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Research Article

Length-Weight Relationship and Condition Factor of *Oreochromis niloticus* (Linnaeus, 1758) from Challawa-Gorge Reservoir and River Hadejia, Nigeria

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ABSTRACT

Length-Weight relationship and condition factor of *Oreochromis niloticus* from Challawa-Gorge reservoir and River Hadejia, Nigeria, were evaluated from July 2022 to March 2023. A total of one thousand, two hundred and forty-four (2244) of *Oreochromis niloticus* fish samples were purchased at the landing site of the two water bodies, were immediately transported in a cold bag to the laboratory for identification using field guide and morphometric measurements were done using measuring board to the nearest 0.1cm for length and digital weighting balance to the nearest 0.01g for weight. The length-weight relationship of fish can be used to assess the wellbeing of individuals and to determine possible difference between separate unit stocks of the same species. The result for the length-weight relationship of *Oreochromis niloticus* showed a positive allometry growth pattern from both water bodies b = 3.51 and 3.11 for Challawa-Gorge and River Hadejia, respectively. The mean condition factor of 1.84 (Challawa-Gorge Reservoir) and 2.22 (River Hadejia). Moreover, the result obtained from this study showed a general positive allometric growth pattern and a well-being of *Oreochromis niloticus* from Challawa-Gorge reservoir and River Hadejia.

Keywords: Challawa-Gorge Reservoir; Condition Factor; Length-weight relationship; *Oreochromis niloticus*; River Hadejia

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INTRODUCTION

In 2022, global catches in inland waters were 11.3 million tonnes, a decrease of 0.3% from 2021. While fishing in inland waters was also severely impacted by COVID-19 pandemic during 2020. Otherwise, global inland water catches appear to remain relatively static according to officially reported data and marginally below the highest level of 12.1 million tonnes recorded in 2018 (FAO 2024). The importance of inland fisheries for nation and global food security and livelihoods, especially in low-income food deficit countries and landlocked developing countries, is well recognized. Unfortunately, production statistics are not routinely collected by many countries, jeopardizing the development of national and regional fisheries policy and planning, and management and conservation of resources and ecosystem, all of which required updated and reliable statistic (FAO 2024).

The Nile *Tilapia*, *Oreochromis niloticus* (Linnaeus, 1758) natural populations occur in Africa and the species *O. niloticus* has been introduced to almost every tropical country in the world for aquaculture purposes (Nchimunya *et al*., 2018). It is much appreciated by consumers, being a good and affordable source of protein. It is well-known among consumers because it benefits the health and well-being of both young and

old people. Tilapia is the world's second most cultured fish species, after carp (Miao and Wang 2020). Nile tilapia is considered as the ideal fish species for aquaculture mainly due to its rapid growth, high fecundity, ability to resist poor water quality, and good performance under sub-optimal nutritional conditions (Opiyo *et al*., 2018 and Tibihika *et al*., 2020). The Challawa-Gorge Reservoir and River Hadejia are considered to be rich with *O. niloticus* and other fisheries resources (Nazeef *et al*., 2018 and Kabir *et al*., 2021).

Length-weight relationship of fish is widely recognized as an important tool in fisheries science especially in ecology population dynamic and stock management (Abdoli and Rasooli, 2008). Fish can attain either isometric growth, negative allometric growth or positive allometric growth. Isometric growth is associated with no change of body shape as the fish grows. Negative allometric growth implies the fish becomes slenderer as it increases in weight, while positive allometric growth implies the fish becomes relatively stouters or deeper-bodied as it increases in length (Riedel *et al.,* 2007). The fish condition factor (K) serves as a physiological indicator of the well-being of the fish (Ajibare and Loto 2022). It compares the well-being of a fish, and is based on the hypothesis that heavier fish of a given length are in a better condition (Abowei and George, 2009).

While the population characteristics (morphometric measurements, length-weight relationship, condition factor, biodiversity and abundance) of *O. niloticus* from several water bodies in Nigeria have been studied by different researchers were studied (Ishaku *et al*., 2020; Famooto and Abdul, 2020; Muhammed *et al*., 2019; Getso *et al*., 2017; Nafiu *et al*., 2017; Ogidiaka and Esenowo, 2015; Egbon *et al.,* 2011). Research work on the morphometric characterization of *O. niloticus* sourced from Chalawa-Gorge Reservoir and River Hadejia is not well understood, this could hinder development of management programs. The present study will be useful in decision-making in the management and conservation of fisheries resources. This study therefore aims in providing knowledge on the length-weight relationship and condition factor of the two populations of *O. niloticus* in both reservoir and river systems that could be used when designing conservation measures.

MATERIALS AND METHODS

Study Area

The Gorge Reservoir is located at 8006'58.04''E latitude 11041'21.95''N longitude in Karaye Local Government of Kano State in the Northwest of Nigeria, about 90 km southwest of Kano city. It is a major Reservoir on the Challawa River, a tributary of the Kano River, while Kano River is the main tributary of the Hadejia River (Etiosa, 2009). River Hadejia is located (longitude 12.65N and latitude 10.64E) in Jigawa state, Northwest of Nigeria. The river forms along with Nguru Lake and is now 80% recharged by the Tiga and Challawa-Gorge Reservoirs in Kano state (Kabir *et al*., 2021).

Sample Collection

A total of one thousand, two hundred and forty-four (1244) Nile Tilapia were collected from fisherfolks at the landing sites of the water bodies in the morning hours (9:00 to 12:00) two times a week for a period of nine (9) months. The Fish samples were transported to the laboratory in an ice chest for further examination and identification using field guide of Olaosebikan and Raji (2013), whereas, the measurements length and weight relationship for are measured to the nearest 0.1cm using measuring board for the Total length and nearest 0.01 g using a digital balance for the Total weight.

Length-weight relationship

The exponents (b) of LWR were tested for departure from isometry (b=3) using using the following formula

W = aL^b (Pauly, 1983)

Where:

W = Weight of fish samples,

L = Total length of fish samples,

a = Intercept

b = Regression coefficient.

The above equation was transformed to a logarithmic according to the following formula:

LogW= Log a+b Log L (Pauly, 1983)

Condition Factor

The condition factor (K) was determined according to Falcon, using the following formula:

K = $100W/L^3$

Where:

W = weight (g)

L = total length (cm)

3 = the cubic relationship between length and weight

Data Analyses

The length and weight data were subjected to (Microsoft Office Excel software (version 2012) for linear regression analysis using the above equations.

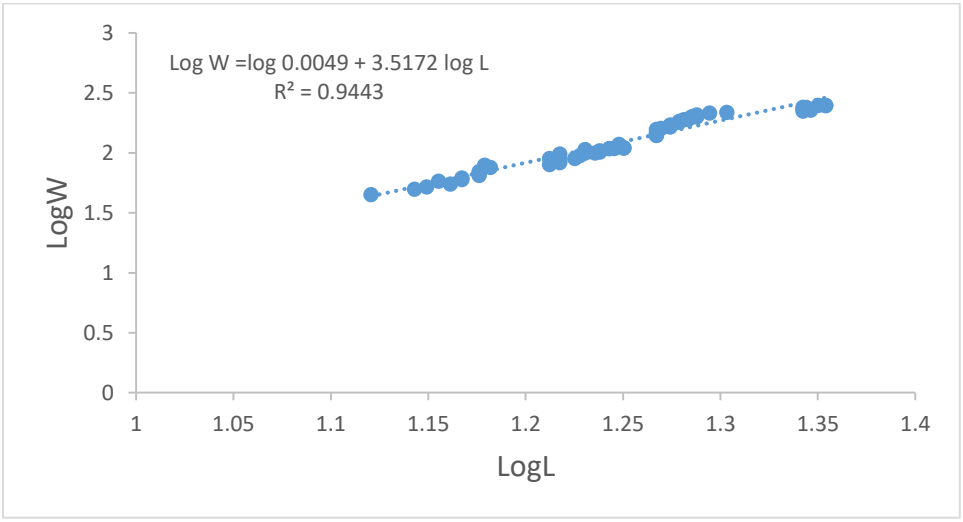
RESULTS AND DISCUSSION

Fish length-weight relationship studies are a useful resource for characterizing the biological characteristics of the fish species. The *Oreochromis niloticus* populations from Challawa-Gorge Reservoir and River Hadejia showed a value of b = 3.51 and 3.11 respectively. All the water bodies had a significant relationship at ($p<0.05$), with a positive allometric growth pattern. Positive allometric growth indicates the fish gets robust, weightier, and deeper-bodied as its length increases as opposed to isometric growth, which

means the fish's length and weight increase at the same rate. This result is comparatively higher than the values of b (2.39 and 2.56) obtained from Ishaku *et al*. (2020 and (2.50 and 1.53) from Imam TS *et al*. (2010). Olurin and Aderibigbe (2006) reported that when b=3, the fish grows isometrically, resulting in ideal shape of fish but when the values of b are not equal to 3, the Fish grows allometric growth. When the value of b is less than 3 the fish experiences a negative allometric growth and when the value of b is more than 3 the fish grows following the positive allometric growth pattern. However, it was observed that all the *Oreochromis niloticus* populations in the two water bodies showed a positive allometric growth pattern which corroborates Egbal *et al.* (2011).

Figure 2, shows a different K value of *Oreochromis niloticus* in the two water bodies. The highest mean K value of 2.22 was observed in River Hadejia populations while the lowest mean K value of 1.84 was observed in mean population. A significant difference at P< 0.05 existed in mean K values between the two water bodies. Based on the finding of Ujjania *et al*. (2012), who reported that a condition factor ≥ 1 is good, indicating a good level of feeding and proper environmental conditions.

Hence, the mean value of condition factors of acquired in the two water bodies during this study implies that the fish found in the water bodies were living healthy and these indicates the state of the fish-supporting aquatic ecosystem (Famoofo and Abdul 2020). Getso *et al*. (2017) found a comparable high K value (1.81) for Oreochromis niloticus from Wudil River, Kano State, Nigeria, and Ishaku *et al*. (2020), reported k value (1.75 and 1.72) from Gubi Dam, Bauchi State, Nigeria. However, the K value in this study is less than the 2.6-3.4 reported by Imam TS *et al.* (2010) from Wasai Reservoir, Kano State, Nigeria.



(b)

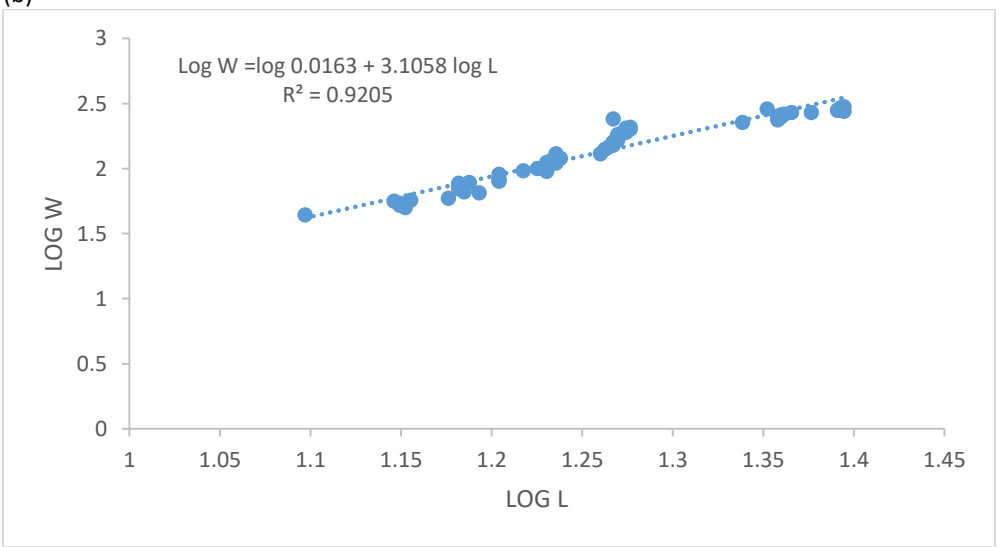


Figure 1: Length-Weight relationship of *Oreochromis niloticus* in (a) Challawa-Gorge Reservoir (b) River Hadejia

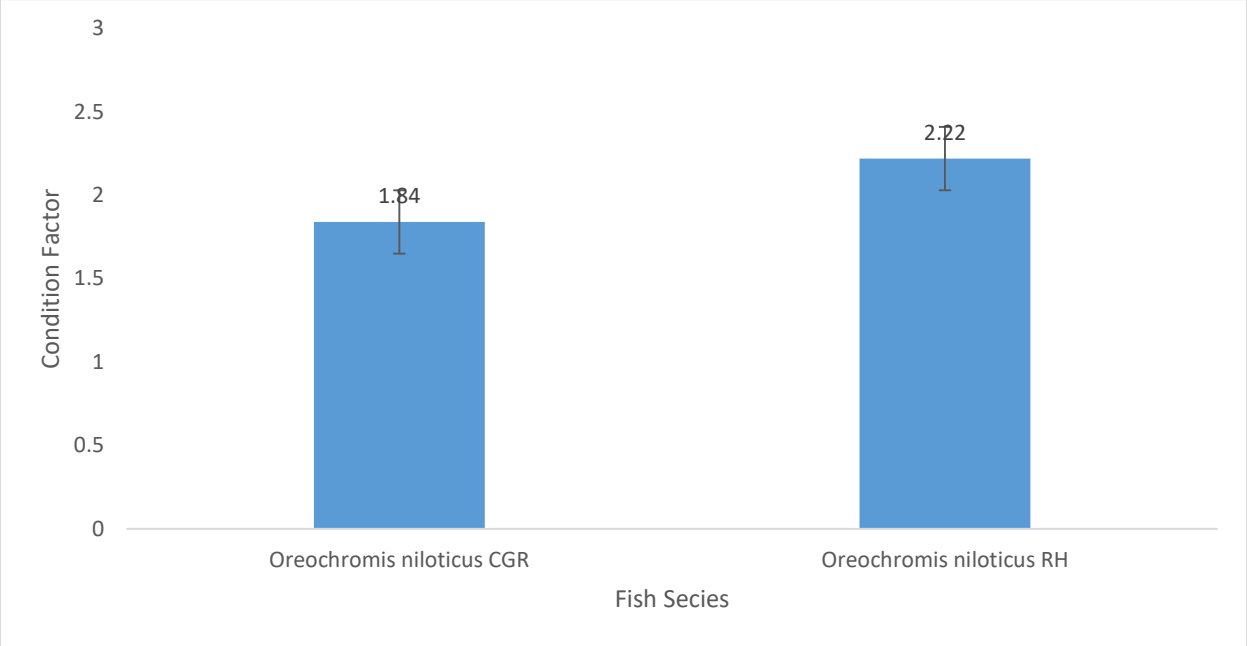


Figure 3: Condition Factor of *Oreochromis niloticus* from Challawa-Gorge Reservoir and River Hadejia
Key: CGR- Challawa-Gorge Reservoir, RH- River Hadejia

CONCLUSION

In conclusion, the length-weight relationship of *Oreochromis niloticus* in both water bodies shows a positive allometric growth pattern, thus, the condition factor between the two water bodies differs, it was found to be within the recommended productive and healthy range for tropical freshwater fish species. Therefore, the results of this study can serve as baseline data for *Oreochromis niloticus* and for comparisons with future studies

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