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Length-weight relationship and condition factor of Redbelly tilapia (*Tilapia zillii*) caught with gillnets in Asejire Lake, Oyo State, Nigeria

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Abstract
The present studies on the Length-weight relationship of Redbelly tilapia (*Tilapia zillii*) caught with gillnet was to determine the growth pattern and their well – being. The different mesh sizes of gillnet were used in this study. The total length (TL) and weight (g) of Redbelly tilapia were measured with ichthyboard and digital weighing balance respectively. Data were collected fortnightly for a period of six months. The length-weight relationship and condition factors were determined by Le Cren's method. The data on length and weight of *Tilapia zillii*, varied between 11-26 cm and 28-330 g respectively. The slope (b) value of the length-weight relationship of *Tilapia zillii* was 2.88. The t-test showed that 'b' values were significantly different (p<0.5) from 3. Hence, the growth pattern of *Tilapia zillii* in the Lake was negative allometric. The condition factor obtained for *Tilapia zillii* was 2, indicating that their well-being in the Lake was normal.

Keywords: Redbelly tilapia, length-weight relationship, condition factor

1. Introduction
Length-weight relationship is an important fishery management tool that can be used to identify or predict the growth pattern of fish. It can be obtained either by linear regression of natural logarithm of length and weight of fish samples or direct relationship of weight and length following exponential law. The slope (b) of the linear regression or the exponential value of the two processes is known as the 'growth coefficient'. The length and weight of fish samples vary with respect to their age group, stock, season, genetic factors, food composition and feeding habits [1, 2, 3, 4]. However, fish having the same food composition or feeding habit, or even with the same age group or stock may have different value of length and weight [5].
Redbelly tilapia (*Tilapia zillii*) is one of the commercially important cichlids of Asejire Lake, which was found to be the most predominant in the fish caught in the Lake [5]. Generally the growth pattern of fish follows the cube law [6]. Such relationship will be valid when the fish grows isometrically, that is, the exponential value is exactly 3. But in reality, the actual relationship between length and weight may depart from the ideal value due to environmental conditions or condition of fish [7]. The somatic growth of fishes according to [8] is influenced by a number of factors such as sex, gonad maturity, growth phase, season, and stomach fullness. In addition to these factors, [9] have stated that there are other factors that are bias and significantly influenced the parameter values of LWRs. These include selective gear (e.g. gillnet), small sampling size, narrow length range. Therefore, this study is aimed at determining the effect of selective gear (gillnet) on length–weight relationship of Redbelly tilapia.
Also, condition of fish in general is an expression of relative fatness of fish. The relative robustness, or degree of well-being, of a fish is expressed by "coefficient of condition," denoted by 'K' (also known as Fulton's condition factor, or length-weight factor, or Ponderal Index). [10] Confirmed that lower values of condition factors among other things have been viewed as indicators of overexploited or depleted stocks. Condition factors decreases with increase in length [11, 12]. Meanwhile, [7] stated that the interpretation of the condition factor is difficult and prone to error. Condition factor compares the well-being of a fish and is based on

the hypothesis that heavier fish of a given length are in better condition [4]. The relative condition factor (Kn) is an expression used to assess the condition of fish, and Kn value 1 or more than 1 is considered as well-being of fish [13].

2. Materials and Methods

The study was carried out in Asejire Lake. Asejire Lake is a man-made Lake located in Ibadan, Oyo State, South-western part of Nigeria. The Lake lies between latitude 07 °21¹N and longitude 04 °07 ¹E and was constructed over River Osun in 1972, [14].

2.1 Fish Sampling

The samplings of fish were done during the daytime (8:00 am–12:00 noon) fortnightly. Fishermen landed catch were sampled at the fish landing sites of Asejire Lake for six months. At Asejire Lake, fishermen used gillnets of mesh sizes that varied from 1 inch (25.4 mm) to 4 inches (101.6 mm). Occasionally they use bigger mesh sizes. Catches from the landing sites were identified using keys and descriptions according to Adesulu and Sydenham [15]. Measurements of the total length (TL) were measured with ichthyboard in centimetre as the distance from the tip of the snout of the fish, with the mouth closed, to the tip of the longest caudal fin ray. The weight of the fish in gram (g) is determined by weighing the fish by digital weighing balance. The fish samples were weighed to the nearest gram (g)

2.3 Estimation of Length-Weight Relationship Parameters and Condition Factor

The relationship between the length (L) and the weight (W) of fish was calculated using [7] equation:

$W = a.L^b$ ---------- (i)

Where:

W = body weight of fish (g)
L = total length of fish (cm)
a = constant
b = exponent or growth coefficient

The linear transformation was made using natural logarithm:

$\text{Log } W = a + b*\text{Log TL}$ ---------- (ii)

Where:

Log W = natural log of body weight of fish (g)
Log TL = natural log of total length of fish (cm)
a = constant
b = slope or growth coefficient

The condition factor will be calculated by using [16] formula:

$C.F. = W.100/L^3$ ---------- (iii)

Where:

W = weight (g)
L = total length (cm).

2.4 Statistical Analysis

The descriptive analysis of the data was done using Microsoft Office Excel 2007. The growth coefficients '*b*' obtained were compared with the expected value of 3 using a *t* – test at 95% level of confidence as expressed by [17].

$t = b – 3 / S_b$ ---------- (IV)

Where:

t – *t*-test value,
b – Slope
S_b – standard error of the slope (*b*).

3. Results and Discussion

3.1 Length-Weight Relationship of Redbelly tilapia (*Tilapia zillii*)

The total catch of Redbelly tilapia (*T. zillii*) of Asejire Lake showed that the total numbers of male, female and combined sexes of Tilapia zillii were: 172, 176 and 348 respectively. The sex ratio of male to female of *T. zilli* was 1:1.02. The length range of male, female and combined sexes of *T. zillii* were: 11 – 26 cm, 11 – 24 cm and 11 – 26 cm respectively. The mean total length (TL) of male, female and combined sexes of *T. zillii*, were: 17.31±0.43 cm, 16.64±0.55 cm and 16.97±0.3 cm respectively. The weight range of male, female and combined sexes of *T. zillii* were: 28 – 330 g, 31 – 300 g and 28 – 330 g respectively. The mean weight of male, female and combined sexes of *T. zillii* were: 110.26±8.02 g, 99.06±7.26 g and 104.6±5.43 g respectively (Table 1). These results are in agreement with works of [18, 19, 20]. The results also showed that there were strong positive correlations, which were significant (P<0.01) between the lengths and weights of male, female and combine Redbelly tilapia observed in this study (Table 2 – 7; Appendix 2).

The length-weight relationship of male, female and combined sexes of Redbelly tilapia (*T. zillii*) showed that the values of intercept 'log a' varied slightly, with their antilogarithm values approximately equals to 0.03. The growth coefficients or slope 'b' of male, female and combined sexes of Redbelly tilapia were 2.86, 2.89 and 2.88 as shown in Figure 1, 2 & 3 respectively (Appendix 1). [21] Had suggested that the exponent 'b' should normally fall between 2.5 and 3.5. Meanwhile, [13] have suggested that value of 'b' less than 2.5 can be considered as subnormal growth of fish in that given aquatic environment. The standard error (SE) of their slopes 'b' were 0.05, 0.06 and 0.04 respectively. The t-test results showed that there was significant different between the values of 'b' of male and combined sexes (2.86 and 2.88 respectively) obtained and the expected value of isometric growth i.e. 3 (P<0.05). There was no significant difference between the slope of female *T. zilli* and expected value of 3 (P>0.05). Therefore, the growth pattern of *T. zillii* of Asejire Lake is said to be negative allometric for male and combine sexes, but it was isometric for the female. Their coefficients of determination (r^2) values were 0.96, 0.94 and 0.95 respectively. The condition factors of male, female and combined sexes of *T. zillii* were 1.99±0.03, 2.0±0.04 and 2.0±0.03 respectively (Table 1). Froese [22] had reported that reproduction results in lower value of condition factor (K<1) marked the fish loses its weight after spawning period. But, result of this study showed that redbelly tilapia (male, female and combine sex) considered has condition factors greater than 1. The results obtained from this study showed that redbelly tilapia of Asejire Lake are in good condition. However, fishermen should be encouraged to fish responsibly for sustainability of the resources.

Table 1: Length – Weight Parameters of Redbelly tilapia (*T. zillii*) of Asejire Lake

Species	n	Min	Max	Mean	Min	Max	Mean	a	b	r^2	K
Tilapia zilli (Male)	172	11	26	17.31±0.43	28	330	110.26±8.02	-1.53	2.86	0.96	1.99±0.03
Tilapia zilli (Female)	176	11	24	16.64 ±0.55	31	300	99.06 ±7.26	-1.57	2.89	0.94	2.0±0.04
Tilapia zilli (Combined sexes)	348	11	26	16.97±0.3	28	330	104.6±5.43	-1.55	2.88	0.95	2.0±0.03

Appendix 2

Table 2: Correlations of length and weight of male Redbelly tilapia

		Lengthmale	Weightmale
Lengthmale	Pearson Correlation	1	.957**
	Sig. (2-tailed)		.000
	Sum of Squares and Cross-products	1424.169	25346.942
	Covariance	8.328	148.228
	N	172	172
Weightmale	Pearson Correlation	.957**	1
	Sig. (2-tailed)	.000	
	Sum of Squares and Cross-products	25346.942	492158.744
	Covariance	148.228	2878.121
	N	172	172

Correlation is significant at the 0.01 level (2-tailed).

Table 3: Correlations of length and weight of female Redbelly tilapia

		LengthFemale	**WeightFemale**
LengthFemale	Pearson Correlation	1	.943**
	Sig. (2-tailed)		.000
	Sum of Squares and Cross-products	1307.449	22169.438
	Covariance	7.471	126.683
	N	176	176
WeightFemale	Pearson Correlation	.943**	1
	Sig. (2-tailed)	.000	
	Sum of Squares and Cross-products	22169.438	422676.313
	Covariance	126.683	2415.293
	N	176	176

Correlation is significant at the 0.01 level (2-tailed).

Table 4: Nonparametric Correlations of length and weight of female Redbelly tilapia

			LengthFemale	**WeightFemale**
Kendall's tau_b	LengthFemale	Correlation Coefficient	1.000	.880**
		Sig. (2-tailed)	.	.000
		N	176	176
	WeightFemale	Correlation Coefficient	.880**	1.000
		Sig. (2-tailed)	.000	.
		N	176	176
Spearman's rho	LengthFemale	Correlation Coefficient	1.000	.969**
		Sig. (2-tailed)	.	.000
		N	176	176
	WeightFemale	Correlation Coefficient	.969**	1.000
		Sig. (2-tailed)	.000	.
		N	176	176

Correlation is significant at the 0.01 level (2-tailed).

Table 5: Correlations of length and weight of combine sex Redbelly tilapia

		LengthCombine	**WeightCombine**
LengthCombine	Pearson Correlation	1	.951**
	Sig. (2-tailed)		.000
	Sum of Squares and Cross-products	2770.213	48164.948
	Covariance	7.983	138.804
	N	348	348
WeightCombine	Pearson Correlation	.951**	1
	Sig. (2-tailed)	.000	
	Sum of Squares and Cross-products	48164.948	925733.871
	Covariance	138.804	2667.821
	N	348	348

Correlation is significant at the 0.01 level (2-tailed).

1. Appendix

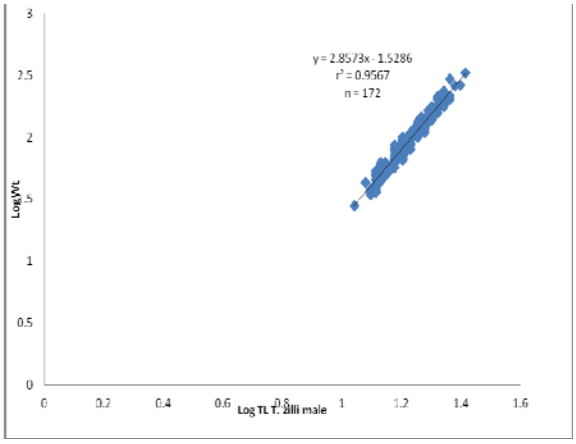

Fig 1: The Length-Weight Relationship of Male *Tilapia zilli* of Asejire Lake

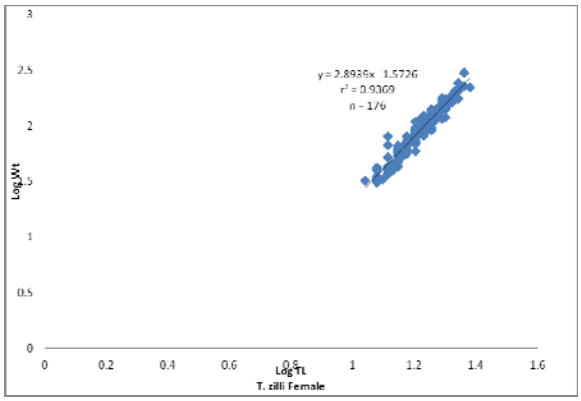

Fig 2: The Length-Weight Relationship of Female *Tilapia zilli* of Asejire Lake

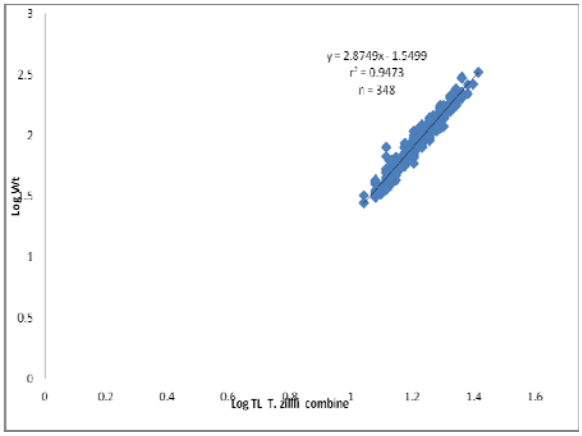

Fig 3: The Length-Weight Relationship of *Tilapia zilli* (Combine sex) of Asejire Lake

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