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SIZE COMPOSITION, GROWTH PATTERN AND CONDITION FACTOR OF NILE TILAPIA (*Oreochromis niloticus* Linnaeus, 1758) FROM WASAI RESERVOIR, KANO STATE – NIGERIA

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ABSTRACT

A study of the size composition, growth pattern and condition factor of Nile Tilapia (Oreochromis niloticus) from Wasai reservoir in Minjibir Local Government Area of Kano State was conducted using length-weight data obtained from local fishermen in the study area. Standard length ranged from 11.30 cm to 18.20 cm, total length ranged from 13.40 to 19.90 cm whereas body weight from 35.90 g to 116.50 g. The length-weight relationship revealed only positive allometric growth in Kundima and negative allometric growth pattern in Dinga and Ungulaye. The condition factor (K) also revealed all K values obtained are ≥ 1 in all the sampling sites indicating that the environment is good in terms of food availability. The results of this study will be useful for the management and conservation of O. niloticus fisheries from Wasai Reservoir.

Key words: length-weight relationship; *Oreochromis niloticus*, Wasai reservoir, condition factor, growth pattern

INTRODUCTION

Freshwater ecosystems have been used for the study of factors controlling the richness and distribution of aquatic organisms including fish (Esenowo and Ugwumba, 2010; Alho, *et al*., 2015). The present global rates of human impact intensification in freshwater ecosystems and their surroundings have triggered an alarming loss of freshwater biodiversity and functioning across multiple trophic levels (Buzhdygan *et al*., 2022). This might be due to certain reasons, pointed out such as fish habitat and environmental degradation, inadequate fish assemblages, inefficient harvesting systems, stakeholders' conflicts, and insufficient institutional and political recognition (Miranda, 2007; Buzhdygan, *et al*., 2022). Other factors could be lack of proper species stocking, over fishing and improper reservoir management (Phan *et al*., 2021). For sustainability of these aquatic resources, an adequate knowledge of species composition, diversity and relative abundance of the water bodies must be understood (Ahmad *et al*., 2015).

Information about length–weight relationship (LWR) and condition factor (*K*) is very vital for assessment and management of fish resources (Phan *et al*., 2021, Ali *et al.*, 2022).

Length-weight relationships provide valuable information on where the fish lives (Balogun, 2005; Usman *et al*, 2016). It also provides important clues on climatic and environmental changes in an aquatic ecosystem (Taheri Mirghaed *et al*., 2021). However, condition factor provides vital index for monitoring feeding intensity, age and growth rates in fish (Balogun, 2005; Phan *et al*., 2021). Also, Length-weight relationships can be used to assess the influence of frequency growth fluctuations due to changes in food composition, environmental variables and spawning conditions among others in fish (Getso, 2017; Taheri Mirghaed *et al.*, 2021). Fish growth, mean weight at a given body length of fish and the relative wellbeing in fish can be known through this relationships (Kulbicki *et al*., 1993; King, 1996). Length–weight relationship has important implications for the life history patterns of fish species (Moutopoulos and Stergiou 2002; Froese, 2006; Taheri Mirghaed *et al*., 2021). The condition factor is defined as a condition representing how lean or fat the fish is. It is an index reflecting interaction between biotic and abiotic factors. The physiological conditions of fishes may vary among fish species in different locations (Blackwell *et al*., 2000). In fisheries science, the condition factor (K) is used to compare the "condition", i.e., fatness or wellbeing of fish (Getso, *et. al*., 2017). This is based on the hypothesis that heavier fish of a particular length are in a better physiological condition. Condition factor also a useful index for monitoring feeding intensity, age, and growth rates in fish (Ujjania *et al*., 2012).

Oreochromis niloticus (O. niloticus) popularly known as Nile tilapia is a popular fish species of the tropics besides being one of the world's most important food fishes. Due to its hardy nature, and its wide range of trophic and ecological adaptations, it has been widely introduced for aquaculture, augmentation of capture fisheries and sport fishing (Raj *et al*., 2016; Keyombe

et al., 2017).This study was carried out with the aim of assessing the length-weight relationship and condition factor of *O. niloticus* from Wasai Reservoir in Kano State. This will be useful for sustainable management of *O. niloticus* fisheries resources.

MATERIALS AND METHODS

Study Area

Wasai reservoir is located in Kano state. It is about 20km northeast of the state capital, Kano. It shares boundaries with three local government Areas namely; Minjibir, Gezawa and Ungogo. It is located at (12º10′ 42′′N) and (8º39′33′′ E) of the equator with total of Area of about 416 km as shown in Figure 1.

Study Sites

The present study was coducted in three sites selected from the study area i.e. Wasai reservoir labeled as site A (Kundima), Site B (Dinga) and Site C (Ungulaye).

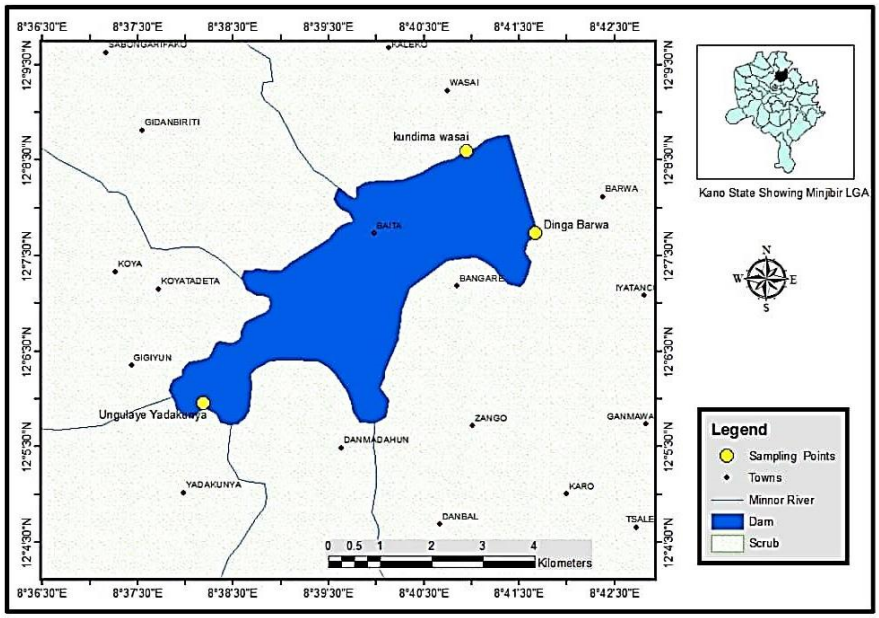

Figure 1: Map of the Study Area showing the Sampling Sites

Sampling of Fish

Fresh samples of *O. niloticus* were obtained directly from local fishermen in the study area. Individual fishes were caught using nets, traps, and hooks and were immediately transported in ice cooler to the laboratory of Biological Sciences Department, Bayero University, Kano for further analyses. Thirty (30) fish samples were collected from each sampling site of the study area. A total of 90 samples were studied.

Fish Identification

The sampled fish were identified in the laboratory up to the specie level with the aid of pictures and standard reference texts of Holden and Reed (1972), Idodo-Umeh (2003) and Olasebikan and Raji (2004) and fisheries experts in the department.

Body Measurements

The total length (TL) and standard length (SL) of the fish were measured in centimeter (cm) using measuring board. TL was measured from the snout to the extreme end of the caudal fin; SL was measured from the snout to the starting point of caudal fin. The weight (W) of the fish was measured in gram (g) using digital weighing balance (Simon TH-5000).

Data Analysis

The parameter of length-weight relationship (LWR) of the sampled fish were evaluated using the equation $W = aL^b$ (Le Cren, 1951), where W= body weight in g, L= total length in cm, a = constant and b = relative growth coefficient. Logarithmic transformation of the formula ($W = aL^b$) into Log W = Log a + b Log TL was done, while each value of 'a' and 'b' was determined empirically employing common statistics. Whereas condition factor (K) was computed using the formula: $K=100W/L^3$, where, W= observed body weight (g), L = total length (cm) (Amin, 2001; Zorica *et al*., 2006). Variations of K between the sites were quantified using one way ANOVA (Mahmood *et al*., 2012). All statistical analyses were performed using Microsoft Excel, MINITAB version 17 and SPSS version 22 statistics software.

RESULTS

Size Composition

In this study, a total number of 90 specimens of *O. niloticus* were collected for this investigation. The descriptive statistics are presented in Table 1. Standard length ranged from 11.30 cm to 18.20 cm (mean 13.99 ± 0.17); total length ranged from 13.40 to 19.90 cm (mean 16.54 ± 0.18) and total weight from 35.90 g to 116.50 g (mean 75.00 ± 2.16). There was no significant difference ($p > 0.05$) in SL among the stations, whereas the differences in TL and W among the three stations were statistically significant ($p < 0.05$).

Growth Pattern

Growth pattern for the fish was based on the Length-weight relationship (Figures 2 – 4). The length weight relationship parameters 'a', 'b', coefficient of determination (r^2) and growth pattern of the studied fish are presented in Table 2. The estimated allometric coefficient value (b) of *O. niloticus* in Kundima was estimated to be 3.374; in Dinga it was found to be 2.217 while that of Ungulaye was 1.982. The coefficient (b) indicated that in Kundima the *O. niloticus* have positive allometric growth pattern, while in both Dinga and Ungulaye, it exhibited a negative allometric growth pattern. The value of (r^2) varied from 0.9053 to 0.9243.The length-weight relationship equations were established as LogW = 3.374 LogTL - 2.3157 for Kundima, LogW = 2.2173 LogTL - 0.8178 for Dinga and LogW = 1.982 LogTL - 0.5066 for Ungulaye

Condition factor

The condition factor (K) of *O. niloticus* in the various sampling sites is presented in Table 4. From the results, there was similar trend of fluctuation of K values in both sampling sites. The condition factor ranged from 1.0021 to 1.0117. There was no significant difference in K between the sampling sites ($p < 0.05$).

Table 1: Descriptive Statistics of Body Measurements of *O. niloticus* in the three selected sites

	Kundima (Mean ± SE)	**Dinga (Mean ± SE)**	**Ungulaye (Mean ± SE)**	**F**	**P**
SL	13.62 ± 0.21^{a}	14.23 ± 0.28^{a}	14.12 ± 0.35^{a}	1.281	0.283^{ns}
TL	16.47 ± 0.27^{b}	17.17 ± 0.31^{ab}	15.98 ± 0.34^{a}	3.765	0.027*
W	63.79 ± 3.61^{b}	84.38 ± 3.34^{a}	76.82 ± 3.37^{a}	9.158	0.000**

SL, Standard Length; TL, Total Length; W, Weight; ns, not significant ($p>0.05$); *significant at $p<0.05$; **highly significant $p<0.001$

Table 2: Computed Parameters of Length-Weight Relationship Parameters of *O. niloticus*

Site	**N**	**a**	**b**	**R^2**	**Growth type**	**LWR Equation**
Kundima	30	0.0048	3.374	0.9053	Allometric (+)	LogW = 3.374 LogTL - 2.3157
Dinga	30	0.1521	2.217	0.9243	Allometric (-)	LogW = 2.217 LogTL - 0.8178
Ungulaye	30	0.3114	1.982	0.9061	Allometric (-)	LogW = 1.982 LogTL - 0.5066

Note: N, number of individuals; a, intercept; b, slope; R^2, coefficient of determination; LWR, length-weight relationship.

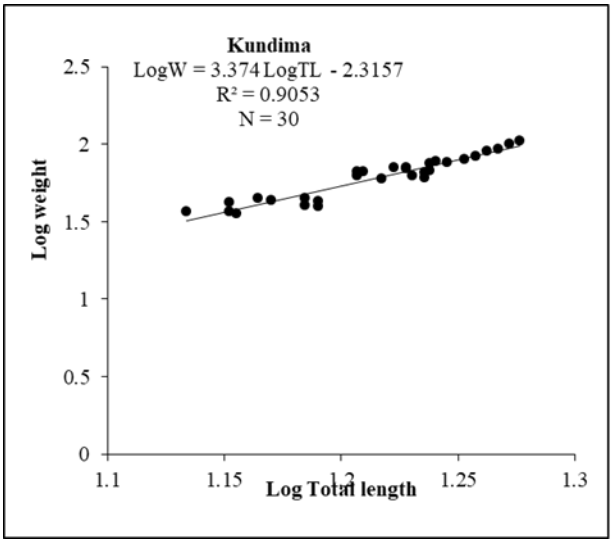

Figure 2: Length-weight relationship of O. niloticus from Kundima

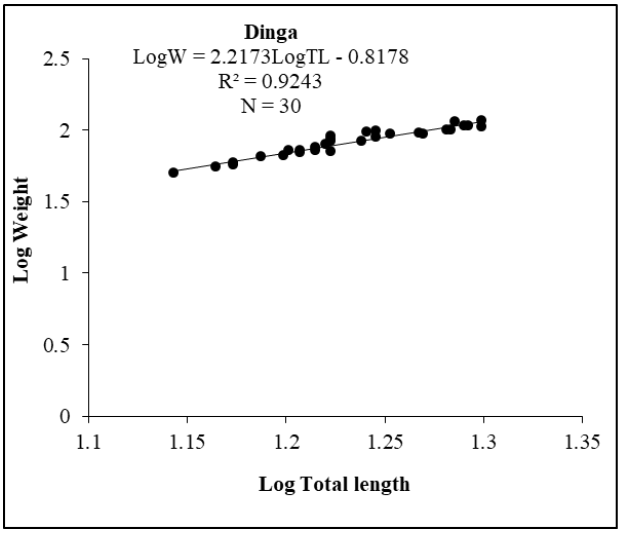

Figure 3: Length-weight relationship of O. niloticus from Dinga

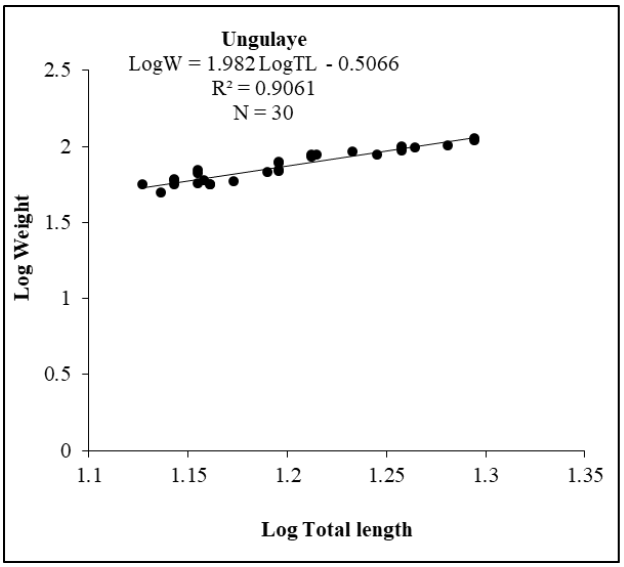

Figure 4: Length-weight relationship of O. niloticus from Ungulaye

Table 4: Compute Parameters of Condition Factor (K) of *O. niloticus* in the three selected sites

Site	N	Mean (K)	SE
Kundima	30	1.0117[a]	0.01785
Dinga	30	1.0021[a]	0.01172
Ungulaye	30	1.0027[a]	0.01352

Means with the same superscript within the column are not significantly different (p>0.05); N = number of individuals, K = condition factor, SE = standard error

DISCUSSION

This study on the size composition, growth pattern and condition factor of *O. niloticus* from Wasai Reservoir. The growth coefficients 'b' of the LWR recorded in this study were within the range of 1.98 to 3.37. Generally, the growth coefficient 'b' lies between 2.50 and 3.50 (Froese and Pauly, 2022). In LWR b-value is used to determine the growth pattern of the fish species, when b is equal to 3 or close to 3, growth in the fish is said to be isometric i.e. fish become more robust with increase in length similarly when b is far less or less than 3, growth is said to be negative allometric i.e. the fish become thinner with increase in length; whereas when b is far more or more than 3, growth is said to be positive allometric i.e. the fish become rounder with increase in length. Furthermore, when b is equal to 3, the fish grow isometric, resulting in the ideal shape of the fish (Kefas *et al*., 2020; Taheri Mirghaed *et al*., 2021; Ali *et al*., 2022). In the present study, the estimated b values were 3.37 for Kundima, 2.22 for Dinga and 1.98 for Ungulaye. The growth of *O. niloticus* in Kundima being positive allometric is in contrast with the value of 1.40 recorded by Imam *et al*. (2010) in Wasai Reservoir. Furthermore, the negative allometric growth recorded in both Dinga and Ungulaye agrees with the negative allometric growth reported for *O. niloticus* by Imam *et al.* (2010). The negative allometric growth reported in the present study match those observed in earlier studies by Getso *et al*. (2017) for *O. niloticus* in Wudil River, Laurat *et al.* (2020) in lower River Benue and Kefas *et al* (2020) in Lake Geriyo The b values for the negative allometric growth reported in the current study were relatively higher than what was reported by Getso *et al*. (2017), Laurat *et al.* (2020) and Kefas *et al* (2020), but were still below the values of 2.5 to 3.5 recorded by Froese and Pauly (2022). However, the values obtained in this study are within the range obtained by Egbal *et a*l. (2011) who reported b value of fish species from Albara River and Khasm El-girba reservoir Sudan to be 2.278 and 3.680. The differences in LWR parameters of *O. niloticus* observed in this study may be due to food supply, food variant as well as the water condition (Siddique *et al.,* 2019). LWR

parameters affected by availability of food, seasonal changes, health condition among others as well as biological and environmental factors (Getso, 2017; Laurat *et al.,* 2019; Taheri Mirghaed *et al*., 2021; Buzhdygan, *et al*., 2022).

The condition factor (K) gives information on the physiological condition of fish in relation to its welfare. It is often used to describe the well-being or condition of fatness of a fish and provides information about physiological state of a fish in relation to some environmental changes (Laurat *et al*., 2019). In the present study there was similar trend of fluctuation of K values in all sampling sites and there was no significant difference in K the sampling sites. All the fish sampled in this study had (K) value greater than 1 and are within the normal range recommended by Ujanial *et al*. (2012) who reported condition factor greater than or equal to1 (≥1) is good, indicating a good level of feeding and suitable environmental condition. The present research is in line with the finding of Oluojo, (2005) who obtained a condition factor of 1.00 for some fish species of Epe lagoon. The finding of this research also contradict with the finding of (Getso *et al.,* 2017) who reported K value range between 0.52-1.00 in *O. niloticus* of Wudil river, Kano. Condition factor is influenced by both biotic and abiotic environmental conditions and can be used as an index to assess the status of the aquatic ecosystem in which the fish live (Anene, 2005; Taheri Mirghaed *et al*., 2021; Buzhdygan *et al*., 2022). Change in condition factor of fishes could be used to interpret various biological factors such as fatness, food availability, reproductive activities and environmental health (Dadzie *et al*., 2000; Laurat *et al*., 2019). Fishes with low factor values are presumably believed to have suffered insufficient nutrition or adverse physical environmental conditions (Getso, 2017; Laurat *et al*., 2019; Buzhdygan, *et al*., 2022). Increase in K values sometimes suggests gonadal development and accumulation of fat (Ahmad *et al*., 2015; Amin *et al*., 2015).

CONCLUSION

O. niloticus in Wasai Reservoir showed both positive and negative allometric growth pattern. The condition factor suggests that the fish lived in a favourable condition for growth. This study contributed to the enhancement of biological data on *O. niloticus*, usable for the fish sustainable management.

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