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Full length research paper

Preliminary studies of the length-weight relationships and condition factor of five fish species from Ibiekuma stream, Ekpoma, Edo state, Nigeria

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This study examined the length - weight relationships and condition factor of five freshwater fishes: *Papyrocranus afer, Parachanna obscura, Malapterurus electricus, Tilapia mariae and Oreochromis niloticus* from Ibiekuma Stream, Ekpoma, Nigeria. The results of the length - weight analyses showed that all the fishes exhibited negative allometric growth pattern with regression exponent b values less than 3, while the correlation coefficients (r) obtained which ranged from 0.850 to 0.963 revealed a high degree of positive correlation. The analyses also showed that the condition factor of *P. afer* and *P. obscura* were less than 1, and implied that these fishes were not in good physiological state of well-being in the stream, but the values for *M. electricus, T. mariae* and *O. niloticus* were greater than 1 and implied that they were in good physiological condition. Other complementary investigations of the length-weight relationships and condition factor of these fishes and indeed of the morphometrics and general biology of the fishes of this stream are advocated.

Keywords: Length - weight relationships, condition factor, fish species, Ibiekuma Stream.

INTRODUCTION

Fishes especially those of tropical and sub-tropical water systems are known to experience growth fluctuations due to many factors such as environmental changes, food composition changes, competition within the food chain, changes in the physical and chemical properties of the aquatic medium (Adedeji and Araoye, 2005; Abowei and Davies, 2009).

Morphometric characters can be used to assess the influence of environmental factors of fish populations. In this regard, it is common to use measurements such as body length, body depth, head length, eye diameter, jaw length of fishes etc to not only assess fish habitat peculiarities and ecological criteria in water bodies, but also to measure discreteness and relationships among various taxonomic categories (Omoniyi *et al*., 2010).

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Growth in fish is in length as well as in bulk (King, 1996). Bake and Sadiku (2004) described growth as the change in absolute weight (energy content) or length of fish over time, while Adedeji and Araoye, 2005 summarized growth as a function of fish size. The study of growth patterns in fish has been based principally on length – weight relationships or relationships between sizes of scales or other calcified tissues and body length because of their importance in age and growth analyses (Adeyemi *et al*., 2009). Abowei and Hart, 2009 reported that the length – weight relationship of fish also known as growth index is an important management tool used in estimating the average weight at a given length growth. It is widely used in fisheries biology for several purposes such as estimating the mean weight of fish based on known length (Araoye, 2004; Da Costa and Araojo, 2003). According to Omoniyi *et al.,* 2010, growth in fish can be evaluated from morphometric parameters relative to total length and length-weight relationship is

used in morphometric inter-specific and intra-specific population comparisons to assess index of well-being of the fish populace. In fact, Akintola *et al.,* 2010 posited that the length-weight relationship of aquatic organisms is an important predictor in fisheries biology. Earlier, Kulbicki *et al*., 1993 and King, 1996 reported that the length-weight is an important parameter to measure several productivity indices of fish. Therefore, such parameters as mean weight of fish of a given length, condition factors and modeling of fish growth can be deduced from the length-weight parameter.

There are many well documented morphometric studies which provide information on growth patterns of many freshwater fish species in Nigeria. However, information on the morphometrics and characterization of growth into isometry and allometry, of growth of body parts of fish species of Ibiekuma Stream, Ekpoma is scarce. It is against this back drop that this study to generate basic scientific data for subsequent studies of the fish species of this stream was embarked upon.

MATERIALS AND METHODS

The fish species investigated in this study were sourced from the catches of fishermen commissioned to fish along the study stretch of Ibiekuma Stream, Ekpoma. Various fishing gears: set and floating nets of various mesh sizes, hooks and lines, assorted traps etc, were employed in the fishing carried out between January and December, 2010. Details of location of Ibiekuma Stream and study area are well documented in Obasohan *et al*., 2008 and Erhabor *et al*., 2010.

The fish samples collected for this study were transported in ice-packed plastic containers in order to keep them fresh. In the laboratory, they were sorted and identified to species levels using keys, catalogues and diagrams according to Reed *et al*., 1967, Olaosebikan and Raji, 1998 and Idodo-Umeh, 2003.

Morphometric Measurements

The measurable morphometric characters used were Standard length (SL) and Body weight (BWT). Standard length (SL) was taken along the antero-posterior body axis, from mouth tip to the mid-point of caudal fin origin. The body weight (BWT) was measured using a digital top-loading electronic weighing balance. SL values were recorded in centimeter (cm) while the BWT values were recorded in grams (g).

Length-weight Relationships

The SL and BWT raw data collected were used in determining the length-weight relationship. This was computed from the formula;

$W = aL^b$ - - - - - - - -(1) …..(Pauly, 1983).

Where b, is an exponent usually between 2 and 4.

W is the observed total weight, a is the intercept on the length axis and

L is the observed standard length.

The logarithmic transformation of equation 1 gives a straight line relationship

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

Log weight is plotted against Log length, the regression coefficient is b and log a is the intercept of the line on the Y axis.

Condition factor (k)

Fulton's condition factor (k) was computed from the formula;

$K = 100W/L^3$ -- - - - - - - - - - (3)

Where W is the observed total weight for each specimen, L is the observed standard length for each specimen and K is the condition factor.

RESULTS

Morphometric Measurements

The results of the measurements of the standard lengths (SL) and body weights (BWT) of the five fishes examined are presented In Table 1. *P. afer* had the highest values with SL range of 25.6 – 34.1 cm with a mean of 30.33 ± 2.12 cm and a BWT range of 8.1 – 169.1 g with a mean of 142.1 ± 25.83 g. *P. obscura* was next with SL range of 17.5 – 28.6 cm with mean of 22.9 ± 4.51 cm, while the BWT range was 69.1 – 140.2 g and a mean of 106.4 ± 23.57 g. *M. electricus* followed with SL range of 14.8 – 17.5 cm with a mean of 16.16 ± 0.89 cm. The BWT values were 66.0 – 106.6 g (range) and 86.03 ± 12.93 g (mean). For *T. mariae*, the SL values were 10.6 – 16.2 cm (range) and 14.38 ± 1.69 cm (mean), while the BWT were 85.2 – 127.2 g (range) and 112.49 ± 15.98 g (mean). *O. niloticus* SL was 12.4 – 15.3 cm (range) and 13.1 ± 1.16 cm (mean), while the BWT were 61.9 – 112.7 g (range) and 82.12 ± 17.37 g (mean).

The values of the regression coefficients (a and b) and the condition factors obtained are presented in Table 2. The intercept (a) values of the fishes were 1.80 (*P.afer*), 1.94 (*P. obscura*), 1.75 (*M. electricus*), 1.84 (*T. mariae*) and 1.58 (*O. niloticus*) respectively. The corresponding exponent b values were 1.72, 1.16, 1.41, 1.52 and 1.94 for *P.afer, P.obscura, M. electricus, T. mariae* and *O. niloticus* respectively. The exponent (b) values of all the fishes were each less than 3 and indicated negative allometric growth pattern in all five fishes. The correlation coefficients which values ranged between 0.8503 and 0.9637 (Table 2) in all five fishes showed a high degree of positive correlation between the SL and BWT in all the fishes

Table 1: Ranges and mean values of Standard lengths and Body weights of five fish species from Ibiekuma Stream, Ekpoma during this study

Fish	Standard Length (SL) (cm)		Body Length (BWT) (g)	
	Range	Mean	Range	Mean
P. afer	25.6 – 34.1	30.33 ± 2.12	81.1 – 169.1	142.1 ± 25.83
P. obscura	17.5 – 28.6	22.9 ± 4.51	69.1 – 140.2	106.4 ± 23.57
M. electricus	14.8 – 17.5	16.16 ± 0.89	66.0 – 106.6	86.03 ± 12.93
T. mariae	10.6 – 16.2	14.38 ± 1.69	85.2 – 127.2	112.49±12.93
O. niloticus	12.4 – 15.3	13.61 ± 1.16	61.9 – 112.7	82.12 ± 17.37

Table 2: Length-weight relationship parameters and Condition factor of five fish species from Ibiekuma Stream obtained in this study

Fish	Regression Coefficient		Correlation Coefficient	Condition Factor (K)
	a	b	r	
P. afer	1.80	1.72	0.886	0.5
P. obscura	1.94	1.16	0.963	0.9
M. electricus	1.75	1.41	0.899	2.1
T. mariae	1.84	1.52	0.901	3.78
O. niloticus	1.58	1.94	0.850	3.26

Figures 1a – 5a show the graphs of the normal length – weight relationships, while Figures. 1b – 5b show the regression graphs of the five fishes. The normal graphs showed that as the fishes increased in length, their weights also increased. The regression graphs gave straight line relationships which also implied that as the length increases, the weight also increases.

The values of the condition factor of the fishes (Table 2) were 0.5, 0.9, 2.1, 3.78 and 3.26 for *P.afer, P.obscura, M. electricus, T. mariae and O. niloticus* respectively. For *P. afer* (0.5) and *P. obscura* (0.9), the values were less than 1 implying that these fishes were not in a good state of well-being in the stream, but in *M. electricus, T. mariae* and *O. niloticus*, the values were greater than 1 and implied that they are in good physiological state of well-being in the stream.

DISCUSSION

The sizes of *P. afer* and *P. obscura* examined in this study were bigger than those of *M. electricus, T. mariae and O. niloticus* judging from their higher standard length and body weight values (Table 1). The bigger sizes of *P. afer* and *P. obscura* sampled could be attributed probably to their faster growth rates and intense feeding habits. Both fishes are voracious predatory carnivores (Read *et al*., 1967). Idodo-Umeh (2005) and Abowei and Hart (2009) attributed bigger sizes of fish to faster growth rate and intensity of feeding. Oni *et al*., 1983 earlier opined that feeding and reproductive phenomena were the main factors responsible for the size of fish. It is conceivable that the bigger sized *P. afer* and *P. obscura* sampled were adults, probably with full-laden stomachs and or with matured reproductive organs.

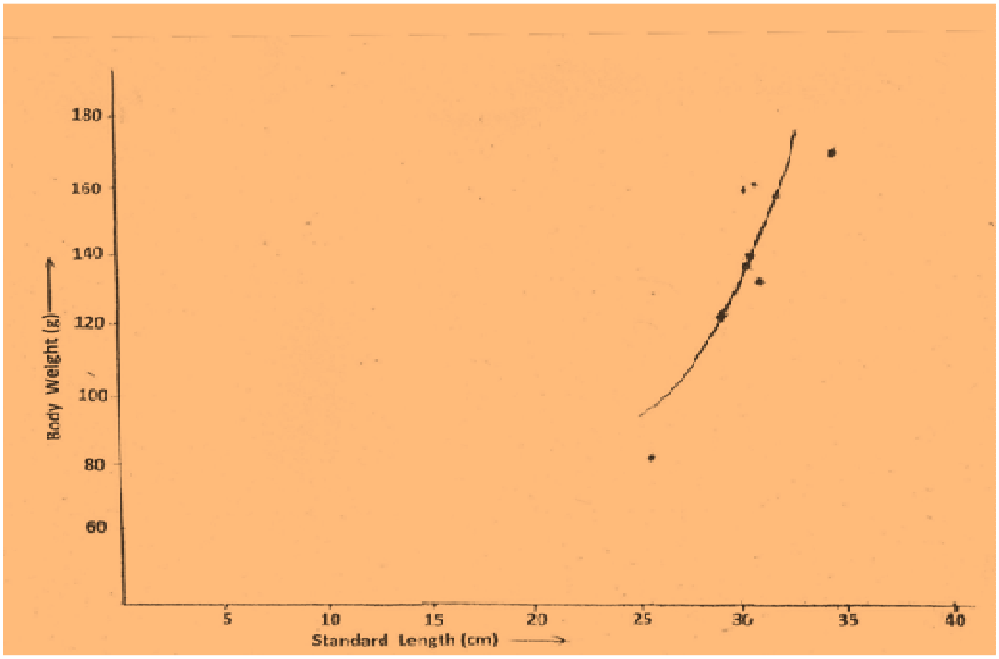

Figure 1a Graph of length-Weight relationship of *P. ofer*

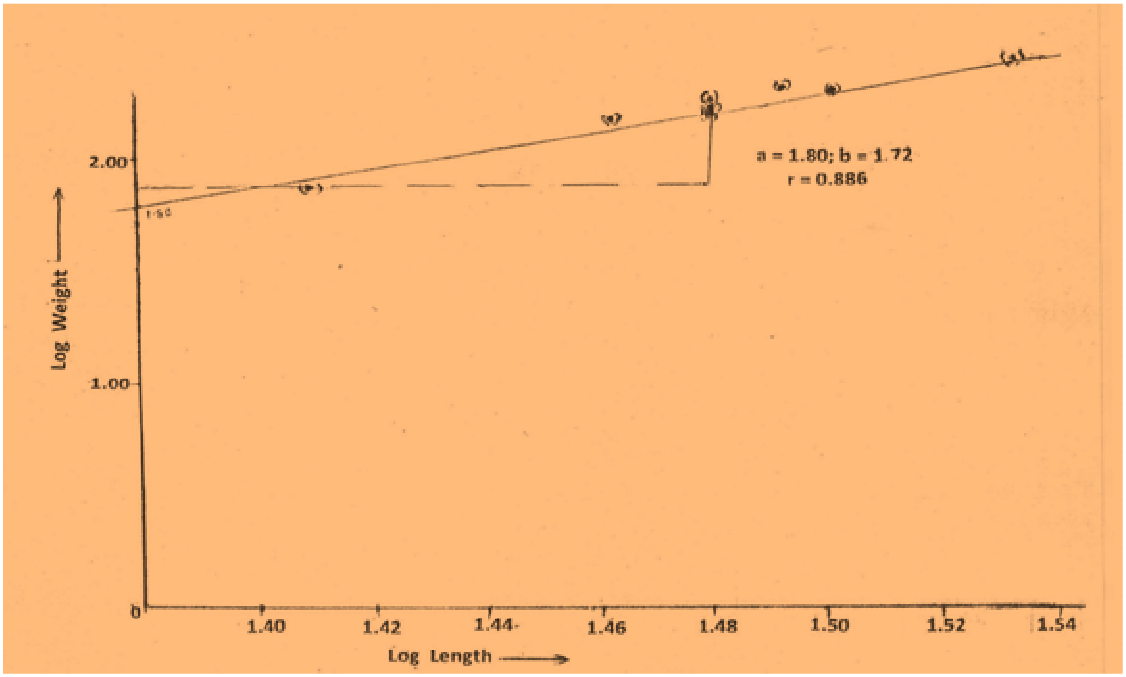

Figure 1b. Log Length- Log Weight relationship of *P. ofer*

The study also revealed that all the fishes investigated exhibited negative allometric growth pattern with regression analyses exponent b values less than 3 (Figures(1b – 5b). The correlation coefficients (r) of the fishes which ranged between 0.8503 and 0.9637 indicated high degree of positive correlation between their standard lengths and body weights. The implication is that the body weights of the fishes increased with increase in body length, but the rate of increase in weight is less than the rate of increase in length.

According to Adeyemi *et al.*, 2009, negative allometric growth pattern in fish implied that the weight increases at

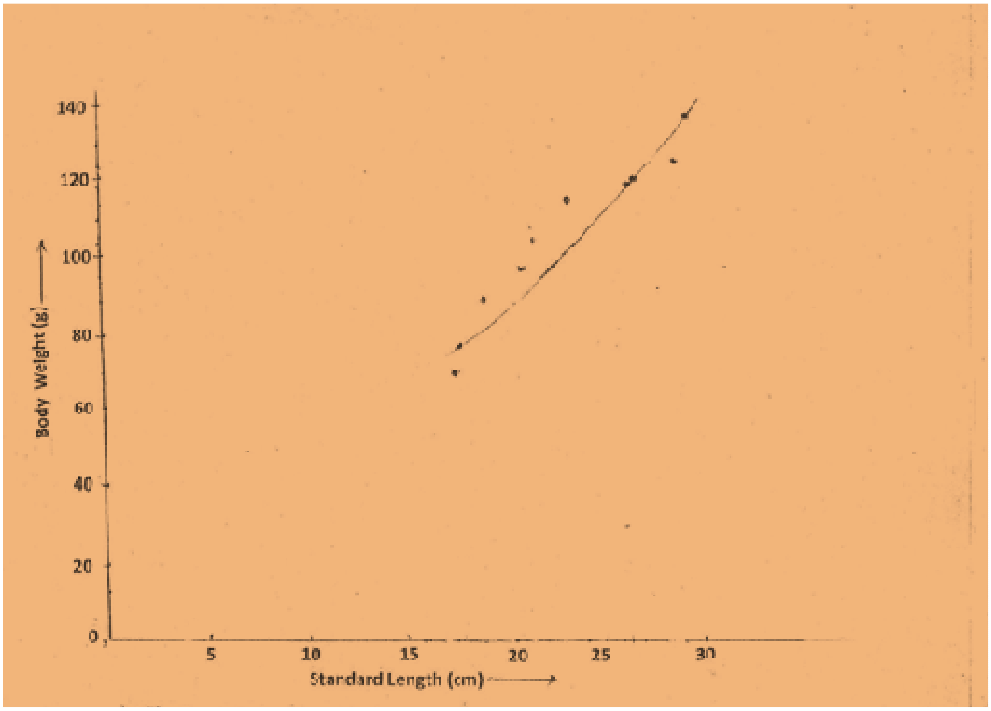

Figure 2a. Graph of Length-Weight relationship of *P. obscura*

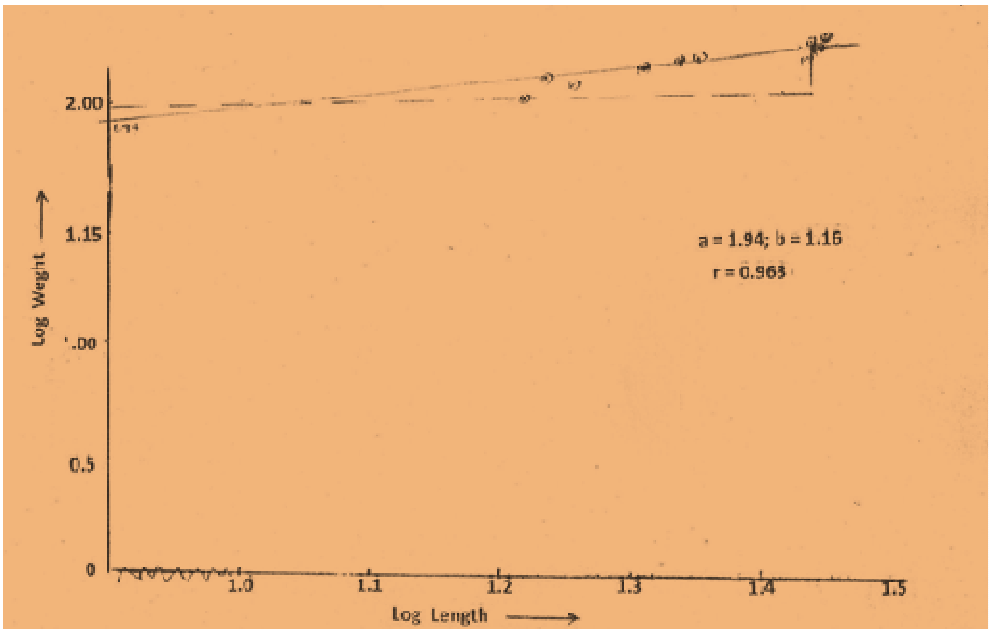

Figure 2b. Log length- Log Weight relationship of *P. obscura*

a lesser rate than the cube of the body length. King (1996) reported similar negative allometric growth pattern in many fishes in the Nigerian freshwaters. Negative allometric growths have also been reported for *Heterobranchus longifilis* from Idodo River, Nigeria (Anibeze, 2000), *Mormyrus rume* from River Osse, South Western Nigeria (Odedeyi et al., 2007) and *Parachanna obscura* from Igwu and Itu Rivers' wetlands, Nigeria

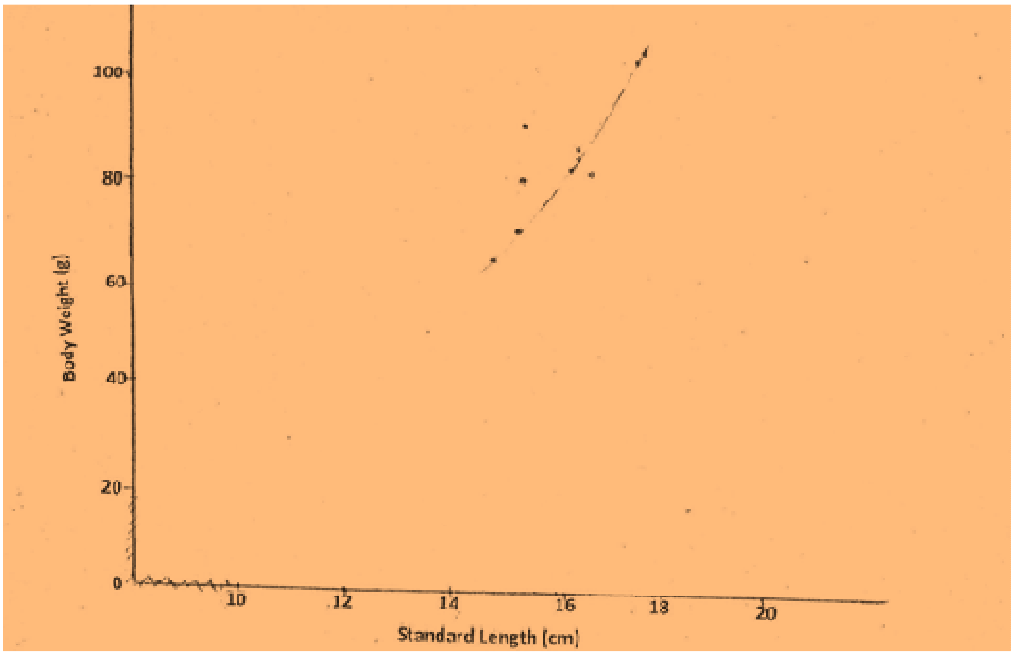

Figure 3a. Graph of Length-Weight relationship of *M. electricus*

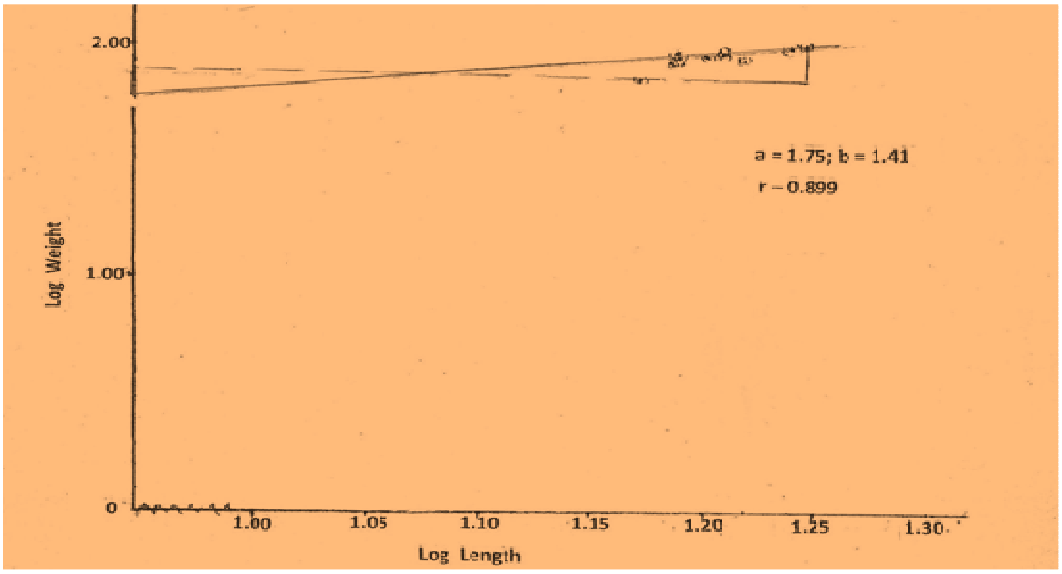

Figure 3b. Log Weight- Log Length relationship of *P. ofer*

(Bolaji *et al*., 2011). However, unlike the results in this study, isometric growth patterns were reported for *M. electricus* from the Lower Benue River, Nigeria (Garba and Arome, 2006) and for *Ethmalosa frimbriata* and *Ilisha africana* from Nkoro River, Nigeria (Abowei *et al*., 2009) and positive allometric growth pattern was reported for *Hemichromis niloticus* from Kainji Lake (Yem *et al*., 2007). The differences in the results of these studies could be attributed to the age, sex, fecundity of the fishes, sampling methods and sample size as well as the prevailing ecological conditions in the different water bodies.

The results of this study also shed light on the state of well-being of the fishes examined. The values of the condition factor for *P.afer* (0.5) and *P. obscura* (0.9) were less than 1, while those of *M. electricus* (2.1), *T. mariae* (3.78) and *O. niloticus* (3.26) were greater than 1. The results implied that *P. afer* and *P. obscura* were not in

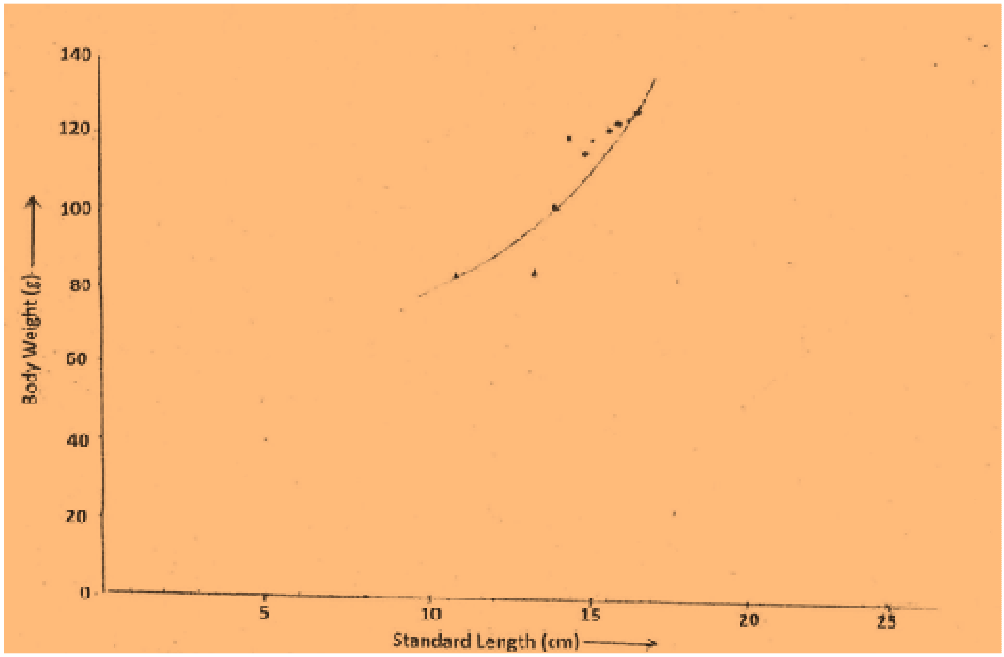

Figure 4a. Graph of Length-Weight relationship of *T. marlae*

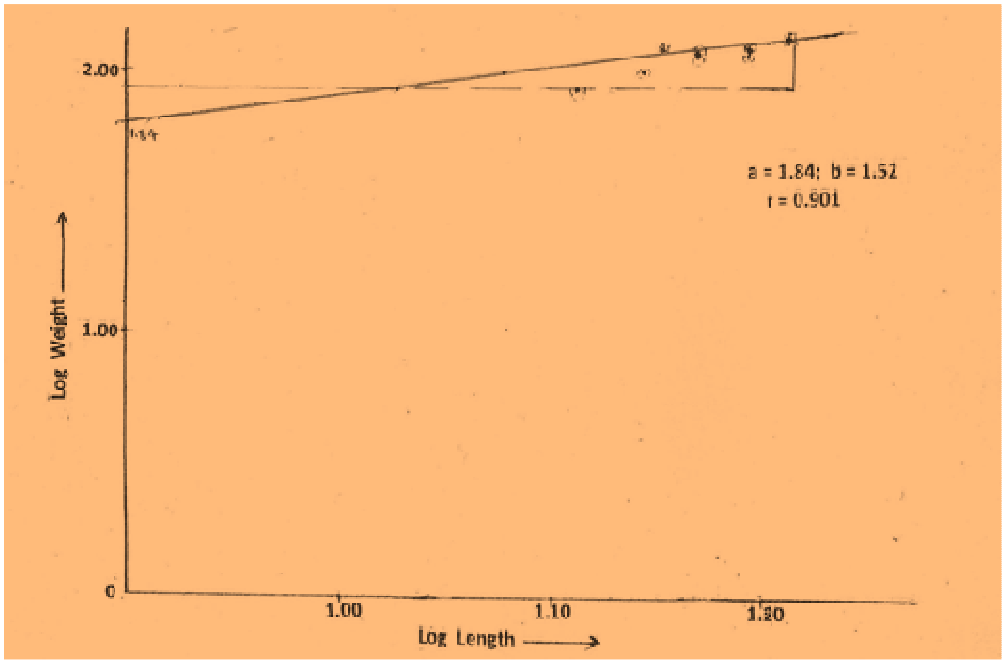

Figure 4b. Log length- Log Weight relationship of *T. marlae*

good physiological condition in the stream, but *M. electricus, T. mariae* and *O. niloticus* were in good condition.

Many factors such as sex, age, state of maturity, size, state of stomach fullness, sampling methods and sample sizes and environmental conditions affect fish condition and parameters of length-weight relationships in fish (Ama-Abasi, 2007; Yem *et al*., 2007; Adeyemi *et al*., 2009).

In this study, the fishes were not sorted by sex, state of maturity and state of stomach fullness and the effects of these factors were not evaluated in this preliminary study.

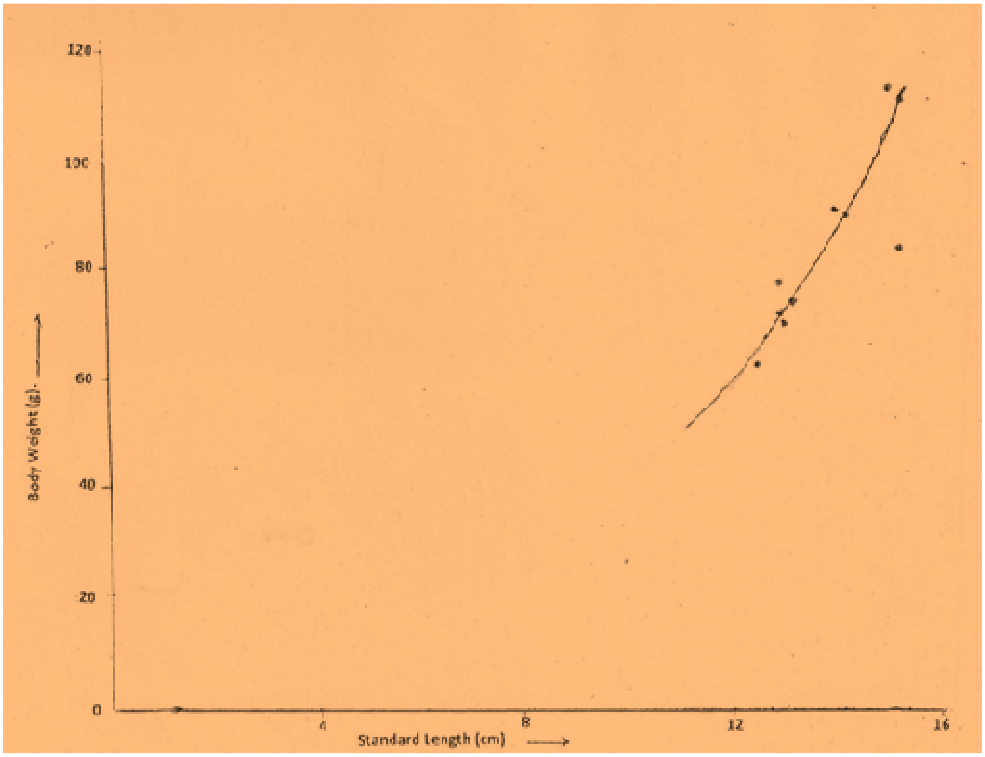

Figure 5a. Graph of Length-Weight relationship of *O. niloticus*

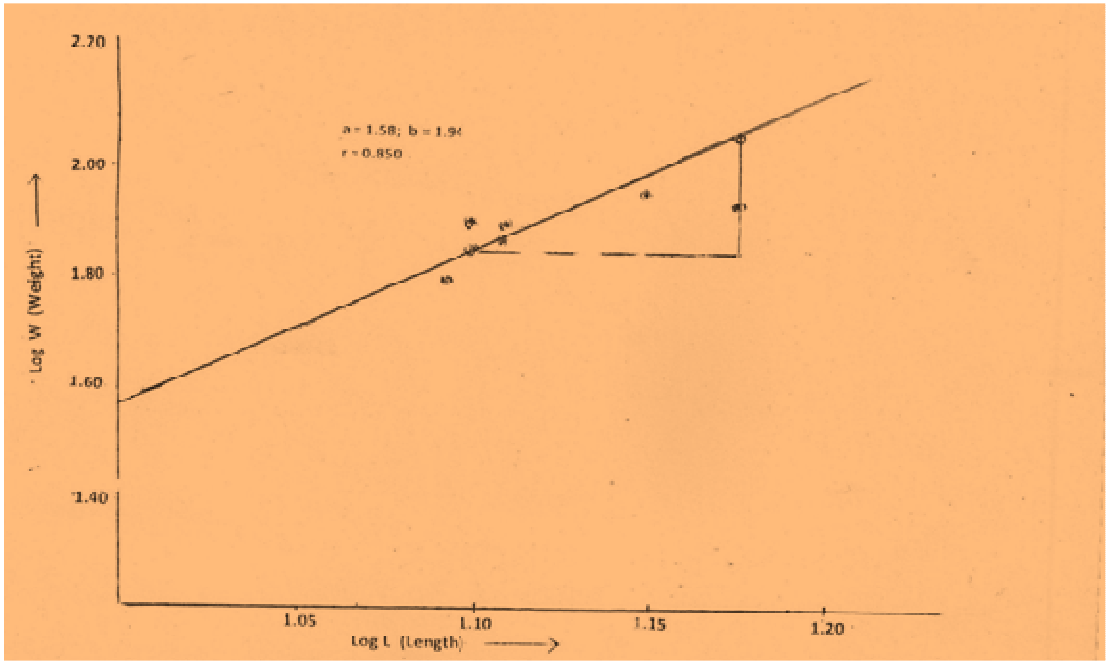

Figure 5b. Log length- Log Weight relationship of *O. niloticus*

Other investigations of the length-weight relationships and condition factor of these fishes and indeed of the morhpometrics and general biology of the fishes of this stream, to complement the results of this study is therefore advocated.

CONCLUSION

This preliminary study revealed that *P. afer, P. obscura, M.electricus, T. mariae* and *O. niloticus* from Ibiekuma Stream, Ekpoma, Nigeria exhibited negative allometric growth pattern. The correlation coefficients of the length-weight relationships indicated high degree of positive correlation. The condition factor showed that *P. afer* and *P. obscura* were not in good physiological state of well-being in the stream, but *M. electricus, T. mariae* and *O. niloticus* were in good state of well-being. Further investigations of the morphometrics and general biology of the fishes of this stream are advocated to complement the results of this study.

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