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Allometric indices of *Chromidotilapia guentheri* (Sauvage 1882), *Tilapia mariae* (Boulenger 1899) and *Tilapia zillii* (Gervais 1848) of the Osse River, Southern Nigeria

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ABSTRACT: Three cichlids, *Chromidotilopia guentheri, Tilapia mariae* and *T. zilli* were collected from the Osse River at Ikoro and examined for length frequency distribution and length weight relationships (LWR). The mean length and weight were 11.05±0.35cm and 51.75±5.63g for *Chromidotilapia guentheri,* 13.57±0.54cm and 124.67±17.54g for *T. mariae* and 17.45±0.69cm and 232.92±28.01g for *T. zilli*. The length frequency distributions for *C. guentheri* presented a slightly positively skewed distribution with modal length being 10.0 - 10.9cm size class. *T. mariae* had a positively skewed distribution with a modal size class of 11.0 – 12.9cm. The frequency distribution was bimodal for *T. zilli*, with modal size classes of 13.0 – 14.9cm and 19.0 – 20.9cm. The regression coefficient (b) was used as an allometric growth index showing a positive regression of weight on length for the three species. The regression coefficients of 1.169, 1.577 and 2.706 for *Chromidotilopia guentheri, Tilapia mariae* and *T. zilli* respectively were tested for significance using the Single Factor Analysis of Variance (ANOVA). *Chromidotilapia guentheri* indicated no significant regression of weight on length ($P > 0.05$); *T. mariae* was significant ($P < 0.05$), while *T. zilli* was highly significant ($P < 0.01$), showing the highest degree of isometric growth.

Key words: Frequency; Length-Weight Relationships; Cichlidae; Regression coefficient; Allometric growth.

Introduction

The length-weight relationships have become prominent indices in the advancement of fisheries research, and these parameters can no longer be ignored in contemporary fisheries studies.

Stergiou and Moutopoules (1) found that the length-weight relationships allow the conversion of growth-in-length equations to growth-in-weight equations used for stock assessment models, and Odat (2) put it that the length-weight relationships facilitated estimations of fish biomass from length measurements, calculation of fish condition indices, and comparison of interregional development of segments of fish life histories, and serve as indicators of fish welfare (3).

Abdurahiman *et al* (4) restated the importance of length-weight relationship in parameterising yield equations and estimation of stock size. They emphasized its relevance in estimating the weight of a fish of a given length, for studies of rate of feeding, gonad development, metamorphosis, maturity and condition, and showed that they can be used for reliable study of fish growth and population dynamics.

According to Nikolsky (5) fish age determination is the solution pathway to ichthyological problems. Unfortunately in the tropics, hard parts (e.g. scales) of many fishes carry misleading impression for non-annual spawning, feeding cessation and exhaustion that make true annual rings for year count difficult to ascertain. This lends credence to the use of length frequency distribution in growth assessment studies.
The tilapias have become the choice species for studies because of their high productivity (6) and ubiquity (7, 8).

This study is the first report on the length-weight relationship of *Chromidotilapia guentheri*, *Tilapia mariae* and *T. zilli* collected from the Osse River at Ikoro.

Material and Methods

During our search for very large tilapia specimens, we were fascinated by large adult stock in the Osse River at Ikoro. The Osse River (Lat, 5^0 16'N and Long. 5^0 30'E) takes its source from Akpata Hills in Ekiti State and flows through the Benin River into the Atlantic Ocean (Fig. 1).

Fish samples were collected from August 2001 to March 2002 with the assistance of a hired fisherman. The gears used were bamboo cage and basket traps, set in water to face the current direction for 48 hours before retrieval. Fish were collected into an iced cooler and transported to the laboratory.
Fish species identification was confirmed with standard taxonomic work (9, 10). Fish Total Length (TL) was measured from the tip of the snout (mouth closed) to the posterior end of the caudal fin. Weight of each fish was measured to the nearest gram with an electronic balance after removing superficial water from the body.

Size classes were determined with total length frequency distributions according to Petersen's method by plotting the number of fish against total lengths for each species. The Length-Weight Relationship (LWR) was calculated for each species from the equation
$W = aL^b$

Where W = weight in grams (g) L = total length in centimetres (cm), a = a scaling constant and b = the allometric growth parameter.

A logarithmic transformation was used to derive the linear relationship equation

$\text{Log } W = \text{Log}_a + b\text{Log } L$, for each fish species, from a regression plot of log weight against log length, where Log_a is the intercept on the weight axis, and b is the slope or regression (allometry) coefficient (11, 4). The 'b' value was compared with cube value, 3 for isometric growth pattern in Fultan's condition factor K equation $K = \frac{100\ W}{L^3}$

Results

The 26 specimens (8.5 - 14.5cm long) of *Chromidotilapia guentheri* weighed 1,345.47g, with mean length of 11.05±0.35cm and mean weight of 51.75±5.63g. The 38 specimens (9.4 - 23.2cm long) of *Tilapia mariae* weighed 4,747.41g, and had mean length of 13.57±0.54cm and mean weight of 124.67±17.54g. For the 34 specimens (12.0 - 28.0cm long) of *T. zilli*, the weight was 7,919.19g, and mean length and mean weight were 17.45±0.69cm and 232.92±28.01g respectively.

Length Frequency Distribution

Figures 2 - 4 describe the Length Frequency Distributions of *Chromidotilapia guentheri*, *Tilapia mariae* and *T. zilli.* The length frequency distributions for *C. guentheri* (Fig. 2) presents a slightly positively

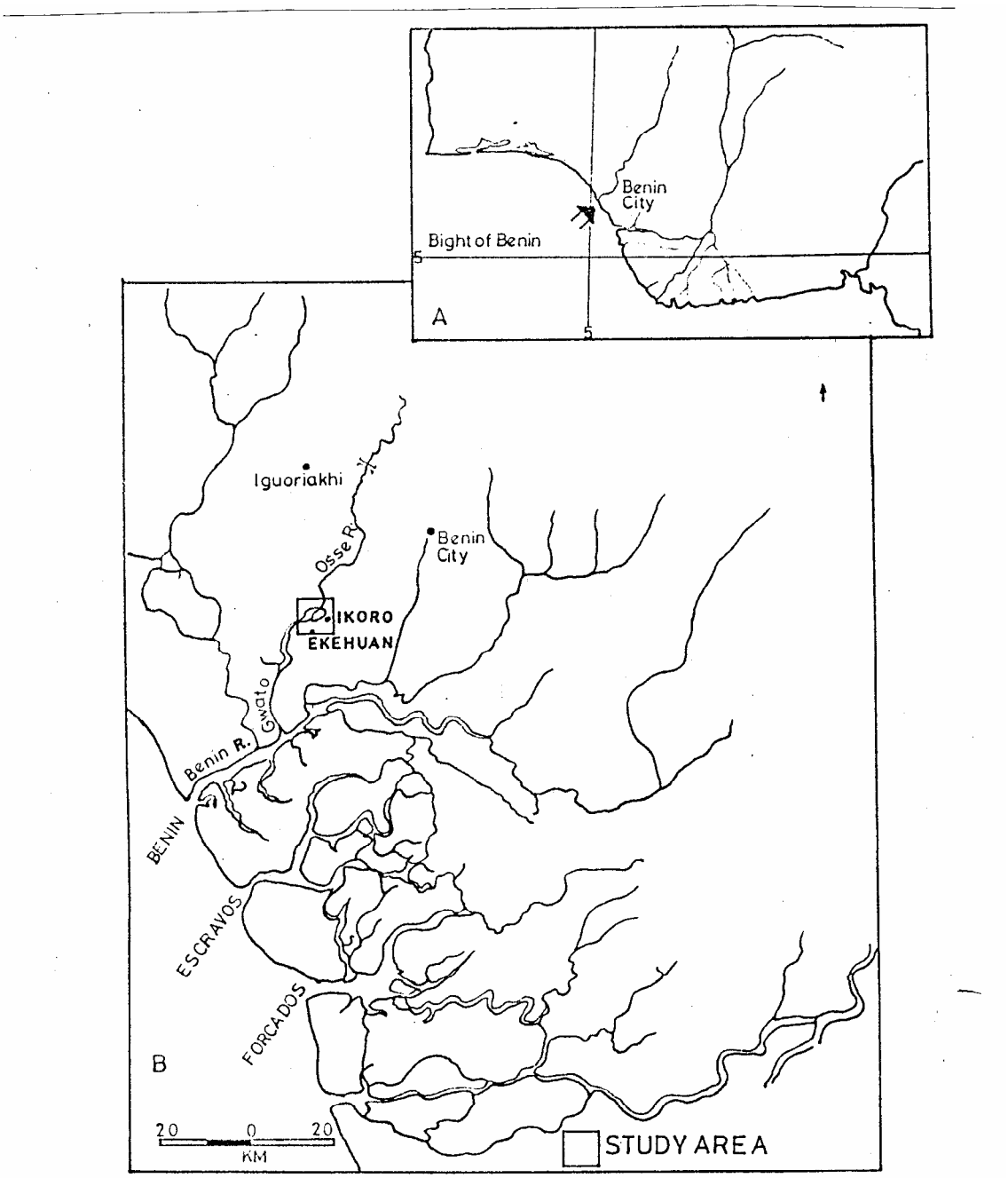

Fig. 1. Map of the Study Area, with Western Niger Delta as inset showing Benin City.

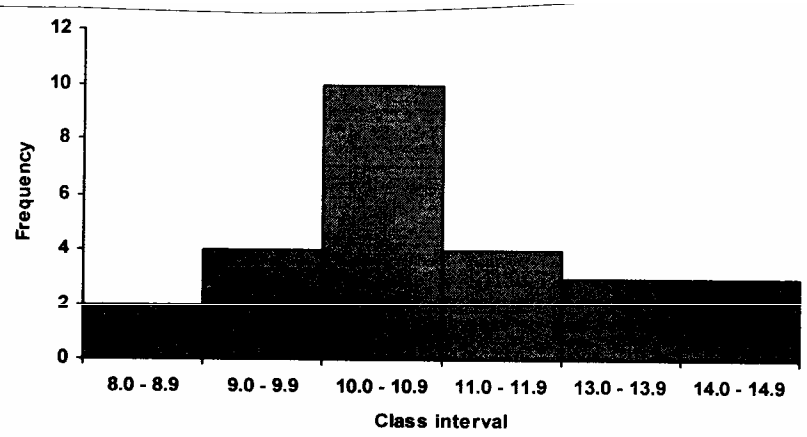

Fig 2: Length Frequency of *Chromidotilapia guentheri*

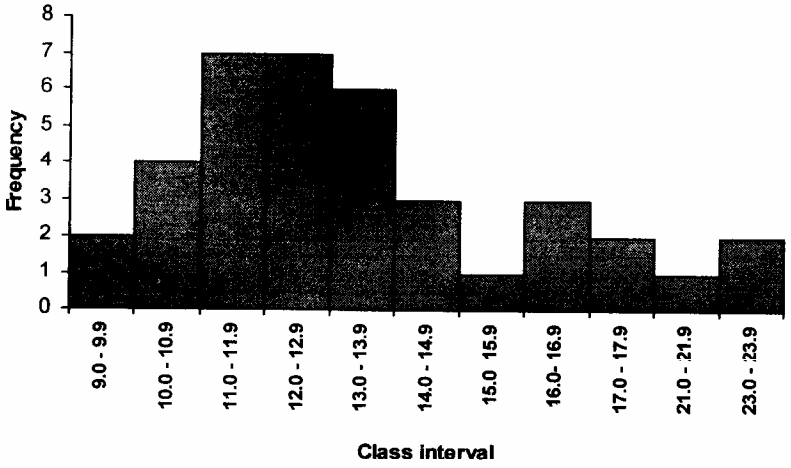

Fig 3: Length Frequency of *Tilapia mariae*

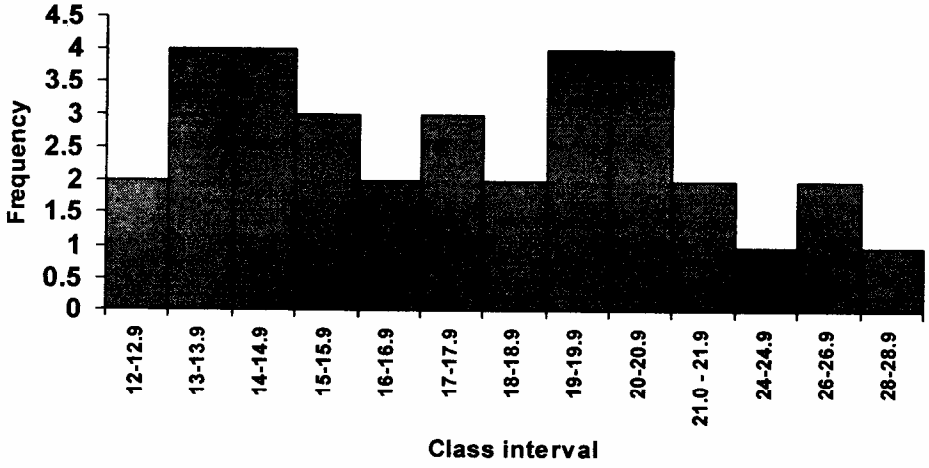

Fig 4: Length Frequency of *Tilapia zilli*

Table 1. Summary statistics of Length – Weight relationship of fishes from Osse River.

TAXA	n	LENGTH (cm)				WEIGHT (g)				LWR		
		Mean	SE	Min	Max	Mean	SE	Min	Max	a	b	r
Chromidotilapia guentheri	26	11.05	0.35	8.5	14.5	51.75	5.63	10.5	127.10	0.443	1.169	0.369
Tilapia mariae	38	13.57	0.54	9.4	23.2	124.67	17.54	37.5	512.75	0.258	1.577	0.323
Tilapia zilli	34	17.95	0.69	12.0	28.0	232.92	28.01	84.5	672.06	-1.085	2.706	0.932

skewed distribution with the longer tail to the right of the central maximum, the modal frequency being 10.0 - 10.9cm class interval. Fish specimens of the smallest (8.0 - 8.9cm) and largest (14.0 - 14.9cm) size were less frequently encountered and occupied the extremes of the distributions.
The length frequency distributions for *T. mariae* (Fig. 3) presents an almost perfect case of a positively skewed distribution, with more of the less frequent values distributed to the right of the central maximum (i.e. the modal values of 11.0 - 12.9cm).
The length frequency distributions for *T. zilli* (Fig. 4) show a bimodal distribution with two distinct modal size classes, 13.0 - 14.9cm and 19.0 - 20.9cm. However, the largest class interval 28.0 - 28.9cm was of the lowest frequency.

Length-Weight Relationships (L.W.R)

The length-weight relationships (LWR) for the three cichlid species comprising a total of 98 individuals were evaluated using regression and correlation analysis on log transformed data. The results are summarized in Table 1.

The mean lengths for *Chromidotilapia guentheri, Tilapia mariae,* and *T. zilli* were 11.50cm, 13.27cm and 17.95cm respectively. *T. zilli* had the highest mean weight (232.92g) while *T. mariae* and *C. guentheri* had mean weights of 124.67g and 51.75g respectively.
The exponential relationships between the log weight and log length for the three fish species are expressed by the following linear regression equations:

C. guentheri: Log W = log 0.443 + 1.169 Log L
T. mariae: Log W = log 0.258 + 1.577 log L
T. zilli: Log W = log - 1.085 + 2.706 log L

For the three species, the weight regressed positively on the length (Figs. 5 - 7). The regression coefficients (b) values 1.169, 1.577 and 2.706 for the three species were tested for significance using the Single Factor Analysis of Variance (ANOVA). *Chromidotilapia guentheri* indicated no significant regression of weight on length ($P > 0.05$); *T. mariae* was significant ($P < 0.05$), while *T. zilli* was highly significant ($P<0.01$)

The total lengths for the three study species as reported by other workers in different localities are presented in Table 2. The total length range for *C. guentheri* was 10.0 - 22.9cm, while *T. mariae* and *T. zilli* had ranges of 17.2 - 25.0cm and 28.0 - 36.2cm respectively

Table 2: Total lengths of *Chromidotilapia guentheri, Tilapia mariae* and *Tilapia zilli* from selected Nigerian waters.

FISH SPECIES	**LOCALITY**	**TOTAL LENGTH (cm)**	**SOURCE**
Chromidotilapia guentheri	Osse River	14.5	Present study
C. guenthei	IITA Lake	22.9	Fagade (18)
C. guentheri	Ase River	10.0	Idodo-Umeh (10)
Tilapia mariae	Osse River	23.2	Present study
T. mariae	Nigeria Benue Confluence	25.0	Burchard (16)
T. mariae	Ethiope River	19.7	Ikomi & Jessa (15)
T. mariae	Ase River	17.2	Idodo-Umeh (10)
Tilapia zilli	Osse River	28.0	Present study
T. zilli	Ase River	36.2	Idodo-Umeh (10)

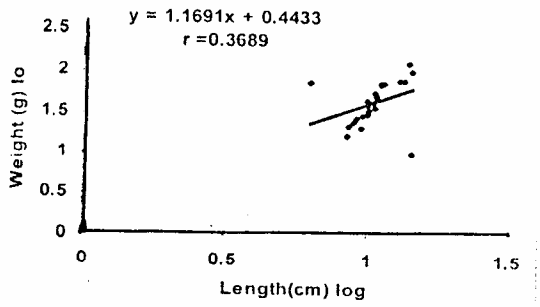

Fig 5: Log weight plot against log length of *Chromidotilapia guentheri*

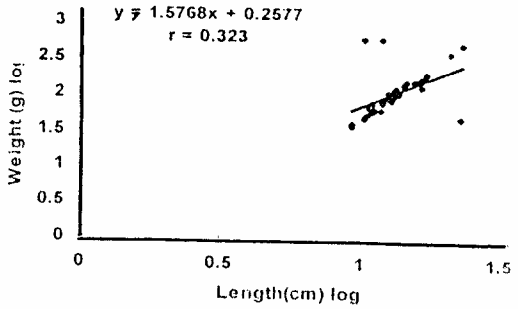

Fig 6: Log weight plot against log length of *Tilapia mariae*

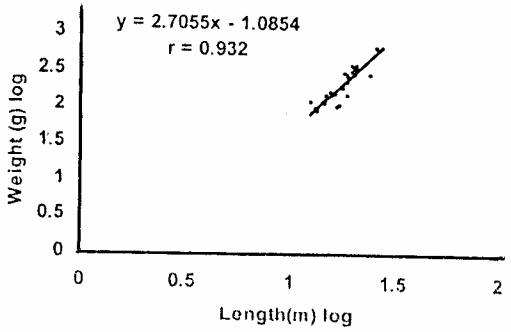

Fig 7: Log weight plot against log length of *Tilapia zilli*

Discussion

The study of fish species of commercial importance has become so expedient because of the quest for better understanding of their population ecology, sustainable utilization and optimized productivity. This study of the tilapine species of the Osse River is remarkable because of the relatively large sizes of the specimens discovered. This report further strengthens the assertion that the coastal saline water tilapias are not so large as the corresponding representatives in the inland freshwaters. In a study of the fish communities of Ewan Oil field, an offshore location of the Gulf of Guinea Large Marine ecosystem, Ogbeibu (12) recorded tilapia species with total length of 6.6 – 9.0cm. The total length of tilapia reported by MacGill (13) in South Farcados of the Niger Delta brackish environment also corroborates the above observations.

Remarkably, the maximum total length 23.20cm of *T. mariae* recorded in this study (larger than 16.0 recorded by Orji and Onyejiaka (14) in Imo River, and 19.7cm recorded by Ikomi and Jessa (15) from the Ethiope River) compares favourably with 25.0cm length recorded by Burchard (16) in the Niger Benue Confluence (Table 2). The maximum total length 28.0cm of *T. zill* (larger than the maximum length of 14.4 recorded by Orji and Onyejiaka (14) can be ranked close to 36.2cm collected from the Ase River by Idodo-Umeh (10). The size of fish is a reflection of the prevailing physical and chemical environment governing aquatic productivity in any habitat.

The symmetry or skewness of the length frequency distribution for the length frequency distribution for the three species were enhanced by the choice of reasonable size – class intervals valuable information are always lost in frequency distribution patterns when size-classes are too few. The skewed distribution patterns obtained for *Tilapia, mariae* and the bimodal pattern for *Tilapia zilli* are reflection of the dominant or modal sizes of these species.

The correlation (r) statistic refers to the fact that two variable, length and weight are related and also to the closeness of the relationship. Regression (b) on the other hand refers to the nature of the relationship. The not significant ($P > 0.05$) correlation and regression coefficients for *Chromidotilapia guentheri* suggest a weak dependent relationship between length and weight of fish. In *T. mariae* and *T. zilli* the correlation and regression coefficients were significant (significant r ($P<0.05$) and b ($P<0.05$) for *T. mariae;* highly significant r ($P<0.05$) and b ($P<0.001$) for *T. zilli),* showing strong dependent relationship between length and weight of the fish. This relationship was stronger in *T. zilli.* These observations point to the fact that the degree of isometry in growth varies with fish species and habitat.

The 'b' values (1.169 for *C. guentheri*, 1.577 for *T. mariae,* and 2.706 for *T. zilli*) indicate departures from isometric growth b value (3). The result indicates that the rate of increase in length is not commensurate with rate of weight gain as shown by the slope (b) value lower than 3, thus these fishes will not appear stout (Thomas *et al,* 2003).

In the converse Fagade (18) found that the 'b' value (3.056) was close to 3, showing that *C. guentheri* exhibited isometric growth in the International Institute of Tropical Agriculture (IITA) Lake. Ikomi and Jessa (15) found the 'b' value (3.018) approximately the cube value (3) indicating isometric growth for *T. mariae* in the Ethiope River.

The regression coefficients (b = 1.69, 1.577, 2.706) and proportionality constants (a = 0.443, 0.258, -1.805) have shown *Chromidotilapia guentheri, Tilapia mariae* and *T. zilli* to exhibit negative allometric length-weight growth relationship.

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