



International Journal of Fisheries and Aquatic Studies

ISSN: 2347-5129

(ICV-Poland) Impact Value: 5.62

(GIF) Impact Factor: 0.352

IJFAS 2015; 2(6): 159-162

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www.fisheriesjournal.com

Received: 09-05-2015

Accepted: 11-06-2015

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Seasonal variation in the length – weight relationships and condition factor of *Gymnarchus niloticus* Cuvier, 1829 in Lekki lagoon, Lagos state, Nigeria

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Abstract

Length-weight relationship (LWR) and Condition factor (K) of *Gymnarchus niloticus* from Lekki Lagoon were studied for 24 months to provide useful information for the sustainable development of *Gymnarchus niloticus* in Lekki lagoon. Samples of *G. niloticus* caught from the lagoon were obtained from fishers on a bimonthly basis for 24 months. Length – weight data were analyzed and Length – weight relationship graphs were plotted for the dry and wet seasons of the sampling years. The b values in the LWR ($W=aL^b$) varied between 2.56 – 2.60 for the dry seasons and 2.51 – 2.62 for the wet seasons revealing that the somatic growth of *G. niloticus* at Lekki lagoon had negative allometry. The average condition factor (K) were found to be 0.7113 ± 0.3485 for dry seasons and 0.7047 ± 0.5069 for wet seasons of the sampling period. There was a strong positive correlation ($r = 0.99$) between the length and weight of fish specimen examined while the Coefficient of determination (R^2) varied between 0.9822 – 0.9976 and 0.9951 – 0.9970 for both dry and wet seasons respectively. It was concluded that the data generated will form a baseline tool for effective fisheries management and sustainable exploitation of *G. niloticus* in Lekki lagoon.

Keywords: fisheries biology, standard lengths, growth trend.

1. Introduction

The fishery resources from brackish-marine environment have contributed a lot in meeting Nigeria domestic demand for fish and fishery products ^[1]. Larger percentage of fish being consumed in Nigeria comes from brackish-marine environment ^[10]. *Gymnarchus niloticus* is one of the dominant species of fish in Lekki lagoon that is yet to be fully studied. It is the only member of the family Gymnarchidae in the order Osteoglossiformes.

The importance of length – weight relationship (LWR) in fisheries biology cannot be over emphasized because it affords easy prediction of average weight of a specific length group of fish population through a mathematical relationship between length and weight of the population of fish species in that habitat ^[8, 6]. Length – weight relationships are also useful in assessing the relative well - being of a fish population as compared to others of the same species exposed to the same or different conditions of food, density, climate or environment ^[3]. LWRs could also be used in fish stock assessment as well as in comparing ontogeny of fish population from different region ^[24] thereby enhancing management, conservation and culture of the concerned species. The relationship between the somatic weight (W) and standard length (L) of fish is expressed as $W=aL^b$ for nearly all species of fish ^[20].

The role of condition factor (K) is to quantify the health of individuals in a population or to determine whether a population is healthy in relative to other fish population ^[22]. Condition factor often reflect food availability and growth of the concerned fish population within few weeks prior to sampling and it is usually influenced by age of fish, sex, season and maturity stages among others ^[4].

This study aimed at comparing seasonal variations in length – weight relationship and condition factor of *Gymnarchus niloticus* in Lekki lagoon so as to provide a baseline tool for effective fisheries management and sustainable exploitation of this species in Lekki lagoon.

2. Materials and Methods

2.1 Study Area

The study site which is Lekki lagoon covers an area of nearly 247km² and lies between longitude 4° 00' and 4° 15'E and latitude 6° 22' and 6° 37'N^[18, 21]. Lekki lagoon is situated in the eastern part of Lagos state. Several fishing villages lie along the lagoon. The lagoon is fed by River Oni in the north east while Rivers Oshun and Saga flow into the north western parts^[14]. Lagos lagoon also linked to Lekki lagoon from the western side of the State.

2.2 Fish Sampling

Fish samples were obtained bimonthly from November 2010 to September, 2012, from fishermen who used hook and lines, gill nets, cast nets and traps of diverse mesh sizes to catch the fish. The collected fish samples were taken to Laboratory of Nigerian Institute of Oceanography and Marine Research (NIOMR), at Badore in Ajah, Lagos State for preservation and analysis. *Gymnarchus niloticus* were weighed to the nearest 0.1g, and total and standard lengths were determined to the nearest 1mm.

The length-weight relationship (LWR) of fish samples from the lagoon was estimated by using the equation: $W = aL^b$,^[19] where W= weight (g), L= Standard Length (cm), a = constant, b = growth exponent. The values of 'a' and 'b' were determined from the transformed logarithm values of length and weight using the equation $\text{Log } W = \text{Log } a + b \text{ Log } L$ with the aid of Microsoft Excel software to estimate 'a' and 'b' values.

Correlation coefficient (r) and Coefficient of Determination

(R²) were computed from the regression analysis graph and compared to 3 using Student's t-test^[21] to determine the seasonal growth pattern of *G. niloticus* in the lagoon. The condition factor (K) of *G. niloticus* was calculated using the formula: $K = 100W/L^3$ ^[4]

Where K = Condition factor, W = Mean Body weight (g), and L = Standard Length (cm).

3. Results

Average standard length and mean body weight of *G. niloticus* in Lekki lagoon for the sampling period are as shown in Table 1. Average Standard lengths for *G. niloticus* were 44.74cm and 52.12cm for dry and wet seasons respectively. The mean body weights were 950.92g and 1335.64g for dry and wet seasons respectively. Both the standard lengths and body weight of fish samples caught for dry and wet seasons were significantly different (P<0.05)

Length – weight relationship parameters of *G. niloticus* in Lekki Lagoon for both dry and wet season is presented in table 2. The growth factor 'b' estimated for dry season was 2.58 while 2.56 was estimated for wet season. Coefficient of correlation value was (r) 0.99 for both seasons.

The regression graphs of length – weight relationship of *G. niloticus* in Lekki lagoon gave a negative allometric growth (Table 2).

Coefficient factor (k) which is an indication of the degree of robustness or the state of well –being of an individual^[3] in the population studied ranged between 0.25 - 1.42 in dry seasons with a mean of 0.7113±0.3485 and 0.27 – 2.12 in wet seasons with a mean of 0.7047±0.5069.

Table 1: Summary of standard length and weight of *Gymnarchus niloticus* during the sampling period

Sampling Period	Standard Length (cm)				Weight (g)			
	Min	Max	Mean	Season Average	Min	Max	Mean	Season Average
Dry Season 2010-2011	5.2	130	40.71	44.74	2	8250	901.548	950.92
Dry Season 2011-2012	5.2	110	48.76					
Wet Season 2010-2011	4.3	118	53.50	52.12	1.5	5300	1430.01	1335.64
Wet Season 2011-2012	5	120	50.73					

Table 2: Length – weight relationship parameters of *Gymnarchus niloticus* in Lekki lagoon

Season	Number of specimen (n)	Intercept (a)	Growth exponent (b)	Season Average for 'b'	Correlation coefficient (r)	Coefficient of Determination (R ²)	Season Average for R ²	Level of Significance
2010 - 2011 Dry Season	115	-1.6488	2.5963	2.5775	0.9988	0.9976	0.9899	*
2011 - 2012 Dry Season	105	-1.5086	2.5587		0.9911	0.9822		
2010 - 2011 Wet Season	90	-1.4641	2.5079	2.5615	0.9985	0.9970	0.9965	*
2011 - 2012 Wet Season	95	-1.6849	2.6151		0.9980	0.9959		

*Significant at 5%

4. Discussion

Fish stock assessment using length – weight parameters are important since the values obtained help in determination of the performance of the concerned fish species in the given environment. Length – weight relationship (LWR) is represented by the equation $W = aL^b$ where W = weight (g), L = Standard length (cm), a = constant and b = growth exponent^[9]. When b is equal to 3 or close to 3, growth in the fish is said to be isometric, i.e. fish becomes more robust as they increase in length, but when 'b' is far less or greater than 3, growth in the fish is allometric, i.e. the fish becomes thinner with increasing length^[7]. *Gymnarchus niloticus* in this study exhibited negative allometric growth for both dry and wet seasons which means they tend to become thinner as they grow larger. Similar observation was made on *Callinectes*

annicola in Badagry, Lagos State and Warri River, Niger Delta Nigeria respectively^[15, 51]. Although, a positive allometry was reported for *Chrysichthys nigrodigitatus* and *Schilbe intermedius* from Owalla and Eko –ende reservoirs^[23], it had been shown that most inland water fish in Nigeria had negative allometric growth pattern^[13]. Likewise, the 'b' values for most intertidal macro-benthos in Southeast Nigeria were found to be less than 3^[25].

Condition factor is a morphometric index used to evaluate physiological status of fish based on the principle that those individual of a given length which have a higher mass are in better 'condition'. The condition factor could be influenced by differences in size or age^[3]. In this study, mean values of 'k' were 0.7113 ± 0.3485 and 0.7047 ± 0.5069 for dry and wet seasons respectively. These values agree with earlier work^[17]

who observed a mean monthly 'k' value of 0.78 ± 0.11 for *G. niloticus* in the floodplain of River Anambra, Nigeria. However, higher values of 'K' (2.39 and 2.38 for 2006 and 2007 respectively) were obtained for *Sarotherodon melanotheron* in Ologe lagoon, Lagos, Nigeria [16]. It has been established that when K value is greater than 1, this indicates that the fish species is living well in the concerned habitat [12]; the 'K' value in this experiment therefore suggest that the wellbeing of *G. niloticus* at Lekki lagoon is being threatened. Research has established that *G. niloticus* breeds between May to July and November to January in Lekki lagoon [18]; a closed season during the breeding period would reduce pressure on the species and increase the 'K' value. The correlation coefficient of 0.99 obtained for *G. niloticus* in this study indicates a very strong positive correlation between length and weight.

5. Conclusion

The results of the length – weight relationships of *G. niloticus* from Lekki lagoon indicated a negative allometric growth. The low condition factor (K) value obtained showed that the wellbeing of this species is being threatened in Lekki lagoon perhaps due to a reduction in the food availability and increased hunt for *G. niloticus* by fishermen. A closed season is recommended during the peak breeding period for the fish. The results of this study have therefore provided baseline information which could enhance production potential of *G. niloticus* and its sustainable development and management in Lekki lagoon.

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