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LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR OF *Sarotherodon melanotheron* AND *Tilapia guineensis* IN LAGOS LAGOON, NIGERIA

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Abstract

The length-weight relationship and condition factor of *Sarotherodon melanotheron* and *Tilapia guineensis* inhabiting Lagos lagoon were examined and the relationship among the parameters was determined by correlation. The mean total length and weight was 16.33±2.24cm and 71.44±30.04g for *S. melanotheron* and 16.08±2.92cm and 84.93±44.24g for *T. Guineensis*, respectively. The regression coefficient (*b*) of length and weight revealed that *S. melanotheron* exhibited negative allometry (*b*=2.36; *a*=-2.39; R^2=0.67) while *T. guineensis* exhibited positive allometry (*b*=3.19; *a*=-4.54; R^2=0.87). The condition factor which measures the physiology (wellbeing) of fish was greater than 1 for the two species although, it was higher in *T. guineensis* (2.04) than *S. melanotheron* (1.64). This difference may be due to variation in the weights of the two fish species as well as environmental factors in the lagoon. The study revealed that both species were healthy despite that Lagos lagoon receives wastewater from different anthropogenic sources. This shows that the study area is conducive for the development and sustenance of fisheries resources.

Keywords: Fish Biology; Eco-Biology; Allometry; Pollution; Fish Growth.

INTRODUCTION

In fish biology, the sizes of fish are generally considered to be more important than their ages because several physiological and ecological factors affect sizes over age. Therefore, the length-weight relationship (LWR) of fish is important in fisheries management because it allows the estimation of the average by establishing a mathematical relationship between the relative well-being of the fish population (Getso *et al.,* 2017). It also has a number of important applications in the fish stock assessment such as enhancement of management, conservation and culture of fish species as well as future comparison between populations of a species (Atindana *et al*., 2016). Similarly, Uneke (2017) reported that basic information that relates length to the weight of fish is of great importance in fish biology.

The relationship between length and weight of fish estimates the condition factor (Atindana *et al*., 2016). In fisheries science, the condition factor (K) serves as an indicator of the physiological state of fish in relation to its welfare. It is based on the hypothesis that heavier fish of a particular length are in a better physiological condition. Generally, a value close to, or above 1 is desirable (Ajibare *et al.,* 2020). Also, it reflects the interaction of biotic and abiotic factors in the physiological conditions of fishes. Therefore, it may vary among fish species in different locations (Uneke, 2017). It is also a useful index for monitoring feeding intensity, age, and growth rates in fish. Since the condition factor is strongly influenced by both biotic and abiotic conditions; it can therefore be used in understanding the life cycle of fish species and to assess the status of their habitats (Getso *et al.,* 2017).

Moreover, it is essential to conduct the length-weight analysis of a stock in order to assess the changes that occur in their growth vis-à-vis the ever-changing ecological conditions. Cichlids (*Oreochromis, Sarotherodon* and *Tilapia*) are generally tolerant to varieties of habitats and their omnivorous feeding habit confers them an important element of fish farming which demands mode of their life and ecological requirements (Ayoola *et al*., 2014; Atindana *et al*., 2016). This importance could be attributed to their hardy nature and prolific breeding ability. According to Adeosun *et al.,* (2019) their distribution is wide in Nigeria waters. They are of high economic viability and play important role in the ecology of freshwater bodies in Africa. *S. melanotheron* and *T.* guineensis are inherently tolerant to unfavourable ecological changes (water volume, food availability and physico-chemistry). For these reasons, they are abundant in the inland waters of Nigeria, their length-weight parameters are sufficient indicators of the well-being of other fish stocks. This study was therefore designed to investigate growth pattern of *T. guineensis* and *S. melanotheron* in Lagos lagoon, South-west Nigeria with the aim of providing information on the condition of fish inhabiting the lagoon.

MATERIALS AND METHODS

The Lagos lagoon (6°31. 048'N and 3° 24. 473'E) is an open, shallow and tidal lagoon, with a surface area of 208km^2 and a depth of about two meters (Figure 1). The lagoon occasionally experiences brackish conditions due to seawater incursion. Also, it provides the only opening for the nine lagoons in South- West Nigeria to the sea (Onyema, 2008). The study area is the part of the lagoon in front of the University of Lagos.

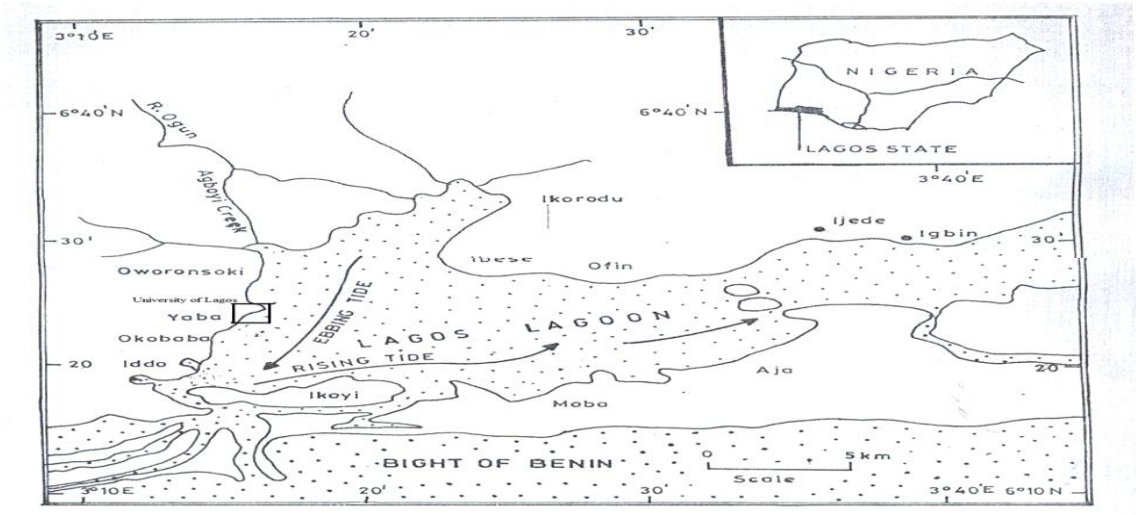

Fig 1: Map of Lagos lagoon

Collection and Identification of Samples: Thirty-six (36) samples each of *Sarotherodon melanotheron* and *Tilapia guineensis* were collected forth nightly from June to August, 2011 using a cast net. The fish were identified according to Olaosebikan and Raji (2013).

Determination of Total Length (TL) and Weight (W)

The total length of each fish was measured using a measuring board as described by Ayoola *et al.,* (2013) and Ajibare *et al.,* (2020) while weight was measured using a top loading weighing balance with a sensitivity of 0.01g.

Determination of Length-Weight Relationship and Condition Factor: The length-weight relationship of the fish was expressed by the equation $W = aL^b$ which was transformed into a natural logarithmic form $logW = \log a + blog\, L$

Also, the condition factor (K) was calculated as$K = \frac{100W}{L^3}$(Ajibare *et al.,* 2020)

Where *W*=Weight (g), *a*=Constant (intercept), *L* =Length (cm), *b*=Length exponent (slope).

RESULTS

The regression graphs showing the *a* (intercept), *b* (slope) and R^2 (Regression coefficient) for both *S. melanotheron* and *T. guineensis* in this study is presented in figures 2 to 5. The figures revealed that *S. melanotheron* exhibited negative allometric growth (b<3) throughout the study period with values of 2.49 (*a*=-2.89; R^2=0.73), 1.42 (*a*=0.31; R^2=0.37) and 2.70 (*a*=-3.21; R^2=0.98) in June, July and August respectively while *T. guineensis* exhibited positive allometric growth (b=3.49; *a*=-5.36; R^2=0.96) in June but exhibited negative allometric growth in July (*b*=1.86; *a*=-0.72; R^2=0.47) and August (b=2.91; *a*=-3.78; R^2=0.81). The mean Length-Weight Relationship as presented in figure 5 revealed that *S. melanotheron* exhibited negative allometry (*b*=2.36; *a*=-2.39; R^2=0.67) while *T. guineensis* exhibited positive allometry (*b*=3.19; *a*=-4.54; R^2=0.87) in the Lagos lagoon.

The total length (TL), weight (W) and condition factor (K) of both *S. melanotheron* and *T. guineensis* is presented in Table 1 which revealed that there was no statistical difference between the mean TL of *S. melanotheron* (16.33±2.24cm) and *T. guineensis* (16.08±2.92cm) however, the weight of *S. melanotheron* (71.44±30.04g) was statistically lower (P<0.05) than that of *T. guineensis* (84.93±44.24g). Hence, *T. guineensis* had a higher condition factor (2.04) than *S. melanotheron* (1.64).

The correlation matrixes of the parameters of *S. melanotheron* and *T. guineensis* are presented in Tables 2 and 3. The results in Table 2 showed that *S. melanotheron* exhibited a positive and significant relationship between weight (W) and condition factor (K) (r=0.98; P=0.02). Also, the LWR of both species displayed a negative and non-significant relationship with TL and W while the condition factor of both species had a positive relationship with the LWR (Tables 2 and 3).

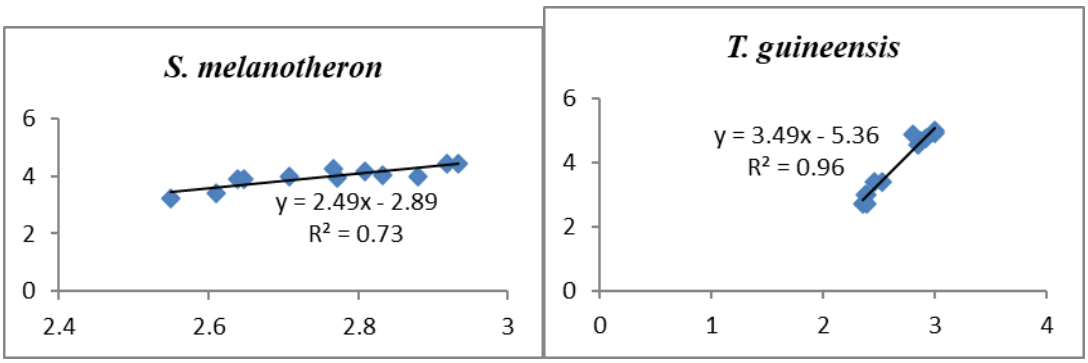

Figure 2: Length-Weight Relationship of *S. melanotheron* and *T. guineensis* in June

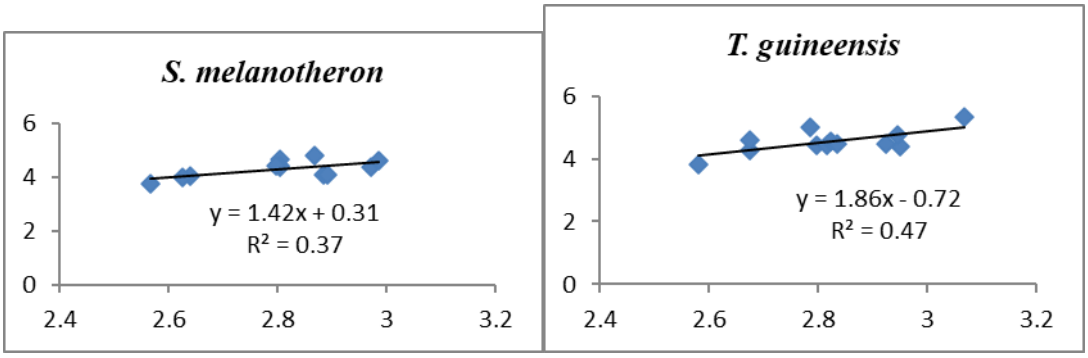

Figure 3: Length-Weight Relationship of *S. melanotheron* and *T. guineensis* in July

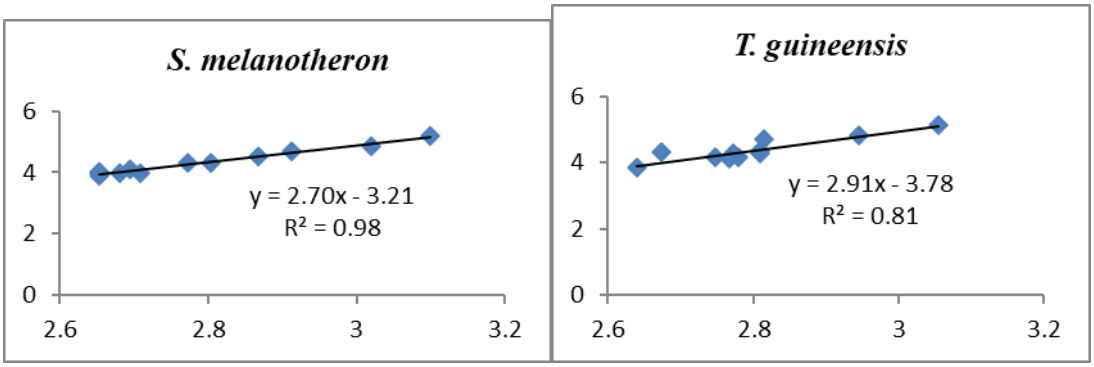

Figure 4: Length-Weight Relationship of *S. melanotheron* and *T. guineensis* in August

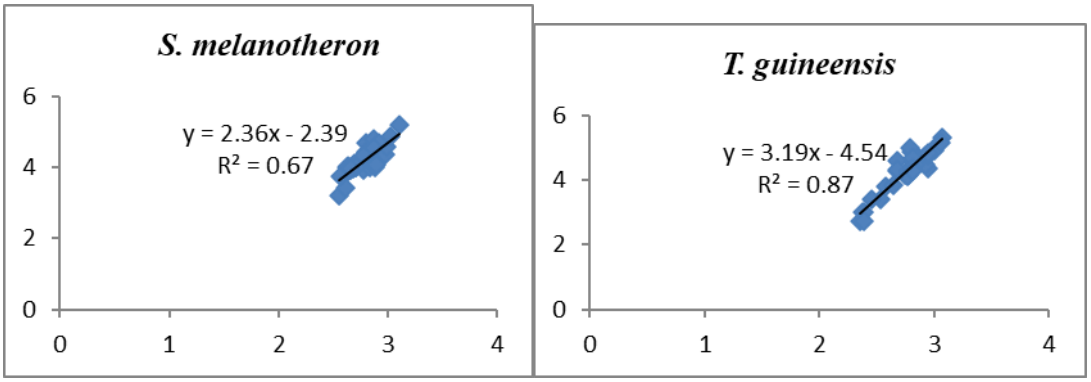

Figure 5: Overall Length-Weight Relationship of *S. melanotheron* and *T. guineensis* in Lagos Lagoon

Table 1: Total Length (TL), Weight (W) and Condition Factor (K) of *S. melanotheron* and *T. guineensis* in Lagos Lagoon

Month	Total Length (cm)		Weight (g)		Condition Factor (K)	
	S. melanotheron	*T. guineensis*	*S. melanotheron*	*T. guineensis*	*S. melanotheron*	*T. guineensis*
JUNE	15.84±1.98	14.76±3.87	56.01±18.40	71.46±53.77	1.41	2.22
JULY	16.63±2.15	16.96±2.32	76.29±23.43	99.67±41.19	1.66	2.04
AUGUST	16.52±2.67	16.52±1.92	82.01±39.70	83.67±34.70	1.82	1.86
MEAN	16.33±2.24	16.08±2.92	71.44±30.04	84.93±44.24	1.64	2.04

Table 2: Correlation matrix of Total Length (TL), Weight (W), Condition Factor (K) and Length-Weight Relationship (LWR) of *S. melanotheron* in Lagos Lagoon

Parameter	*TL*	*W*	*K*	*LWR*
TL	1			
W	0.94 (0.06)	1		
K	0.86 (0.14)	**0.98 (0.02)**	1	
LWR	-0.47 (0.53)	-0.16 (0.84)	0.03 (0.97)	1

Bold values are significant at P < 0.05

Table 3: Correlation matrix of Total Length (TL), Weight (W), Condition Factor (K) and Length-Weight Relationship (LWR) of *T. guineensis* in Lagos Lagoon

Parameter	*TL*	*W*	*K*	*LWR*
TL	1			
W	0.92 (0.08)	1		
K	-0.76 (0.24)	-0.43 (0.57)	1	
LWR	-0.84 (0.16)	-0.95 (0.05)	0.33 (0.67)	1

DISCUSSION

The significance of the study is to assess the condition of the two major cichlid species in Lagos lagoon and provide information that will aid in the management and maintenance of the biological equilibrium of the species and ecosystem. The *b* values of the two studied species ranged from1.42 to 2.70 and 1.86 to 3.49 for *S. melanotheron* and *T. guineensis* respectively. This result is similar to the observations (2.28-3.68) of Egbal *et al.* (2011) on fish species from Khashm el- Girba reservoir and Atbara River in Sudan. Other studies that reported similar findings are that of Atama *et al*. (2013) and Dan-Kishiya (2013) who reported negative allometry for both males and females in both wet and dry months. Also, Olawusi-

Peters *et al.* (2015), Atindana *et al*. (2016) and Uneke (2017) in their individual studies reported allometric growth patterns for different fish species.

Ajibare *et al.,* (2020) reported that, when *b* is less than 3, the fish experiences a negative allometric growth, but when the value is higher than 3, the fish grows following the positive allometric growth pattern. It was further reported that *b* becomes greater than 3 when the fish becomes fatter, and slimmer when *b* is lower than 3. This study observed that *T. guineensis* exhibited positive allometric growth patterns while *S. melanotheron* exhibited negative algometric growth. However, all values observed for both fish species during the study indicated that the two fish species experienced a negative allometric pattern of growth at some point. The coefficient of determination R^2 for length-weight relationship was high for *T. guineensis* than *S. melanotheron*, indicating that the length increased with the weight of *T. guineensis* than *S. melanotheron*. This means that *S. melanotheron* becomes thinner/slender as length increases while *T. guineensis* becomes stocky or robust as its length increases (Ajibare *et al.,* 2020). This could be due (among other factors) to gonad maturity, diet, sex, seasons, growth increment, sample size, temperature and salinity of the environment, fishing, individual metabolism, habitat suitability, age, and maturity (Atama *et al*. 2013; Uneke *et al*., 2017; Lawal *et al*. 2019).

The observed condition factor ranged from 1.41 to 2.22 which falls within the observations of Kumolu-Johnson and Ndimele (2010) for fishes (0.91 to 8.46) from Ologe lagoon, in Lagos; Ajani (2013) for five fish species (0.45 to 2.25) of Lagos coastal lake; Oso and Iwalaye, (2016) for four cichlids (0.99 to 4.35) from Ero dam, Ekiti State Nigeria. The variation in the values obtained in the above-mentioned researches may be attributed to several factors such as the sizes, ages, sexes, feeding intensity/fullness of the gut, degree of muscular development, the amount of reserved fat and life history, variations in the stage of maturity, stress, season, mutagens from human interference and other water quality parameters (Gupta and Banerjee, 2015; Getso *et al.,* 2017). Prominent among the environmental factors that are peculiar to Lagos lagoon are the variation in salinity and water level (which prompts water physico-chemistry) as a result of siltation and shortage and/or unavailability of food in the ecosystem. According to Uneke (2017), the condition factor of fish is affected by strain, species, stress, sexes, availability of feeds, water quality, etc. Hence, this could justify the differences between the observation of the present study and those of previous studies on different fishes under different experimental conditions.

Atindana *et al*., (2016) and Uneke (2017) reported that fishes with a low value of condition factor are presumed to have experienced inadequate nutrition and/or adverse physical environmental conditions. According to Olawusi-Peters *et al.,* (2015), when *K* increases, it

often indicates gonadal development and accumulation of fat while Ajibare *et al.,* (2020) reported that the highest values of *K*are reached in fully matured fish or those that have higher reproductive potentiality. It was observed that the two examined fish species recorded consistent condition factors; with higher values observed in *T. guineensis*. Both fish species had condition factors higher than 1(i.e. K ≥ 1), and were within the normal range recommended (as suitable for matured fish) by Olawusi-Peters *et al.,* (2015) and Getso *et al.* (2017) who stated that condition factor greater or equal to one (K ≥ 1) implied that the fish are in good condition of the physiological state within their habitat. It may also indicate adequate nutrition and positive environmental conditions. Based on this, it could be said that all the fish samples are in good condition of well-being. Therefore, *T. guineensis* and *S. melanotheron* revealed that Lagos lagoon had good quality food and favourable environmental conditions during the study.

CONCLUSION

This study provided information on the length-weight relationships and condition factors of *S. melanotheron* and *T. guineensis* in Lagos lagoon, Nigeria. The result revealed negative and positive allometric growth for *S. melanotheron* and *T. guineensis* respectively. The values for the condition factor indicated that the fish are in good state. Therefore, various factors may have contributed to variations recorded among the fish species hence; there is a need for an assessment of the water quality parameters and other factors affecting the lagoon in order to establish its sustainability. Also, fishermen in the area should be educated on the sustainable management of the lagoon.

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