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LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR OF *Sarotherodon galilaeus*, Linnaeus, OF ASEJIRE DAM, OYO STATE, NIGERIA

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ABSTRACT

The isometric growth pattern or the length-weight relationship of fish is expected to be '3', but fish often deviate from this value due to the dynamics of their habitat. Therefore, this study examined the length-weight relationship and condition factor of *Sarotherodon galilaeus* of Asejire dam. *S. galilaeus* was sampled monthly between March 2019 and February 2020, the total length were measured with fish measuring board in centimetre and weighed in gram (g) using digital weighing balance. This data was used to determine the length-weight relationship ($W = a.L^b$) and condition factor of *S. galilaeus*. The total number of male and female sampled was 249 and 252 respectively. The sex ratio of male to femalewas 1:1.01. The mean total length (TL) and weight were 16.58±0.26 cm and 102.77±5.57 g respectively. *S. galilaeus* exhibits negative allometric growth since 'b = 2.8' is significantly less than 3 ($P < 0.05$). However, the condition factor (2.08±0.02) shows *S. galilaeus* dam is in good physiological condition since its condition factor is greater than 1.

Keywords: Allometric growth, sexes, negative, freshwater, cichlids

Introduction

Cichlids are endemic to Nigerian freshwaters widely distributed throughout natural and artificial water bodies. They are regarded as the most economically important fish (Adesulu and Sydenham, 2007). Tilapia fish possess a single pair of nostrils, the most distinctive feature of the group. Their lateral line is broken into two and their head is partly covered with scales. Their body is laterally flattened and the tips of their teeth are brownish (Fryer and Iles, 1972; Adesulu and Sydenham, 2007).

Sarotherodon is one the major genera of the cichlids represented by two species in Nigeria (Olaosebikan and Raji, 2013). *Sarotherodon galilaeus* is an important species of the genera widely distributed across many water bodies. Its abundance in many aquatic ecosystems in Nigeria has been reported by many authors such as Olopade and Rufai (2014); Famoofo and Abdul (2020) and Ajagbe *et al*. (2020). Meanwhile, *S. galilaeus* breeds throughout the year; it matures at very small size of a total length of 12.5 cm and a weight of 36 for male; while at the total length of 11.7 cm a weight of 34g for female. So length and weight of fish is an important morphometeric features use to determine the maturity in fish (Famoofo and Abdul, 2020).

Length-weight relationship is an essential small-scale fisheries management tool that helps to determine the well-being and 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 of the linear regression or the exponential value of the two processes is known as the 'growth coefficient'. The '*b'*

value or growth coefficient from the growth equation ($W = aL^b$) indicates the rate of weight gain relative to growth in length (Frota *et al*. 2004). The length and weight of fish samples vary with respect to their age group, stock, season, genetic factors, food composition and feeding habits. 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 ((Kuriakose, 2017; Famoofo and Abdul, 2020).

The condition factor of fish is a parameter which is used to determine the survival, reproduction, maturity and health of fish (Le Cren, 1951). It is a good indicator of water quality or general health of fish populations of a particular aquatic ecosystem (Ridanovic *et al*. 2015). Therefore, this study aims to determine the length-weight relationship and condition factor of *S. galilaeus* of Asejire Lake with a view to determining their growth pattern and generally determine their health status.

Materials and Methods

The study site was Asejire dam(07° 42' - 7° 00' N; 4° 02' - 4° 08'E). The dam has gross storage of 7,403 million/L with an elevation of 137 m. It has relative humidity of 73.4 – 79.1%, transparency range between 0.7 – 1.72 m, surface water temperature of 24 – 31.5°C, dissolved oxygen 5.1 – 8.9 mg L^{-1}, pH 6.2-8.5 (Ayoade, 2007). It is an important dam that is co-managed by Oyo and Osun States of Southwest Nigeria. The dam plays many roles to the communities around its location. But principally, it supplies water for municipal use and it is also open for fishing.

Fish Sampling

Sarotherodon galilaeus was sampled monthly during the daytime (8:00 am – 12:00 noon) from the fishermen landed catch at the fish landing site of Asejire dam, during the months of March 2019 to February 2020. It was identified using the keys and descriptions according to Olaosebikan and Raji (2013); Adesulu and Sydenham (2007). Sampled fish were counted and recorded. Fish specimens were weighed in gram (g) using digital weighing balance. Measurements of the total length (TL) and standard lengths (SL) were measured with fish measuring board in centimetre.

Estimation of Length – Weight Relationship Parameters and Condition Factor

The relationship between the length (L) and the weight (W) of fish was calculated using Le Cren (1951) equation:

$$W = aL^b \text{----------} \quad \text{(i)}$$

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:

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

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 is calculated by using Pauly (1984) formula:

$$C.F = W * {}^{100}/_{L^3} \text{----------}$$

(iii)

Where: W = weight (g); L = total length (cm).

Statistical Analysis

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The growth coefficients '*b*' obtained were compared with the expected value of 3 using a *t* – test as expressed by Rahman *et al., (*2012).

$$t = b - {}^{3}/_{Sb} \text{----------} \quad \text{(iv)}$$

Where: t -is the *t*-test value; b – is the slope and S_b – is the standard error of the slope (*b*).

Results

The total catch of *Sarotherodon galilaeus* of Asejire dam showed that the number of male, female and combined sexes were 249, 252 and 501 respectively. The sex ratio of male to female was 1:1.01. The length range of male, female and combined sexes were: 11-32 cm, 11-24 cm and 11-32 cm respectively. The mean total length (TL) of male, female and combined sexes were: 16.88±0.38 cm, 16.29±0.34 cm and 16.58±0.26 cm respectively. The weight range of male, female and combined sexes were: 29-778 g, 26-320 g and 26-778 g respectively. The mean weight of male, female and combined sexes were: 108.58±11.8 g, 97.03±6.35 g and 102.77±5.57 g respectively (Table 1).

The length-weight relationship of male (Figure 1), female (Figure 2) and combined sexes (Figure 3) of *S. galilaeus* showed that the values of intercept 'log a' were -1.42, -1.47 and -1.44 respectively. The value of antilogarithm of male and combined sexes was approximately equals to 0.04 while that of female was 0.03. The growth coefficients or slope 'b' for male, female and combined sexes were 2.78, 2.82 and 2.8 respectively. The standard error (SE) of their slopes '*b*' were 0.05, 0.04 and 0.03 respectively. The t-test results showed that there was significant different between the values of '*b*' (2.78, 2.82 and 2.8 respectively) obtained and the expected value of isometric growth i.e. 3 ($P < 0.05$). Therefore, the growth pattern of *S. galilaeus* of Asejire Lake is said to be negative allometric; since it is less than the isometric growth value '3'. They have uniform value of coefficients of determination ($\mathbf{r^2}$) values which was 0.94. The condition factor of male, female and combined sexes of *S. galilaeus* was 2.08±0.05, 2.08±0.03 and 2.08±0.02 respectively (Table 1).

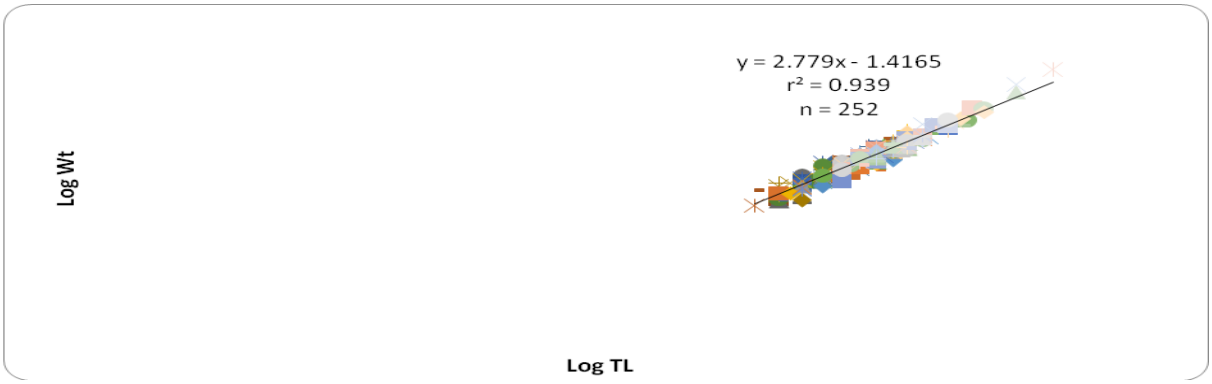

Figure 1: The Length-Weight Relationship of Male *Sarotherodon galilaeus* of Asejire dam

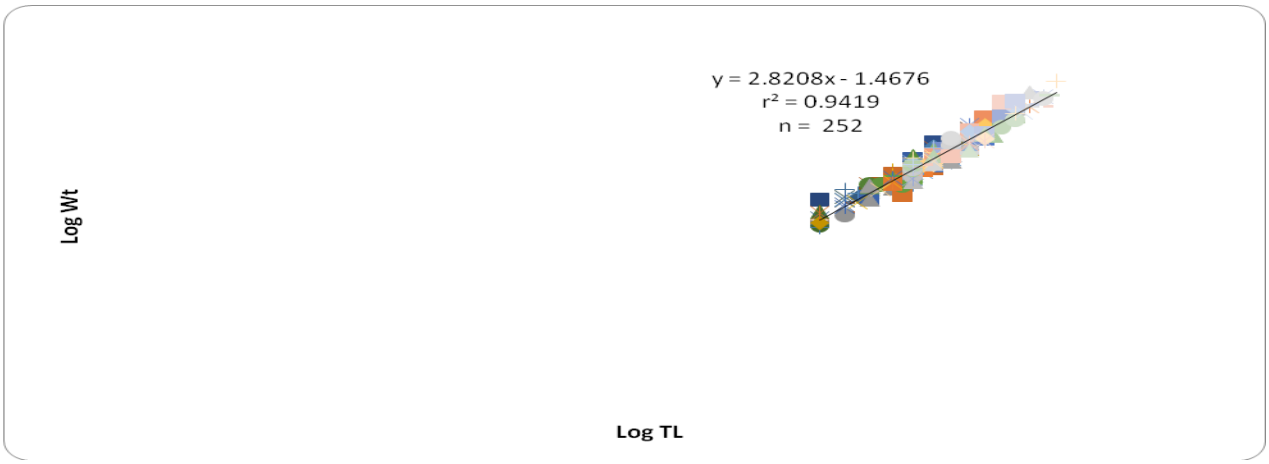

Figure 2: The Length-Weight Relationship of Female *Sarotherodon galilaeus* of Asejire dam

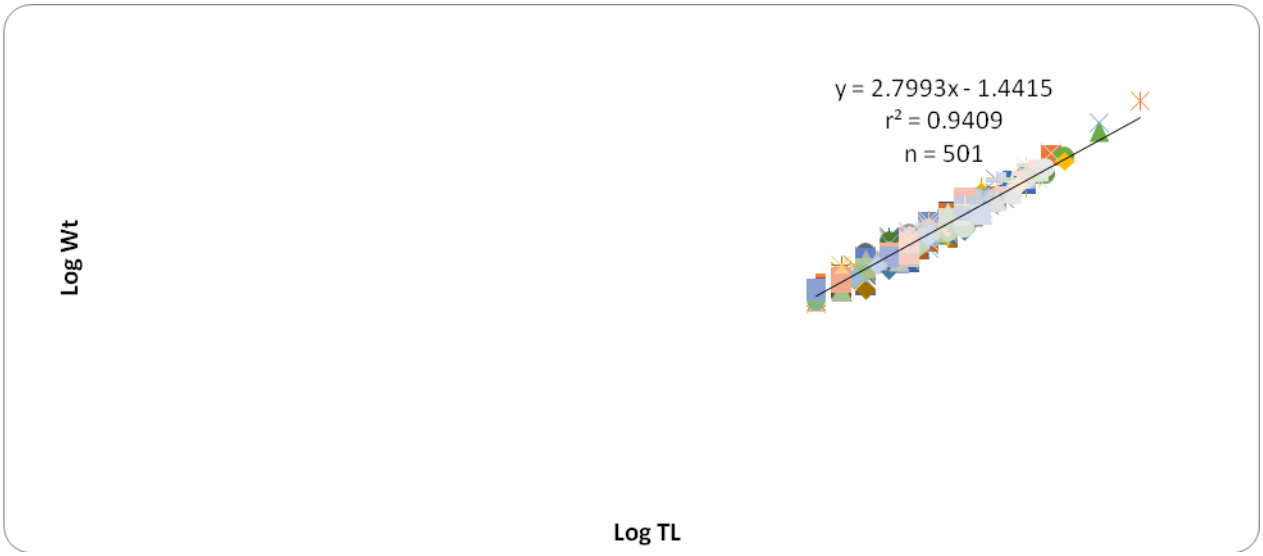

Figure 3: The Length-Weight Relationship of *Sarotherodon galilaeus* (combine sex) of Asejire dam

Table 1: Length – Weight Parameters of *Sarotherodon galilaeus*of Asejire Lake

		Total length (cm)			Weight (g)			Length-weight parameters			
Species	n	Min	Max	Mean	Min	Max	Mean	a	b	r^2	K
Sarotherodon galilaeus (Male)	249	11	32	16.88 ±0.38	29	778	108.5±11.8	-1.42	2.78	0.94	2.08±0.05
Sarotherodon galilaeus (Female)	252	11	24	16.29 ±0.34	26	320	97.0±6.35	-1.47	2.82	0.94	2.08±0.03
Sarotherodon galilaeus (Combined sexes)	501	11	32	16.58±0.26	26	778	102.77±5.57	-1.44	2.8	0.94	2.08±0.02

Discussion

The sex ratio of *S. galilaeus* estimated in this study 1:1.01 is not significantly different from the expected sex ratio 1:1 (male: female) for cichlids. This shows that for every male of *S. galilaeus* there is corresponding one female, to enhance sustainable recruitment of *S. galilaeus* in Asejire dam. However, the sex ratio of *S. galilaeus* may vary due to prevailing environmental conditions and other parameters. This is in agreement with the observation of Olopade *et al*. (2014).

The total length range of *S. galilaeus* of Asejire dam is 11-32 cm.This implied that some *S. galilaeus* were caught before they reach their expected sexual maturity length of 13cm (Ben-Tuvia). Abdul *et al*. (2010) reported a total length of 22 – 34cm. The weight of *S. galilaeus* varies between 26 – 778 g. Alhassan *et al*. (2015) reported a weight range of 12 – 120g. The mean weight of *S. galilaeus* observed in Asejire dam is 102.77±5.57 g. Abdul *et al*. (2016) reported a mean weight of 792.76±106.72g for the same species. Fishing pressure and water qualities parameters of the respective aquatic ecosystems could be responsible for the difference on the growth and development of *S. galilaeus*.

The weight of fish determined by its length and the exponential relationship (growth coefficient = b) is defined as isometric growth for an ideal fish having a value of 3 (Weatherley and Gill, 1987).Often, isometric growth 'b' of fish is influenced by environmental factors such as different stages in the ontogenetic development, sex, feeding habit etcetera (Froese, 2006) and can vary between 2.5 and 3.5 (Gayanilo and Pauly, 1997). This shows that fish can have negative allometric growth when the value of its growth function is below3 and positive allometric if its growth functions is above3. Therefore, *S. galilaeus* of Asejire dam can be said to exhibits negative allometric growth since its 'b' value is less than 3. This implies that the weight of *S. galilaeus* of Asejire dam is increasing at a lesser rate than the cube of the body length (Adeyemi *et al.* 2009). This might implied that the fishing pressure of Asejire dam is having negative impacts on *S. galilaeus*. However, *S. galilaeus* greater of Asejire dam is said to be in good physiological condition since its condition factor is greater than 1 (Obasohan *et al*. 2012).

Conclusion

The growth pattern and general physiological condition of *S. galilaeus* of Asejire dam is examined in this study. The sex ratio of male to female (1:1.01) showed that sustainable recruitment of *S. galilaeus* is possible in Asejire dam. It was noticed that with length range of 11-32 cm, some fish were not allowed to reach their sexual maturity size before they were caught in Asejire dam. Likewise, this study showed that *S. galilaeus* of Asejire dam exhibited negative allometric growth (b = 2.8) an implication that the aquatic ecosystem is not suitable for the growth of this fish. Therefore, fishing activities of Asejire dam should be adequately regulated for the fisheries resources of the dam to be sustainable.

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