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RESEARCH ARTICLE

Length-frequency distribution and relative condition factor of *Brycinus nurse* in the New Calabar River, Niger Delta, Nigeria

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ABSTRACT

This study assessed the length-frequency distribution and condition factor of *Brycinus nurse* from two sampling stations in the New Calabar River. A total of 401 individuals of *B. nurse* were collected from artisanal fishers and assessed between February 2020 and January 2021.The collected samples were analyzed for growth pattern using FISAT II. The mean values were 11.80±1.59 cm and 9.52±1.28 cm for total length and standard length The mean weight was 20.63±8.38 g. The length- weight relationship revealed an exponent b value of 2.539, showing negative allometric growth. The condition factor ranged from 1.09 to 1.42 indicating that the species is in good growth condition. The size structure of *B. nurse* recorded indicated that most individuals were relatively medium to small sizes and were not allowed to grow to adults as a result of overfishing. Therefore, proper management and intervention is needed to manage overexploitation of *B. nurse* in the New Calabar River.

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Introduction

Brycinus nurse (commonly referred to as nurse tetra) is a pelagic, potamodromous ray-finned fish species (Riede, 2004) belonging to the family Alestidae. It inhabits rivers, lakes, irrigation canals, and fringing vegetation. *B. nurse* (Rüppell, 1832) is widely distributed in west Africa (Paugy, 1990; Paugy, 2003), in lower Guinea, where it is present in the Cross and Mèmé rivers. Also, in the Chad basin and the Nile River (Getahun, 2007) up to Lake Albert. It feeds on zooplankton, caridina, insects, snails, and vegetation (Bailey, 1994), and less frequently, small fishes, mainly *Haplochromis* spp. It spawns at the beginning of the rainy season. Dwarf populations are described in lake basins.

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B. nurse is a native to freshwater systems in Africa, thriving well in both lacustrine and riverine conditions (Boulenger, 2002), particularly in the Niger Delta, Nigeria. *B. nurse* is easily identified by its bright red tail fin. Other fins are tinged with red, and there is a black patch on the tail peduncle (Adesulu & Sydenham, 2007). This species is said to be of commercial importance due to the fact that they are widely consumed locally and has food value (Reed et al., 1967; Saliu & Fagade, 2004). Like other commercially important fish species in Nigerian inland water, this fish family is currently subjected to intense fishing pressure and pollution due to the lack of proper management policies. As a result of this unregulated exploitation, there is an urgent need to monitor and assess the state of the fish stock.

Growth studies are particularly important for describing the status of a fish population and for predicting the potential yield of a fishery. Unfortunately, age and growth determination in fishes of tropical waters are not easily calculated. This is because water temperatures vary only slightly throughout the year, making the formation of growth marks on the scales and other hard parts uncertain (Arowomo, 1982). Mohanraj (2000) opined that a better understanding of growth and size/age relationships is a must for one applying equilibrium yield models to the management of a fishery. This study was therefore designed to investigate biological information such as length-frequency distribution and relative condition factors of *B. nurse* in the New Calabar River, Niger Delta, Nigeria.

Materials and Methods

Description of the Study Area

The study area is the stretch of the New Calabar River. The New Calabar River lies between longitude 06°53 53086'E and latitude 04°53 19.020'N in Choba, Rivers State, Nigeria. The entire river course is situated between longitude 7°60'E and latitude 5°45'N in the coastal area of the Niger Delta and empties into the Atlantic Ocean. The New Calabar River region has an annual rainfall between 2000 and 3000 (mm) (Abowei, 2000). The New Calabar River is a black water type (RPI, 1985) located in Rivers State, Nigeria. It lies on the eastern arm of the Niger Delta and empties into some creeks and coastal lagoons bordering the Atlantic Ocean. At the source at Elele-Alimini, the water is fresh and acidic but brackish and tidal at the mouth. Aluu is the upstream part of the river where the river is fresh and tidal (Erondu, 1983), whereas it is brackish at a little distance downstream (Choba and Ogbogoro) The New Calabar River is among the essential water resources in the Niger Delta region of Southern Nigeria; it is in the vicinity of the rapidly expanding oil city of Port Harcourt in Rivers State, Southern Nigeria. The river is subjected to effluent discharge from industries sited along its banks. Also, surface run-off resulting from soil erosion, lumbering activities, forestry operations, dredging activities, and domestic sewage inputs may lead to wide scale contamination of the river (Dienye & Woke, 2015). Fish samples were collected from two sampling stations in the New Calabar River; Choba and Ogbogoro station.

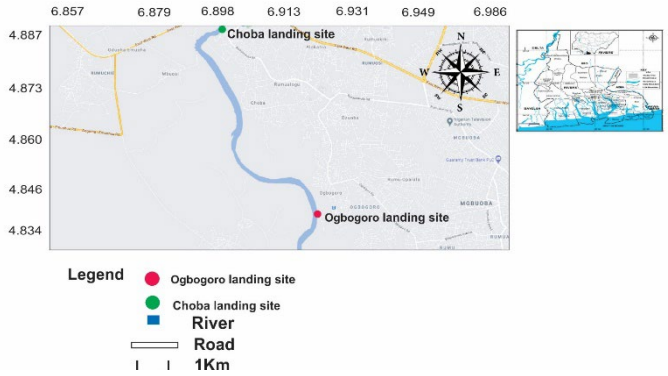

Figure 1. Map showing the sampling stations

Data Collection

Sampling was done twice a month from February 2020 to January 2021 from the two sampling stations with the assistance of local artisanal fishers. The fish species was identified using fish identification keys (Paugy, 2003; Adesulu & Sydenham, 2007). Measurements were taken at the landing sites of the fishers. The measurements collected were: the total length (TL), fork length (FL), standard length (SL), and girth length (GL) which is a contouring measurement to find the maximum circumference around the body of individuals of the species in the sampling stations in centimeters (cm) using a measuring board with a 30 cm ruler measured to the nearest ±0.1 cm. The body weight (W) was measured in grams (g) to the nearest ±0.01 g with an electronic sensitive scale.

Data Analysis

Analysis was carried out on the data obtained from the samples using FISAT II (FAO-ICLARM Stock Assessment Tools) as explained in details by (Gayanilo et al., 2005). The following stages of analytical methods were used;

The length-frequency distribution for *B. nurse* was estimated by using 1 cm intervals of TL.

Length-weight relationship was estimated using the equation (1):

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

Where, W=weight of fish in grams (g), L=length of fish in centimeters (cm), a=regression constant which describes the rate of change of weight with length (intercept), b=regression coefficient which is the weight at unit length (slope).

The equation would be transformed to log to estimate the parameters a and b (Nehemiah et al., 2012) as provided in the equation (2):

$$\log W = \log a + b \log L \quad (2)$$

The relative condition factor is the ratio of observed weight (w) of a fish at a given length to the expected weight (w) of a fish of the same length as calculated from the length weight regression (Le Cren, 1951).

Ponderal index (k) was calculated using the equation (3) of Fulton (1904):

$$K = 100 \times \left(\frac{W}{L^3}\right) \quad (3)$$

where W is the weight of the fish in gram (g), L is the total length in cubic centimeters (cm^3) for the length (L). The scaling factor of 100 was used to bring the relative condition factor (K_n) close to the unit for each individual was calculated using the equation (4) of Le Cren (1951):

$$K_n = \frac{W}{aL^b} \quad (4)$$

where W is the body weight in (g), L is the total length in (cm), a and b are the LWRs parameter. The variation in the length and weight between the two sampling stations; Choba and Ogbogoro was done using T-test.

Results

Length Frequency Distribution

In Figure 2, mean was 11.8 cm the highest frequency distribution, the lowest length was 8.90 cm and the highest length recorded throughout the study period was 16.80 cm, and the total length of 10 to 12 cm was the dominant class.

Length-Weight Relationship

Descriptive statistics on the length (cm) and weight (g) measurements are presented in Table 1 with the mean total length estimated as 11.80 cm, and the mean weight as 20.63 g. The number of individuals (N) was 401 sampled across 12 months. The highest number of samples was recorded in June (70) while the lowest was in September (15). The b value was found to be 2.539. The value of the coefficient of correlation (r^2) estimated for the species was 0.8193 showing that the relationship between length and weight of the fish was highly significant (Figure 3).

Table 2 below compared the variation in the length and weight between the two sampling stations; Choba and Ogbogoro stations recorded higher mean values in all the parameters measured (TL, SL, FL, GL and W). indicating a significant difference between the two stations at $p<0.05$.

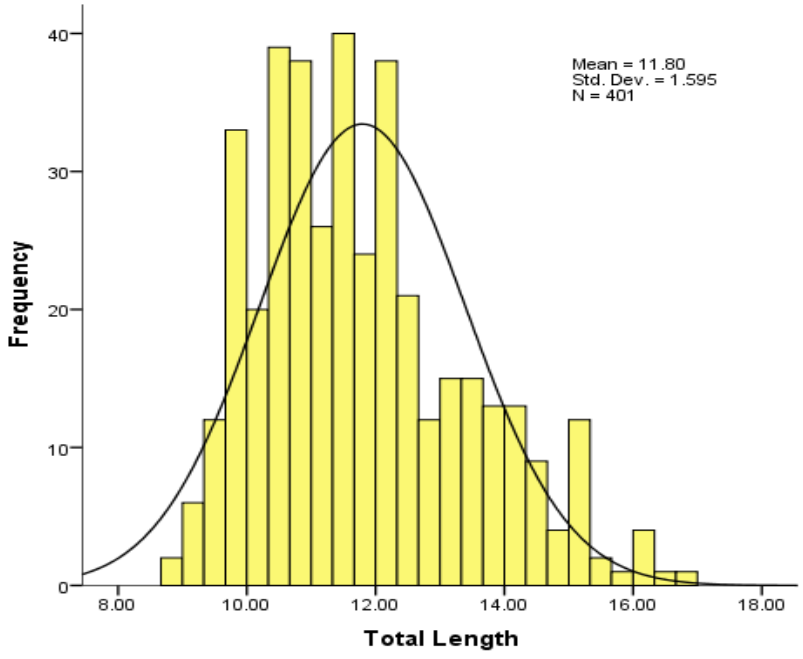

Figure 2. Length-frequency distribution of *B. nurse* during the study period

Table 1. Descriptive statistics on the length (cm) and weight (g) measurements

Parameters	N	Minimum	Maximum	Mean	SD
Total length	401	8.90	16.80	11.80	1.59
Standard length	401	7.00	13.30	9.52	1.28
Fork length	401	7.70	14.50	10.43	1.45
Girth length	401	5.70	11.70	7.64	1.07
Weight	401	10.00	55.20	20.63	8.38

Note: *N* is the sample size; *SD* is the standard deviation

Table 2. Comparisons of length (cm) and weight (g) between stations

Parameters	CHOBA	OGBOGORO	t-value	p-value
Total length	11.62±1.58	12.08±1.59*	-2.85	0.01
Standard length	9.34±1.22	9.81±1.32*	-3.62	0.00
Fork length	10.24±1.38	10.74±1.51*	-3.47	0.00
Girth length	7.31±1.00	8.17±0.97*	-8.43	0.00
Weight	19.62±8.40	22.24±8.12*	-3.08	0.00

Note: * Significant at $p<0.05$

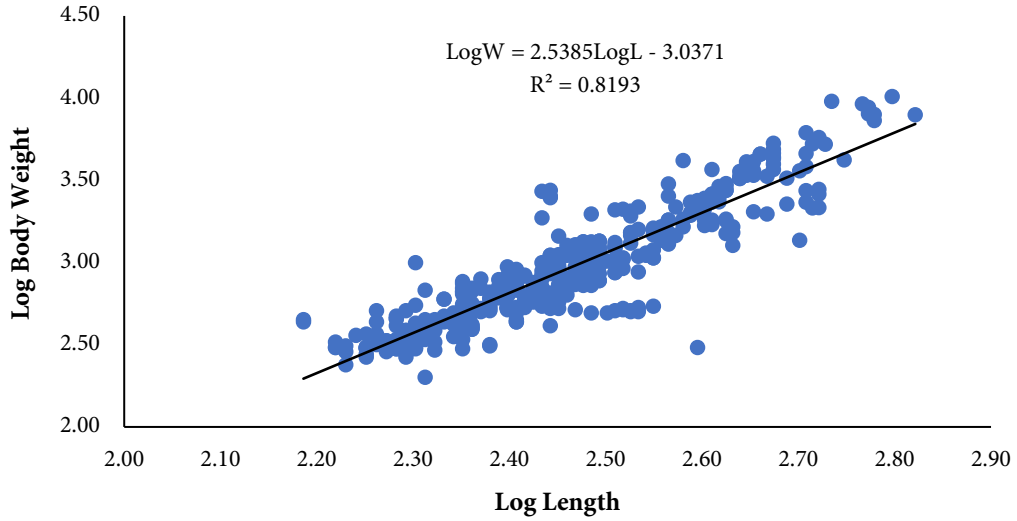

Figure 3: Length-weight relationship of *B. nurse* during the study period

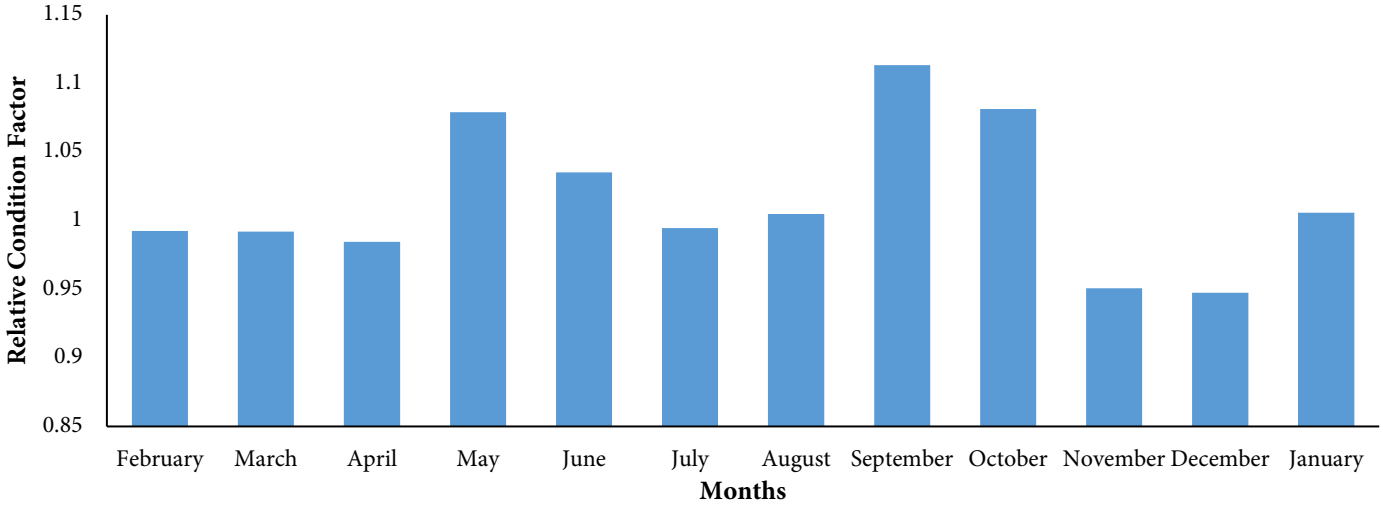

Figure 4. Month wise relative condition factor (K_n) of *B. nurse* during the study period

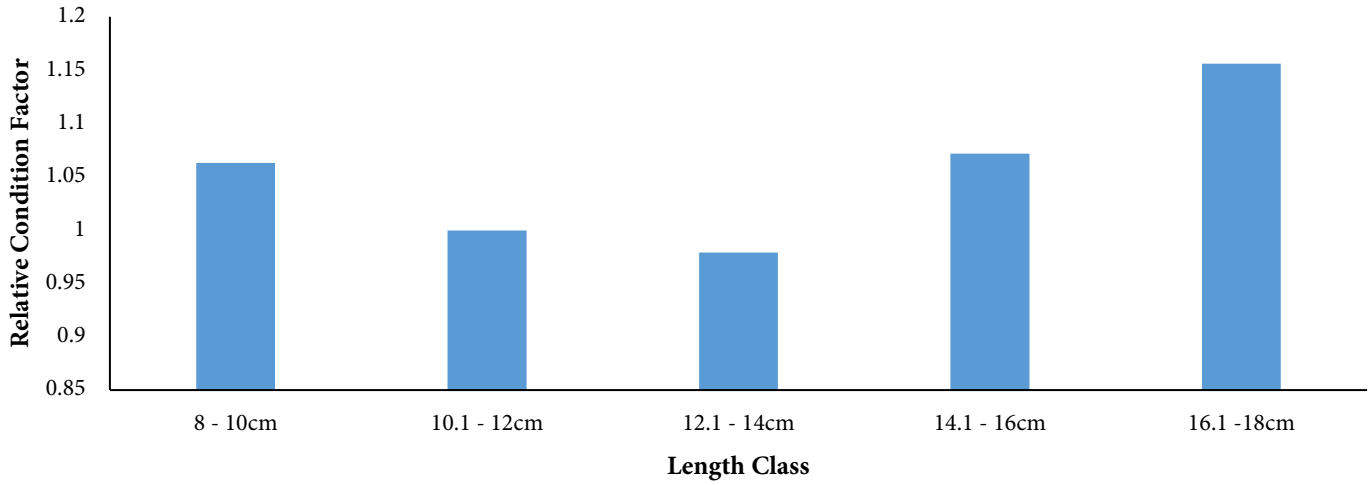

Figure 5. Length wise relative condition factor (K_n) of *B. nurse* during the study period

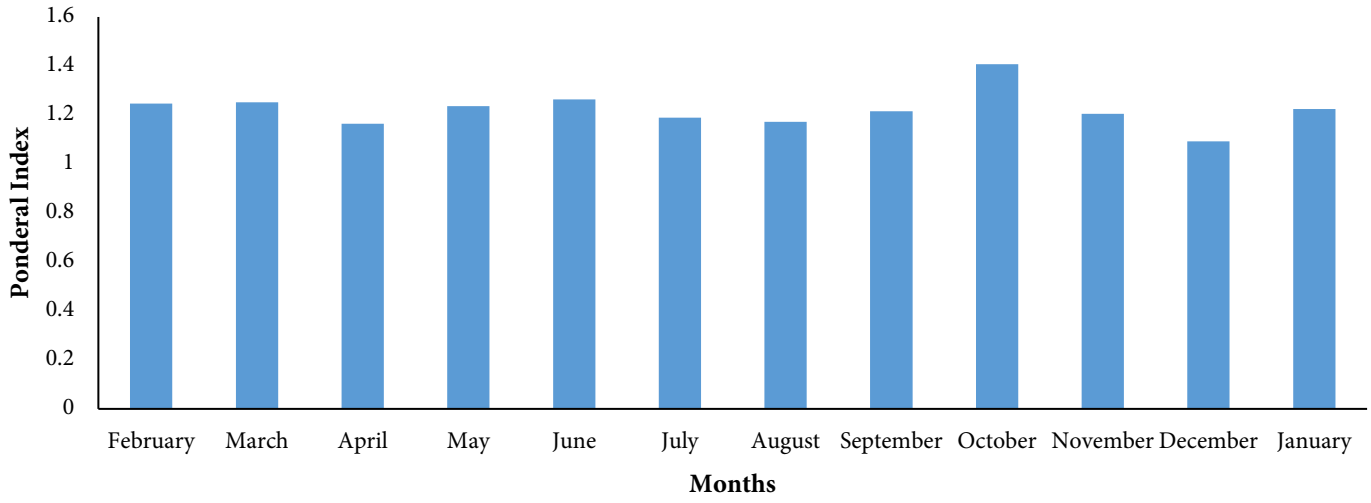

Figure 6. Month wise ponderal index (*K*) of *B. nurse* during the study period

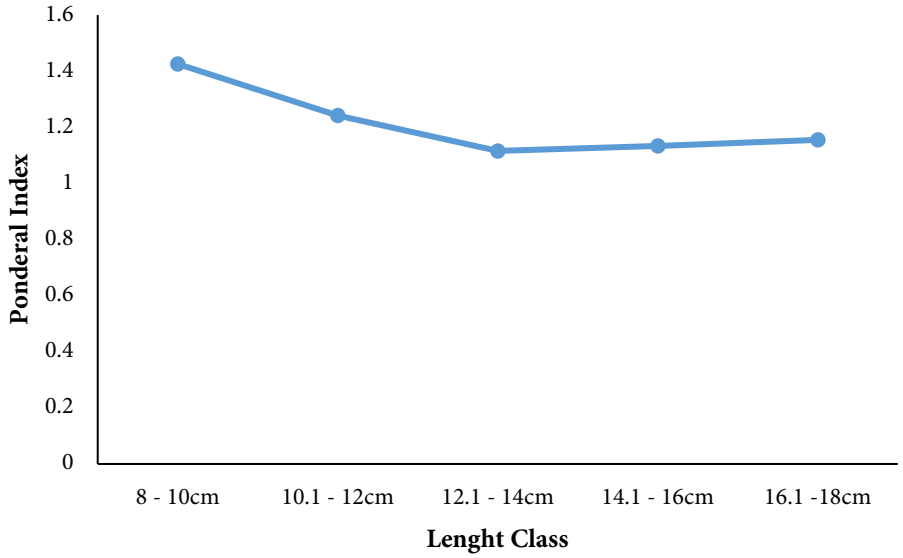

Figure 7. Length wise ponderal index (*K*) of *B. nurse* during the study period

Relative Condition Factor (K_n)

The Figure 4 below shows the monthly relative condition factor (K_n) for *B. nurse*; the highest value was 1.11 recorded in September, followed by 1.08 in October, while the lowest was 0.94 in December. Also, Figure 5 shows the length wise relative condition factor; the highest value of 1.15 was recorded in the length class of 16.1-18 cm and the lowest value of 0.97 was recorded in the length class of 12.1-14 cm.

Ponderal Index (K)

The figure 6 shows the month wise ponderal index (*K*) for *B. nurse* with the highest value observed in October (1.40), and lowest in December (1.09). *K* was determined for *B. nurse* on a length wise basis in Figure 7 highest value range of 1.42 was recorded in the length class of 8-10 cm, and 1.11 with the lowest in the class 12.1-14 cm.

Discussion

The weight of *B. nurse* throughout the study ranged from 10.0 to 55.20 g, with an estimated mean weight of 20.63±8.30 g, while its total length was observed to be in the range of 8.9 to 16.8 cm with an estimated mean total length (TL) of 11.80±1.59 cm. Olopade et al. (2019) recorded the weight of *B. nurse* that ranged from 5.0 to 210 g (mean=39.44±2.73 g) and a total length which ranged from 7.30 to 23.0 cm (mean=14.58±0.25 cm) in the New Calabar River. These results are in contrast with those from this study, and this variation in length and weight could possibly be as a result of some factors such as: growth stages, level of exploitation of the fish species in the water body as well as predation by other fish species, nature of the aquatic environment (pollution), and abundance of food for the fish species.

The length weight relationship of this study revealed that *B. nurse* had an exponent *b* value of 2.439, which shows a negative allometric growth. The value, however, falls within the acceptable range of 2.5 and 3.5, which is typical for tropical fish stocks (Carlander, 1969; Froese, 2006). A similar observation was also reported in *B. nurse* from the mid Cross River basin by Iyabo (2014), with a '*b*' value of 2.425 and 2.958 recorded by Lalèyè (2006) in the Ouémé River, Bénin. Also, Dankwa (2003) recorded 2.959 in Volta Lake Ghana. These are in contrast with the findings of this study as they exhibit closely isometric growth. While Getahun (2007) recorded a value of 3.086 for the same exponent in the River Bia; Abobi & Ekau (2013) reported 3.0737 for *B. nurse* from the White Volta River in Ghana; and Olopade et al. (2019) recorded 3.5405 in the New Calabar River, all showing positive allometric growth. The differences in these findings may be due to several factors that affect the growth of fish, including habitat, seasonal variation, sexual dimorphism, gonadal maturation, availability of food, and general health of the fish (Ozcan & Balik, 2009).

Adesulu & Sydenham (2007) reported that the condition factor in fish is mainly affected by the amount of food in the stomach and the stage of egg development that will affect the weight of the fish, and the weight of the fish is a function of the condition factor in fish. The condition factor and relative condition factor of *B. nurse* in this study were in the range of 1.09-1.42, indicating that the population is in good growth condition as the value is greater than 1. *K* values greater than 1 imply that the fishes thrive well in their current habitat (Komolafe & Arawomo, 2011).

According to Ikomi & Sikoki (2001), the '*K*' value for B. nurse in the River Jamieson, Nigeria ranged from 2.33 to 2.65 in the wet season and 1.99-2.21 in the dry season. The peak value was obtained in July and the least value was in September where the value dropped dramatically. Concerning size and sex variations, mean *K* values decreased with an increase in the fish size within the range of 7-11 cm. After that, the *K* values increased with additional size. The condition factor varied with the size of the fish. It was inversely related to increasing length in the medium size group. Moreover, with the large size group, *K* values increased with increasing fish size. A similar observation was made by Paugy (1979). However, Brown (1985) reported an inverse relationship with all size groups. The high rainy season peak in *K* values may be related to the food regime of the fish. During this season, the fish were able to utilize the rich food resources and accumulate a lot of fat, which probably resulted in their improved well-being (Ikomi & Sikoki, 2001). However, these are in contrast with the results of *B. nurse* in this study, where the condition factor values were unrelated to particular periods, sex, or length size, although all values were above unity, indicating that the fish were in good condition.

Conclusion

This study provides important baseline knowledge on the size structure and general well-being of *B. nurse* in the New Calabar River. The length-weight relationship revealed negative allometric growth (less than 3) for *B. nurse*. The species is also in good growth condition as revealed in the condition factor (*K*) which ranged from 1.09 to 1.42. The maximum size of *B. nurse*

recorded in this study indicated that most individuals were relatively medium to small sizes, and were not allowed to grow to adults as a result of overfishing. This information will help in the development of efficient management strategies of the species and also, proper management and intervention are needed to prevent and manage the over exploitation of *B. nurse* in the New Calabar River.

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Compliance With Ethical Standards

Authors' Contributions

Author HE and OA designed the study, HE wrote the first draft of the manuscript, SA performed the statistical analyses. All authors read and approved the final manuscript.

Conflict of Interest

The authors declare that there is no conflict of interest.

Ethical Approval

For this type of study, formal consent is not required.

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