys nigrodigitatus* from Lekki Lagoon ranged between 5.0 and 64.9 cm with respective mean weights of 3 and 1649 g, respectively (Table 1). Class size 15.0 – 19.9 cm had the highest number of 968 from the samples collected in the wet season while class size 45.0 – 49.9 cm recorded the lowest occurrence of 2. In the dry season, the least frequency was 3 for length size 40.0 – 44.9 cm while the highest frequency of 1317 against 10.0 – 14.9 cm. Mean lengths for the wet and dry seasons were 18.53±7.41 and 16.16±5.72 with mean weights of 106.32±171.97 and 69.26±104.40 cm, respectively (Table 1). The b value of the regression analyses which depicted the growth pattern of the fish species was highest in March – 3.12 (r = 0.92), followed by

September – 2.88 (r = 0.94) and December – 2.86 (r = 0.93) while the lowest b-value was recorded in May – 2.52 (r = 0.88) with a mean value of 2.73±0.17 (r = 0.91±0.02) –Table 2. The condition factor (k) of this study varied between 1.18 (May) and 2.07 (September) with a mean value of 1.61±0.26 (Fig.2).

Table 1: Seasonal length and weight distributions of *Chrysichthys nigrodigitatus* from Lekki lagoon

	Wet season			**Dry season**		
Length Size (cm)	Fre-quency	Total weight (g)	Mean weight	Fre-quency	Total weight (g)	Mean weight
5.0 – 9.9	139	1730	12.45	207	2044	9.87
10.0 – 14.9	961	20130	20.95	1317	24333	18.48
15.0 – 19.9	968	58925	60.87	853	46954	55.05
20.0 – 24.9	570	63197	110.87	500	72577	145.15
25.0 – 29.9	150	45731	304.87	77	20476	265.92
30.0 – 34.9	136	46501	341.92	40	17281	432.03
35.0 – 39.9	116	58495	504.27	52	18960	364.62
40.0 – 44.9	5	3179	635.80	3	2035	678.33
45.0 – 49.9	2	1671	835.50	9	7128	792
50.0 – 54.9	4	5632	1408.00	-	-	-
55.0 – 59.9	5	6611	1322	-	-	-
60.0 – 64.9	9	14071	1563.44	-	-	-
Total	3065	325873		3058	211788	
Mean length (cm)	18.53±7.41			16.16±5.72		
Mean weight (g)	106.32±171.97			69.26±104.40		

Table 2: Length-weight relationship analyses of *Chrysichthys nigrodigitatus* from Lekki Lagoon

Month	N	a	b	$b_{CL95\%}$	R^2	r
January	536	3.56	2.68	2.61-2.75	0.85	0.92
February	526	3.36	2.55	2.45-2.65	0.82	0.91
March	508	4.97	3.12	3.00-3.25	0.82	0.91
April	428	3.77	2.73	2.58-2.89	0.75	0.86
May	561	3.42	2.52	2.40-2.63	0.78	0.88
June	569	3.72	2.66	2.59-2.74	0.89	0.94
July	600	4.00	2.81	2.73-2.89	0.88	0.94
August	525	3.50	2.65	2.55-2.74	0.85	0.92
September	402	4.02	2.88	2.74-3.02	0.80	0.89
October	408	3.57	2.66	2.54-2.78	0.83	0.91
November	527	3.65	2.67	2.56-2.78	0.81	0.90
December	533	4.21	2.86	2.76-2.96	0.86	0.93
	6123					
Mean±SD		3.81±0.45	2.73±0.17		0.83±0.04	0.91±0.02

N – Number of specimens, a – intercept, b – slope, CL – confidence interval,
R^2 – coefficient of determination, r – regression coefficient.

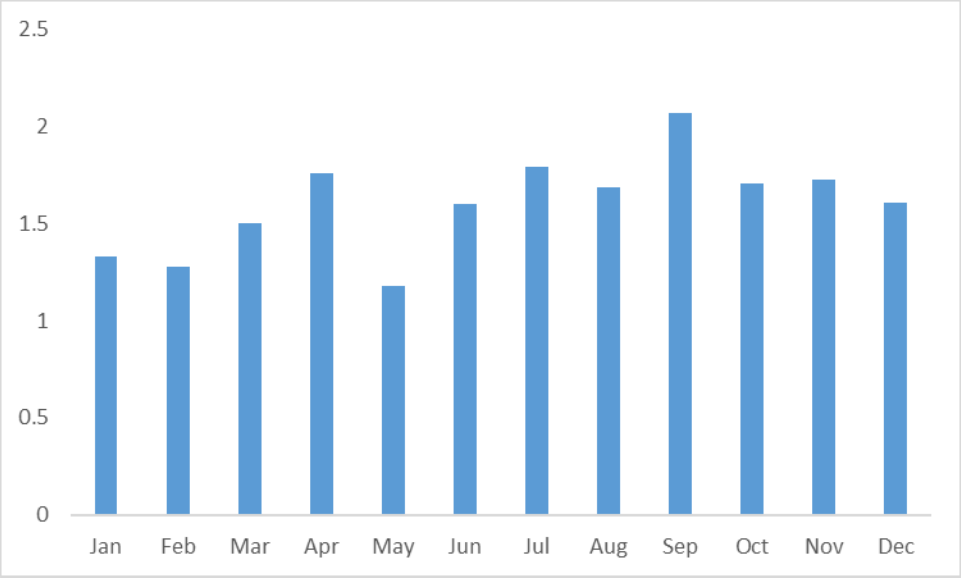

Fig. 2: Monthly mean condition factor of *Chrysichthys nigrodigitatus* from Lekki Lagoon

DISCUSSION

In the field of fishery sciences, the length-weight relationship is employed in population dynamics, ecological research, general health and habitat condition assessment, and age estimate (Froese, 2006; Rao *et al*., 2024). The b –values recorded were significantly ($P < 0.05$) lower than 3, which signified a negative allometric growth pattern except for the month of March. The b-values recorded in this study were within the expected range of $2.5<b<3.5$ (Froese, 2006). Famoofo and Abdul (2020) also reported a negative allometric growth for *C. nigrodigitatus* in Lekki Lagoon with a mean b –value of 2.87±0.12. However, the values recorded in this study were higher than those recorded by Kareem *et al.* (2015) for *C. nigrodigitatus* (1.76 – 2.56) in Erelu Lake of Oyo State, Nigeria. The mean "b" value of the current study shows that *C. nigrodigitatus* exhibited an overall negative allometric growth pattern. This agrees with the studies of Abdul *et al.* (2023) who reported similar growth pattern for the fish species in the same water body. Edem *at al.* (2018) also reported "b" values of 1.6067, 1.6791 and 1.7311 for males, females and combined sexes respectively for *C. nigrodigitatus* in Lower River Benue. There is however a high difference in the "b" value recorded for combined sexes of *C. nigrodigitatus* from lower River Benue when compared with the current study which could be a reflection of variations in environmental parameters, food resources availability and ecosystem dynamics.

The range of b values in this study could be caused by several other factors such as food availability (quality, quantity, and size), seasonal environmental variability, salinity, water temperature, sex, and maturity stage, as well as sampling size, the interval between sampling locations, and habitat suitability (Pauly, 1983; Philip and Matthew, 1996; Morey *et al*., 2003).

According to Ferraz *et al.* (2021), fish species with regression coefficient (b) values less than 3 show negative allometric growth, which suggests that, these species typically experience smaller weight increases relative to their body's cubic length. Since the shape of fish varies with growth, most species frequently deviate from isometric growth (Thomas *et al*., 2003). Also, no theory dictates that the b-value must be positively or negatively allometric (Pauly, 1983). Absolute isometric growth ($b = 3$) is however, observed periodically in nature (Bagenal and Tesch, 1978). It is common to observe deviations from isometric growth because most aquatic organisms undergo shape changes during growth (Thomas *et al.,* 2003). The productivity organisms' immediate environment's productivity has a significant impact on the direction and degree of deviation of b. According to study by Prasad (2001), low-productive waters, like the deep-sea zone, tend to enhance negative allometric growth, whereas highly productive ones typically promote positive allometric growth. This study recorded strong positive correlation coefficient (r) between the total length and body weight just like the study of Abdul *et al.* (2023) in the same lagoon.

The Fish species condition factor (K) can be estimated using the length-weight relationship. The condition factor is used in fisheries science to compare fish condition, fatness, or well-being (Atama *et al*., 2013). It is based on the hypothesis that heavier fish of a particular length are in a better physiological condition (Bagenal and Tesch, 1978).

Results of this study shows that the fish spe-

cies were in good physiological condition throughout the study period. This result is dissimilar to that of Famoofo and Abdul (2020) who recorded a condition factor of <1 for *C. nigrodigitatus* in the same water body and that of Abdul *et al.* (2023) who recorded values of 0.97. The c.f. values of this study for this study are also higher than that of Kareem *et al.* (2015) for combined sexes of *C. nigrodigitatus*. The current research aligns with the findings of George and Atakpa (2015) who also reported varied mean condition factors values that were greater than 1 for *C. nigrodigitatus* in Cross River Estuary. Bagenal and Tesch (1978) documented higher values (2.9–4.8) for matured freshwater fish with fresh body weight. Thus, numerous factors which include sex, age, state of maturity, size, and state of stomach fullness, sampling methods and sample sizes and environmental conditions affect fish condition and parameters of length-weight relationships (Kumolu-Johnson and Ndimele, 2011).

CONCLUSION

Findings from the study have demonstrated that *C. nigrodigitatus* from Lekki Lagoon displayed both positive and negative allometric growth patterns. The correlation coefficients of the length-weight relationships' correlation coefficients showed a strong positive correlation. The condition factor indicated that *C. nigrodigitatus* in the lagoon was in a healthy physiological state.

To complement findings of this study, more research on the different sexes of the fish species and their bionomics in this lagoon is recommended.

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