BIU Journal of Basic and Applied Sciences 3(1): 31 – 40, 2017.

ISSN: 2563-6424

DETERMINATION OF THE LENGTH - WEIGHT RELATIONSHIPS AND CONDITION OF TWO FISHES, *Ctenopoma peterici* AND *Oreochromis niloticus* FROM A TRANSECT OF IKPOBA RIVER, BENIN CITY, NIGERIA

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ABSTRACT
This investigation analyzed the length-weight relationships of two important food fishes (*Ctenopoma peterici* and *Oreochromis niloticus*) from Ikpoba River, Benin City, Nigeria to determine their growth pattern and their condition. The fish samples were sourced from fishermen landings on the river. For each fish sample, length (L) and weight (W) were measured using standard methods. The statistical relationship between these parameters of the fishes was established by using the parabolic equation: $W=aL^b$ while the condition factor was determined using $K = 100(W/L^3)$. The results showed that both fishes exhibited negative allometric pattern of growth with regression exponent b values (1.3 and 2.44) less than 3. The correlation coefficients (r^2) of 0.8 and 0.83 obtained from the length and weight data indicated a high degree of positive correlation and implied that the fishes increased in weight as they increase in length. It can thus be inferred that although the fishes increased in length and weight with growth, they however increased more in length and so have a tendency to become more slender in shape. The results also showed that the condition factor (k) values of 2.15 and 2.07 obtained for the fishes were higher than one (>1) and implied that the fishes were in good condition in the river. Based on these findings, it is recommended that strategies to conserve these fishes be implemented in order to ensure the sustainability of the species in view of their importance to the fish food basket of the teaming local population.

KEYWORDS: Length -weight relationship, Condition, Fish species, Ikpoba River, Benin City, Nigeria

INTRODUCTION
Fishes are known to exhibit a 'determinate' type of growth in short-lived species in tropical regions and an 'indeterminate' type in long-lived temperate regions. Growth in fish has been described as a function of fish size or the change in absolute weight or length of fish over time (Obasohan *et al.*, 2012). Growth is measured in units of length and weight but can also be measured by hepatosomatic index and by protein retention in the tissues (Nunes *et al.*, 2011). Fisheries management and

research often require the use of biometric relationships in order to transform data collected in the field into appropriate indices (Ecoutin and Albert, 2003). Morphometric characters such as length and weight relationships of fishes are important in fisheries and fish biology because they allow the estimation of the average weight of the fish of a given length by establishing a mathematical relation between them (Mir *et al.*, 2012; Sarkar *et al.*, 2013).

Knowledge of the quantitative aspects such as the length-weight relationships (LWR) can be used as a character for the differentiation of taxonomic units and the relationship changes with the various developmental events in life such as metamorphosis, growth and onset of maturity (Sarkar *et al.*, 2013; Thamos *et al.*, 2003). LWR can also be used to assess the influence of environmental factors of fish populations (Omoniyi *et al.*, 2010) as well as in setting yield equations for estimating the number of fish landed and comparing the population in space and time (Singh *et al.*, 2011). Besides, LWR is useful in other ways such as assessing fish habitat peculiarities, measure fish population discreteness and study ontogenetic allometric changes (Teixeira de Mello *et al.*, 2006; Omoniyi *et al.*, 2010).

Fish can attain either isometric growth, negative allometric growth or positive allometric growth. Isometric growth is associated with no change of body shape as a fish grows. Negative allometric growth implies that the fish becomes more slender as it grows while positive allometric growth implies the fish becomes relatively stouter or deeper-bodied as it increases in length (Riedel *et al.*, 2007; Nehemiah *et al.*, 2012).

The condition factor of fishes is the most important biological parameter which provides information on the condition of fish species and the entire community and is of high significance for management and conservation of natural populations (Muchlisin *et al.*, 2010). According to Richter (2007), condition factor (K) is a quantitative parameter of the state of well-being of the fish that determines present and future population success because of its influence on growth, reproduction and survival. It compares the state of well-being of a fish and is based on a hypothesis that a heavier fish of a given length is in better condition than a lighter one of the same length (Nehemiah *et al.*, 2012).

Many investigations are available that provide information on the morphometric characters and growth patterns of many freshwater fishes in Nigeria, but such information on members of the family Anabantidae, of which the Ctenopoma species are very important in the fisheries of the study river, is rare. The aim of this study is therefore to provide preliminary basic information on the length-weight relationships, growth patterns and conditions of *Ctenopoma peterici* (Gunther) and a common Cichlid, *Oreochromis niloticus* (Linne), as both species are very important in the conservation and sustainability of the fisheries of Ikpoba River, Benin City, Nigeria.

MATERIALS AND METHODS

Study Area

This study was conducted on a stretch of Ikpoba River (Figure 1), a fourth order stream flowing from north to south through Benin City, Edo State, Nigeria (6^{O} 20'N; 5^{O} 31'E). On the northern fringe of the river is located a reservoir built for potable water supply to urban Benin City (Obasohan and Oronsaye, 2000). Various other authors: Ogbeibu and Ezeunara, 2002; Oguzie, 2003; Oronsaye *et al.,* 2010 and Wangboje and Ekundayo, 2013 have also described Ikpoba River. Fish samples were collected at three landing sites weekly from fishermen for a period of three months. Various fishing methods which include set and floating nets of various mesh sizes, hooks and lines and assorted types of fish traps were employed by the fishermen. The fish samples collected were transported to the laboratory in ice-packed plastic containers.

In the laboratory, the samples were sorted and *Ctenopoma peterici* and *Oreochromis niloticus* were identified using keys, catalogues and diagrams according to Reed *et al*., 1967; Olaosebikan and Raji, 1998; Idodo-Umeh, 2003).

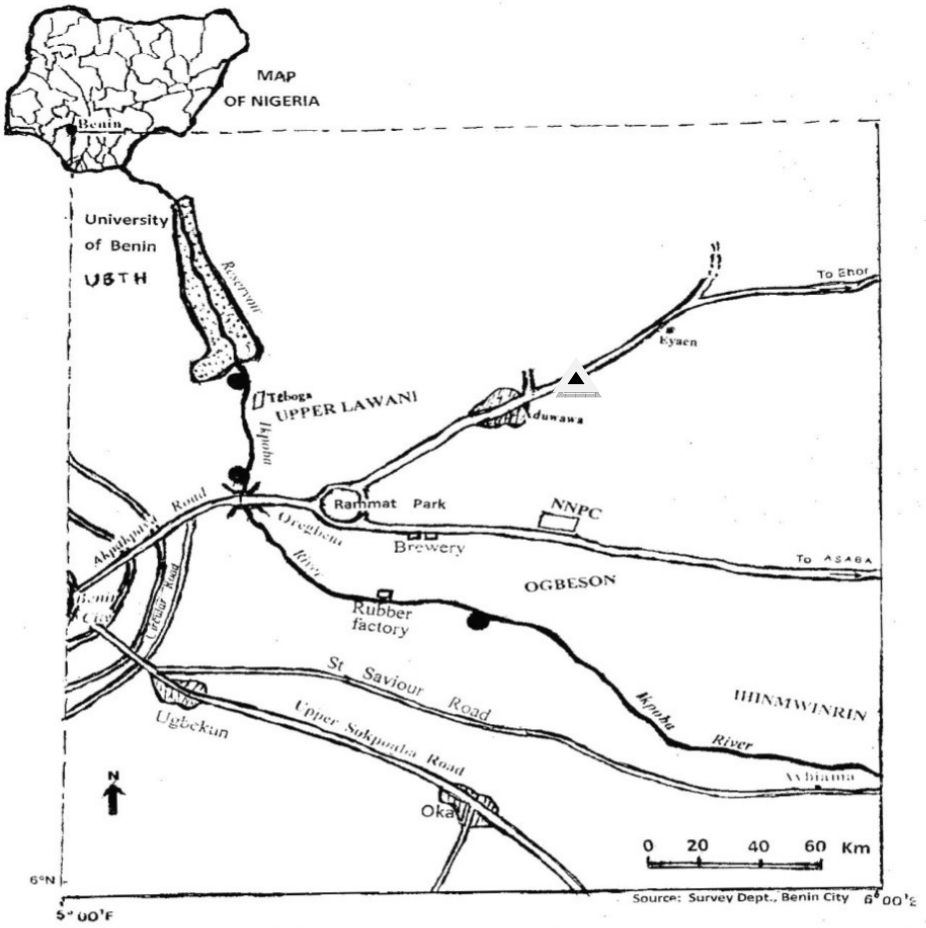

Fig. 1: Map of Benin City showing landing Sites on Ikpoba River

Morphometric Measurements

The morphometric characters measured were fish body weight (WT) and body total length (TL). Fish were mopped on a filter paper before they were weighed to remove excess water from their body in order to ensure accuracy. Body weight (WT) was measured using a top-loading digital electronic balance (Digital scale Model No: HS-502 ND) while total length (TL) was measured using a Measuring Board and taken as distance from fish snout to the mid-point of caudal fin origin. TL were recorded in centimetre (cm) while WT were recorded in grams (g).

Data Analysis

The length-weight Relationships were analyzed by using the equation

$W = aL^b$ (Pauly, 1983)

Where: W = weight of fish

L = Length of fish

a = rate of change of weight with length (intercept),

b = weight at unit length (slope)

The equation was log transformed to estimate the parameters 'a' and 'b'. When b is equal to 3, isometric pattern of growth occurs, but when b is not equal to 3, allometric pattern of growth occurs, which may be positive if >3 or negative if <3.

The condition factor is used for comparing the condition, fatness, or well-being of fish, based on the assumption that a heavier fish of a given length is in better condition. Therefore, fishes with condition factor value greater than one (>1) are considered as high while those less than one (<1). The coefficient of condition (k) was calculated using the formula:

$k = 100W/L^3$ (Nehemiah *et al.*, 2012)

Where: k = Condition factor,

W = weight of fish (g)

L = total length of fish (cm) and 100 is a factor to bring the value to unity.

RESULTS

The results of the morphometric measurements of the length and width of the fishes examined in this study are presented in Table 1. The total length (TL) of *Ctenopoma peterici* samples ranged from a minimum value of 9.1 - 15.2cm with a mean of 12.28cm. The fish body weight (WT) range was 22.7 - 95.7g, with a mean of 39.86g. For *Oreochromis niloticus*, the values for total length ranged from 9.9cm (minimum) to 18.8cm (maximum), with a mean of 14.32cm while the weight ranged from 20.38g (minimum) to 122.70g (maximum) with a mean of 60.69g. The equation parameters of the length-weight relationships and the condition factor of the fishes are also shown in Table 1.

Table 1: Length-Weight data, Equation parameters and Condition factor of *C. Peterici* and *O. niloticus* in this study

Fish	TL Range (cm)	Mean TL (cm)	Body Weight Range (g)	Mean WT (g)	Regression Coefficient a	Regression Coefficient B	Correlation Coefficient (r2)	Condition Factor
C. peterici	9.1-15.2	12.28	22.7 - 95.7	39.86	0.15	1.30	0.80	2.15
O. niloticus	9.9-18.8	14.32	20.38 -122.7	60.69	0.09	2.44	0.83	2.07

The intercept (a) value obtained for *C. peterici* was 0.15 while the exponent (b), correlation coefficient (r^2), and condition factor (k) values were 0.13; 0.80; 2.15 respectively. The corresponding values for *O. niloticus* were a (0.09); b (2.44), r^2 (0.83) and k (2.07). The exponent b values for both fishes (1.3 and 2.44) were lower than 3 and portrayed the species as having negative allometric growth pattern. The coefficients of determination (r^2) of both fishes (0.08 and 0.83) were high and showed a high degree of positive correlation between the total length (TL) and body weight (WT) in the fishes.

Graphical illustration of the normal length-weight relationship, and log weight and log length regression of *C. Peterici* are in Figures 1a and 1b, while the corresponding normal length-weight and regression graphs of *O. niloticus* are displayed in Figures 2a and 2b. The normal graphs showed that the fishes increased in weight as they increased in length. The plot of the log length and log weight for both fishes gave straight line relationships also indicating that the fishes increased in length as their weights increased. The Condition factor (k) values (2.15 and 2.07) obtained for both fishes (Table 2) were greater than one (1) and implied that both fishes were in good condition in the river.

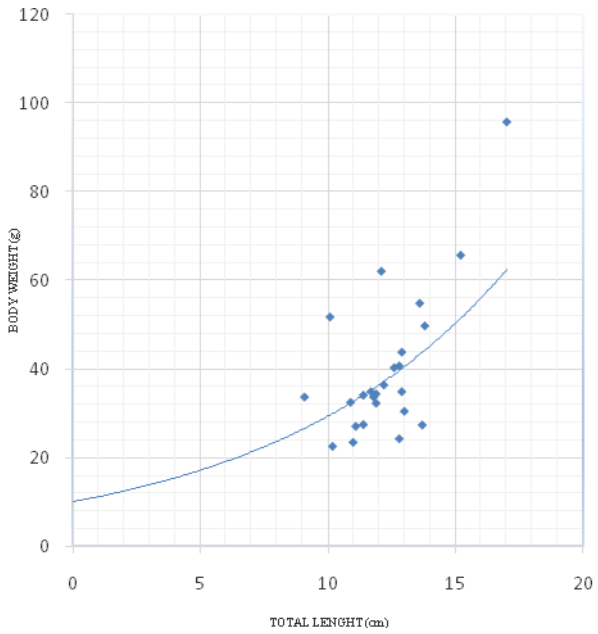

Fig. 1a: Graph of Length and Weight relationship of *Ctenopoma peterici*

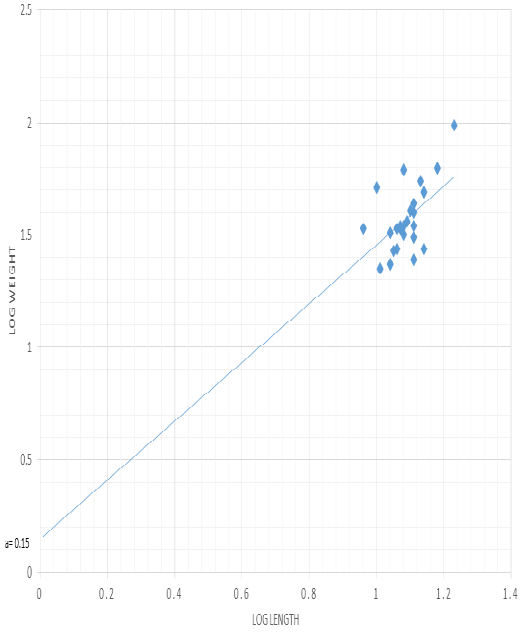

Fig. 1b: Log Length and Log Weight relationship of *Ctenopoma peterici*

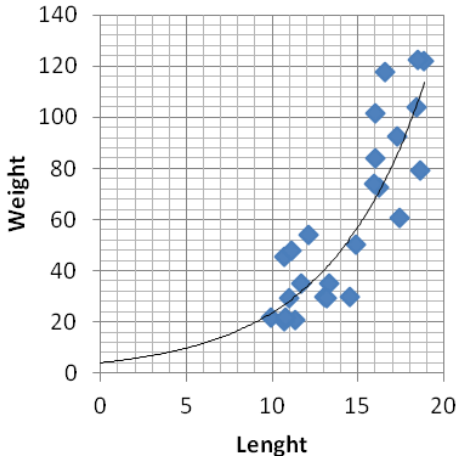

Fig. 2a: Length –Weight relationship of *Oreochromis niloticus.*

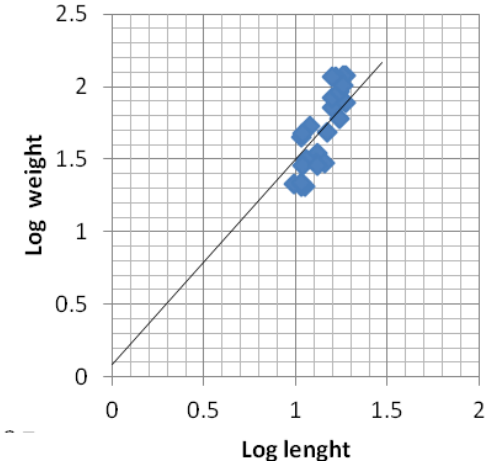

Fig. 2b: log length – log weight relationship of *Oreochromis niloticus*

DISCUSSION

The values obtained for the length-weight relationships showed that *C. peterici* and *O. niloticus* are negatively allometric in their growth pattern in Ikpoba River. Several authors have reported similar negative allometric growth pattern in fishes from some other water bodies. Fiogbe (2003) obtained negative allometric growth for *Epinephalus aeneus* from Benin, West Africa. Sangun *et al.*, 2007) and Sarkar

et al. (2013) reported negative allometric growth pattern in fishes in River Ganga, India. From water bodies in Nigeria, negative allometric growth pattern have been reported for *Mormyrus rume* in Osse River (Odedeyi *et al.*, 2007), *Parachanna obscura* from Igwu and Itu wetlands (Bolaji *et al.*, 2011) and in fishes from Ibiekuma Stream, Ekpoma (Obasohan *et al.*, 2012).

The results of these studies notwithstanding, isometric growth pattern (b=3) as well as positive allometric growth patterns (b>3) have similarly been reported by other authors. Yem *et al.*, (2007) and Abowei *et al.,* (2009) reported positive allometric growth pattern for fishes from Kainji Lake and Nkoro River, Nigeria; Waly *et al.*, (2015) reported positive allometric pattern south-west coast of Senegal while Garba and Arome (2006) and Kamelan *et al.* (2014) found isometric pattern in *Ethmalosa frinbriata* and *Ilasha africana* from the Lower Benue River, Nigeria and in *Petrocephalus bovei, Chrysichthys maurus* and *Heterobranchus isopterus* from Tai National Park in Senegal.

Many factors such as sampling methods, age, sex, fecundity of the fishes and the prevailing ecological conditions have been reported to influence the growth pattern in fishes (Singh *et al*., 2011; Akintoye *et al*., 2010; Waly, *et al.*, 2015). In this study, the fishes were not sorted by fishing methods, sex, state of maturity and state of stomach fullness and the effects of these factors were not evaluated in this preliminary investigation.

The results of this study also shed light on the condition of the fishes in Ikpoba River, Benin City, Nigeria, based on the coefficient of condition (k) calculated from the body length and body weight of the two species. The k values obtained for the fishes were greater than one (>1) and implied that the fishes were in good condition. It can thus be inferred that Ikpoba River presents a favourable aquatic ecosystem for a healthy growth and well-being for fish. Edah *et al*., 2010 opined that the condition factor (k) is an index to assess the status of an aquatic environment. Ighwela *et al.*, 2011 reported similar high condition factor for *Oreochromis niloticus* in Malaysia. Several other investigators: Sarkar *et al.*, 2013; Kamelan *et al.*, 2014; Waly *et al.*, 2015 have also reported high k values for fishes in many water bodies and concluded that the fishes were in good condition. They all attributed their findings favourable environmental conditions.

CONCLUSION

This preliminary study has revealed that *Ctenopoma peterici* and *Oreochromis niloticus* from Ikpoba River in Benin City, Nigeria exhibited negative allometric growth pattern. The correlation coefficients of the length-weight relationships of the fishes indicated high degree of positive correlation. The condition factor obtained from the length-weight data showed that the fishes were in good condition in the river and thus implied that the ecological conditions of Ikpoba River favour healthy growth and well-being of fish. The study also provided first hand data on the growth pattern of *C. peterici* as well as confirmed the existing information on the common Cichlid *O. niloticus* that would be useful to Biologists and Environmentalists on the status of the fishes in the river. Based

on the findings of this study, it is recommended that strategies to conserve these fish species, be implemented in order to ensure their survival and sustainability, in view of their importance in the fisheries of the river and towards the fish food basket of the teaming local population.

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