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ASSESSMENT OF LENGTH-WEIGHT RELATIONSHIPS, CONDITION FACTOR, AND GROWTH PATTERNS OF *Clarias gariepinus* AND *Oreochromis niloticus* IN SABKE RESERVOIR, NIGERIA

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ABSTRACT

Sabke Reservoir in Katsina State, Nigeria, is a crucial water body supporting agriculture, fisheries, and domestic use, but faces increasing ecological stress due to anthropogenic activities, prompting the need to assess its physicochemical status and environmental health. This study investigated the length-weight relationship (LWR), condition factor (K), and growth pattern of two economically important freshwater fish species—*Clarias gariepinus* and *Oreochromis niloticus*—from the Sabke Reservoir, Katsina State, Nigeria, between June and November 2024. A total of 120 specimens (60 per species) were collected and analyzed to determine growth dynamics and physiological condition using standard morphometric methods. Results revealed negative allometric growth in both species, with b-values less than 3 across sexes and combined groups. In *C. gariepinus*, females exhibited a higher b-value (2.18) and condition factor (1.27) than males (b = 1.54; K = 1.15), suggesting better health and consistent growth in females. Similarly, *O. niloticus* demonstrated higher b-values and strong length-weight correlations ($r \approx 0.74–0.75$), with condition factor values exceeding 3.1 for both sexes, indicating excellent physiological status and adaptation to the reservoir environment. Comparatively, *O. niloticus* showed more favorable growth patterns and health indices than *C. gariepinus*. These findings suggest that environmental and biological factors such as food availability, reproductive status, and species-specific traits influence growth and condition. The study highlights the need for continuous monitoring and species-specific management strategies to enhance fishery productivity and sustainability in inland water bodies like Sabke Reservoir.

Keywords: *Clarias gariepinus*, Condition factor, Growth pattern, Length-weight, *Oreochromis niloticus*, Reservoir

INTRODUCTION

The study of the length-weight relationship (LWR) and condition factor (K) provides important biological insights into the growth dynamics, ecological fitness, and health status of fish populations (Froese, 2006). These metrics are essential for effective fisheries management and ecological monitoring. Understanding fish growth dynamics is fundamental for evaluating population health and developing effective fisheries management strategies. The length-weight relationship (LWR) and condition factor (K) are widely used tools in fisheries science to assess individual growth patterns, environmental adaptation, and habitat suitability (Olopade & Ajani, 2021; Eyo & Akinwumi, 2022). These parameters help estimate biomass, monitor ecological stress, and guide conservation planning. *Clarias gariepinus* and *Oreochromis niloticus* are key species in Nigeria's inland fisheries due to their economic value and ecological roles (Ibrahim *et al*., 2020). However, environmental variations, pollution, and overexploitation can significantly alter their growth and condition, especially in vulnerable water bodies like reservoirs (Aliyu *et al*., 2018; Yakubu *et al*., 2019). This study investigates these growth metrics in the Sabke Reservoir, a critical resource in Katsina State, to inform sustainable management and ecological monitoring.

Monitoring length-weight relationships (LWR) and condition factors (K) has become increasingly important for assessing fish population health, especially under the growing pressures of environmental change and overfishing (Yakubu *et al*., 2019; Olopade & Ajani, 2021). These parameters offer insight into growth efficiency, resource utilization, and the overall well-being of aquatic species in specific ecosystems. *Clarias gariepinus* and *Oreochromis niloticus* are widely cultured and harvested in Nigeria due to their adaptability and economic value (Ibrahim *et al*., 2020). However, their growth and condition can be strongly influenced by localized environmental variables such as water quality, nutrient availability, and anthropogenic stressors (Aliyu *et al*., 2018; Eyo & Akinwumi, 2022). In light of this, current data from reservoirs like Sabke are critical for understanding ecological trends and formulating sustainable fishery management strategies. Hence, this study evaluated the length-weight relationship, condition factor, and growth patterns of *Clarias gariepinus* and *Oreochromis niloticus* in Sabke Reservoir, Katsina State, Nigeria in order to inform sustainable fisheries management and ecological monitoring strategies.

MATERIALS AND METHODS

Study Area

The study was conducted at Sabke Reservoir, located between latitudes 12°57'30" and 13°05' North, and longitudes 8°11'00" and 8°14'00" East, at an elevation of 451 meters above sea level (Figure 1). The reservoir is situated approximately 35 km northwest of Daura in Katsina State (Bala & Abdullahi, 2011; Suleiman & Rabi'u, 2024). It was created by damming two primary seasonal rivers, Bulbula on the eastern bank and Babbar Ruga on the western bank, which flow through the Mai'adua and Mashi Local Government Areas, respectively (Bala & Abdullahi, 2011; Suleiman & Rabi'u, 2024). These

rivers are further supplemented by smaller streams from both Local Government Areas and spillovers from the nearby Daberam Dam, which is located in the Daura and Dutsi LGAs. Sabke Reservoir has an active water storage capacity of 31.60 million cubic meters, with a flood storage capacity of 56 million cubic meters (Suleiman & Rabi'u, 2024). During the dry season, approximately 1,000 hectares of land are utilized for farming, with surface lift irrigation systems in place (Zango & Rafindadi, 2015; Suleiman & Rabi'u, 2024). The area primarily supports the cultivation of vegetables, while fishing and domestic activities also contribute to the uses of the reservoir (Suleiman & Rabi'u, 2024).

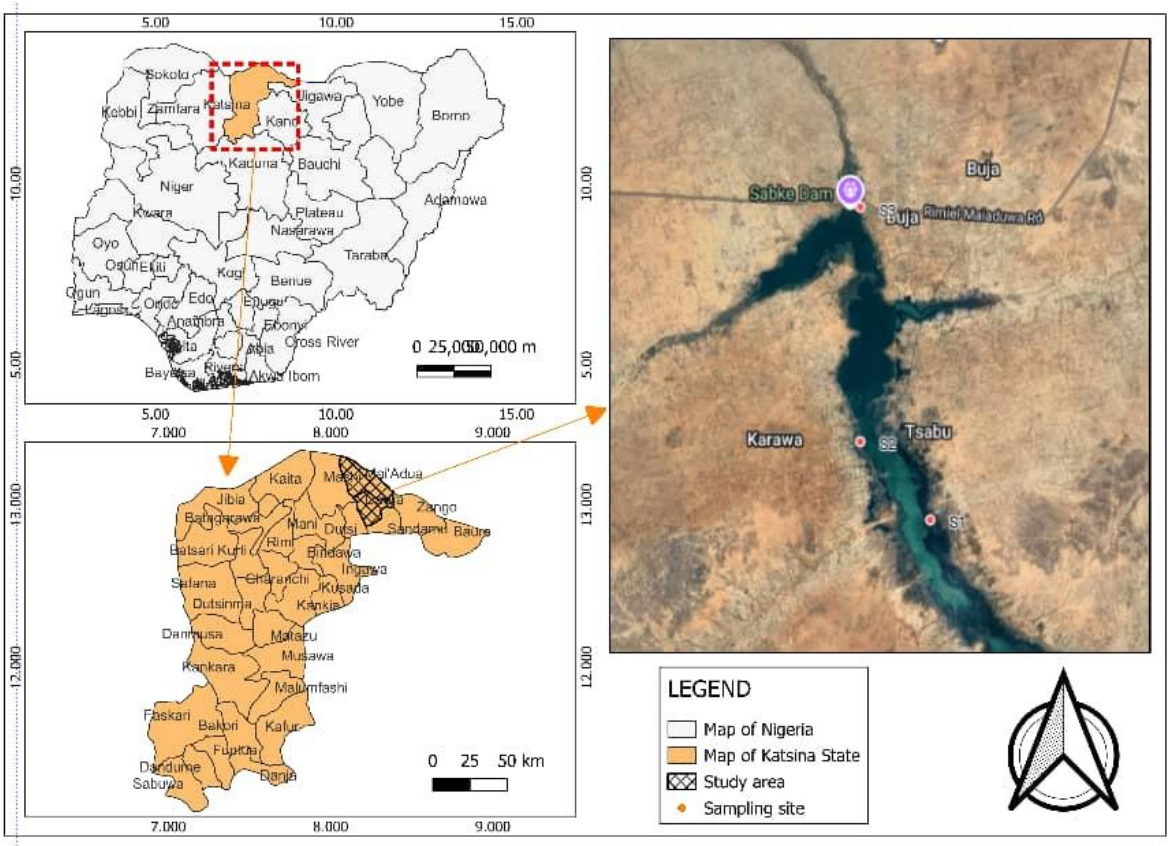

Figure 1: Map of Sabke Reservoir, Showing the Sampling Locations

Fish Collection

Fish samples were collected twice in a month from the catches of artisanal fishermen, who employed various fishing methods including traps, longlines, and nets of different mesh sizes at designated fish landing sites between June to November 2024. The fish were then transported to the laboratory in ice-filled boxes for subsequent analysis. In the laboratory, fish species were identified using the identification guides by Holden and Reed (1972) and Olaosebikan and Raji (2004).

Morphometric Data Collection

The weight of each fish was recorded using a digital weighing balance (Model: SF-802 digital scale), while the length was measured using a standardized measuring board.

Length-Weight Relationship, Condition Factor, and Growth Pattern

The length-weight data analysis is conducted to establish a mathematical relationship between the length and weight of fish, allowing for the conversion of one measurement to the other. It also helps in assessing how an individual fish's weight deviates from what is expected for its length. The calculations were performed separately for male and female fish, as well as combined, using the standard formula outlined by Le-Cren (1951) and referenced in Dan-Kishiya (2013) as:

$W = aL$ (1)

Before carrying out the calculations, the data and equation (1) were converted into logarithmic form, resulting in the transformed equation:

$\log W = \log a + b \log L$ (2)

Where:

W = weight of the fish in grams

L = total length of the fish in centimeters

a = constant

b = exponent

The condition factor (K) was calculated to assess the general well-being or "plumpness" of the fish. It provides an indication of the fish's health and suitability to its environment. A higher condition factor typically reflects better physiological condition. The formula used for computing the condition factor described by Worthington and Richardo (1930) as:

$K = (W/L^3) \times 100$ (3)

Where:

K = condition factor

W = weight of the fish in grams

L = total length of the fish in centimeters

Le -Cren (1951). This formula assumes a cubic relationship between weight and length, and it helps compare the condition of different groups or populations of fish.

RESULTS AND DISCUSSION

The length-weight relationship (LWR) and condition factor (K) analyses for *Clarias gariepinus* revealed negative allometric growth across all groups (b < 3), indicating that these fish grow more in length than in weight (Table 1). This pattern was most pronounced in males (b = 1.54) with a weak correlation coefficient (r = 0.51), suggesting inconsistency in their growth, likely due to biological factors such as maturity stage or environmental stress. Females, on the other hand, showed a higher b-value (2.18) and a stronger correlation (r = 0.82), indicating more predictable and stable growth. The condition factor values (K) also showed that females (K = 1.27) were in better physiological condition than males (K = 1.15), suggesting sex-based differences in energy allocation, possibly related to reproduction or foraging behaviour.

Figures 2 to 5 support these findings, with female and combined LWR plots showing stronger linearity than males. The condition factor chart (Figure 5) further highlights the better health of females, which may suggest more favorable metabolic or environmental conditions for them within the reservoir.

Table 1: Length-Weight Relationship, Condition Factor, and Growth Pattern of *Clarias graepinus*

Sex	N	Regression Coefficient		Correlation Coefficient r	Condition factor (K)	Growth Pattern
		a	b			
Male	22	0.98	1.54	0.51	1.15	A-
Female	38	0.16	2.18	0.82	1.27	A-
Combined	60	0.21	2.07	0.73	1.23	A-

= Negative allometric growth, N = number samples..

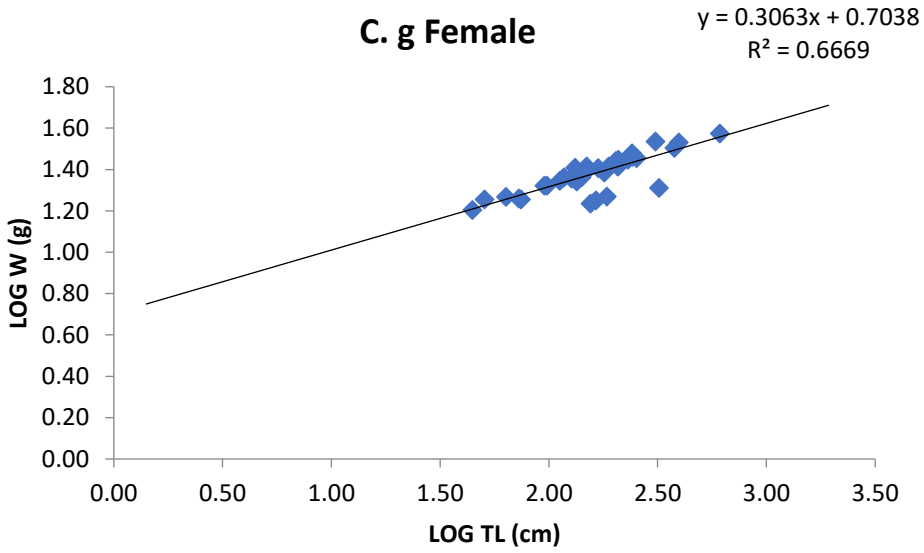

Figure 2: Female LWR of *C.graepinus*

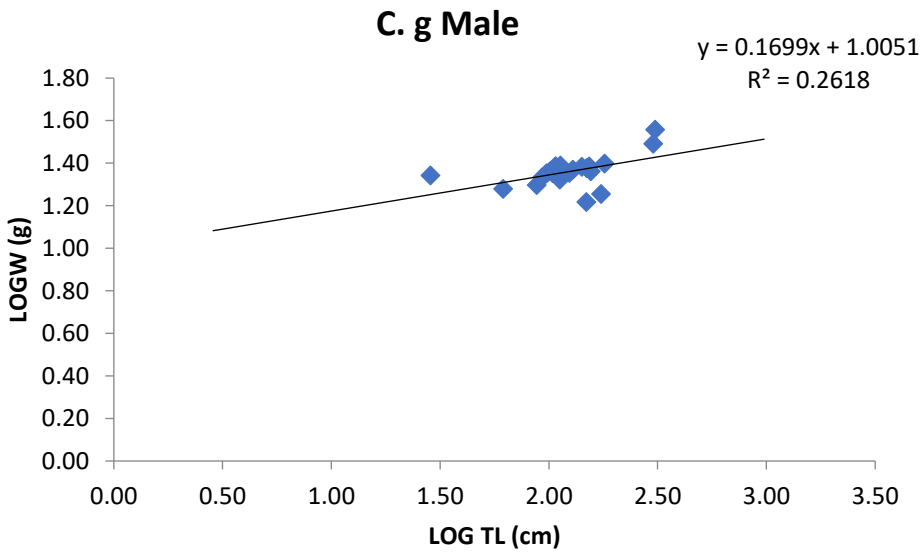

Figure 3: Male LWR of *C.graepinus*

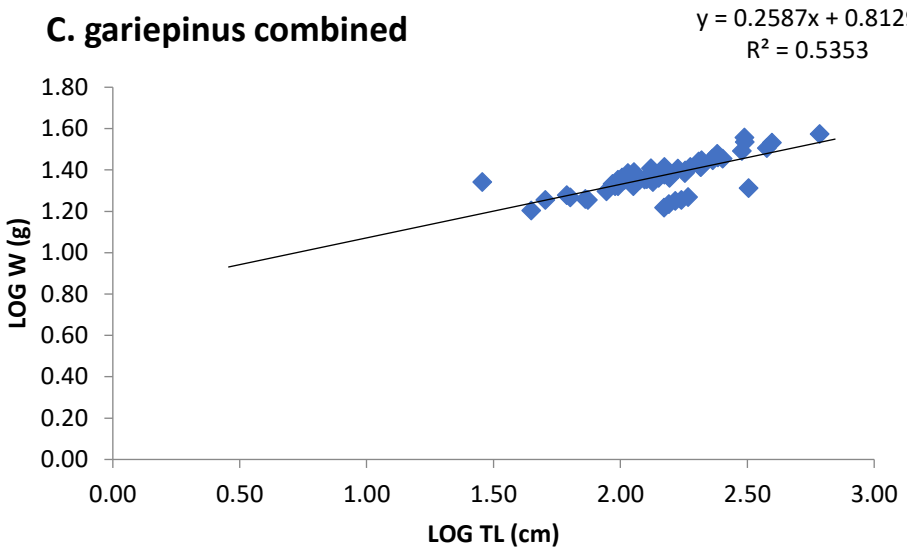

Figure 4: Combined LWR of *C. gariepinus*

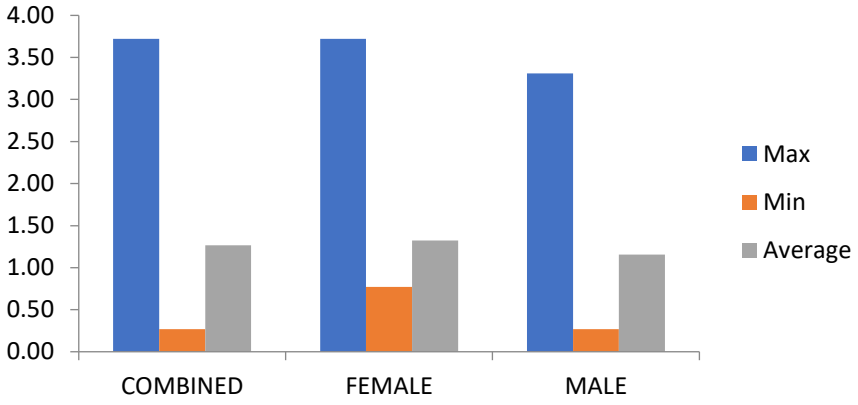

Figure 5: Condition factor of *Clarias gariepinus*

For *Oreochromis niloticus*, all b-values were also below 3, confirming negative allometric growth (Table 2). However, the growth was more consistent across sexes, as reflected in the high correlation coefficients ($r \approx 0.74–0.75$). Notably, *O. niloticus* showed remarkably high condition factor values across all groups ($K > 3.1$), indicating that individuals are in excellent health and well-suited to the reservoir environment. This is likely due to their omnivorous diet and adaptability to varying ecological conditions.

Figures 6 to 9 reinforce these observations, with LWR plots showing strong linear relationships and Figure 8 highlighting the high condition factor of *O. niloticus*. Overall, this species appears to be thriving more successfully than *C. gariepinus*, suggesting its ecological advantage in Sabke Reservoir and highlighting the need for targeted management strategies that consider species-specific responses to environmental conditions

Table 2: Parameters of length-weight relationship and condition factor for *Oreochromis niloticus* from Sabke reservoir

Sex	N	Regression Coefficient		Correlation Coefficient r	Condition factor (K)	Growth Pattern
		a	b			
Male	15	2.29371	1.5	0.742	3.193	A-
Female	37	1.06572	1.748	0.741	3.162	A-
Combined	60	1.04429	1.759	0.748	3.19	A-

= Negetive Allometry, N = Number of Samples

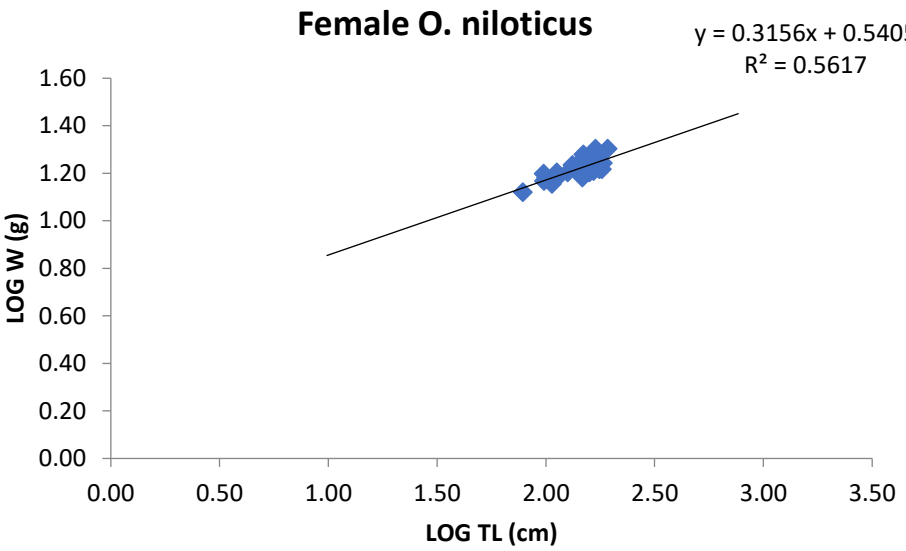

Figure 6: Female LWR of *O. niloticus*

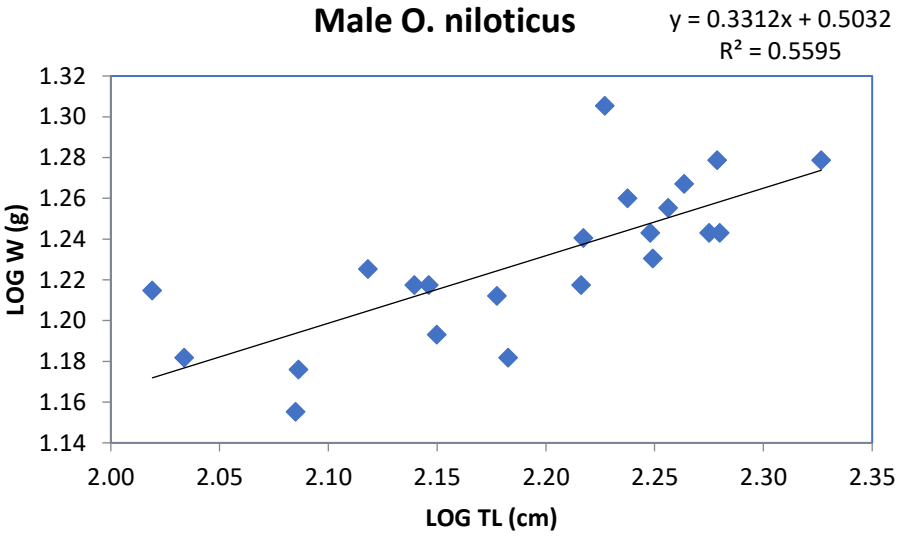

Figure 7: Male LWR of *O.niloticuS*

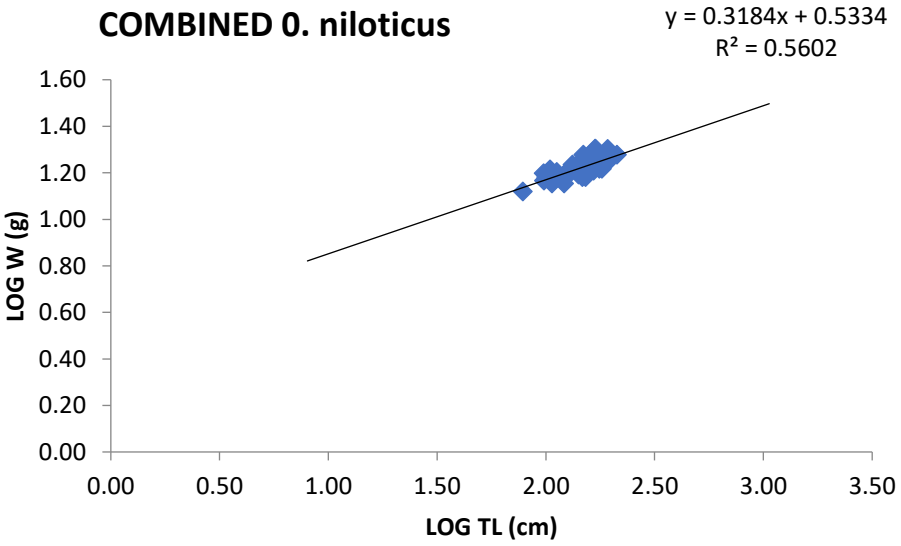

Figure 8: Combined LWR of *O. niloticus*

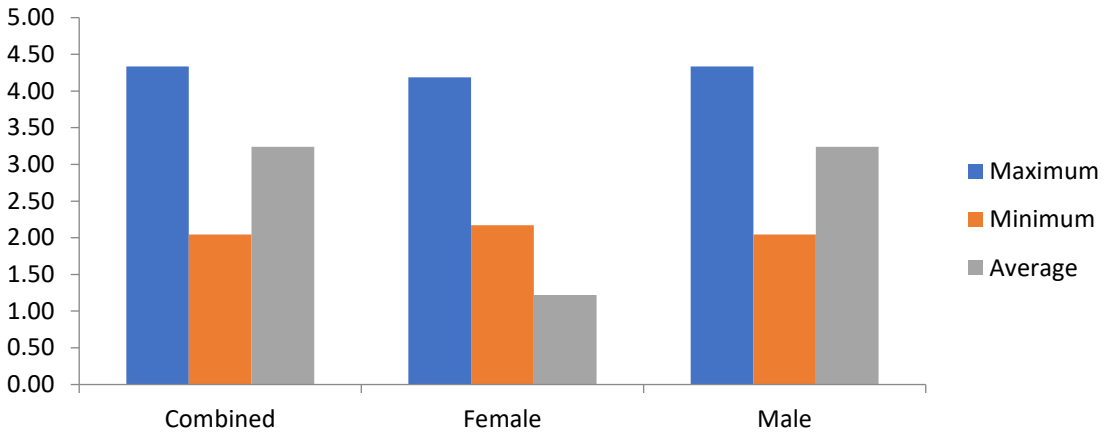

Figure 9*: Oreocrhomis niloticus* Condition Factor

Discussion

The findings from this study indicate a consistent pattern of negative allometric growth (b < 3) in both *Clarias gariepinus* and *Oreochromis niloticus* in Sabke Reservoir, suggesting that these fish grow more in length than in weight. This growth pattern aligns with several recent studies conducted in similar freshwater systems across Nigeria. For instance, Yakubu *et al*. (2019) reported similar growth trends in fish species from Tagwai Dam, Minna, while Ibrahim *et al*. (2020) observed comparable results in northern Nigerian reservoirs. Such growth behaviour is often attributed to suboptimal feeding conditions, high population density, and environmental stressors such as low dissolved oxygen or pollution (Aliyu *et al*., 2018; Olopade & Ajani, 2021).

The higher condition factor (K) values observed in *O. niloticus* (3.193 in males and 3.162 in females) compared to *C. gariepinus* (1.15 in males and 1.27 in females) indicate that *O. niloticus* is better adapted to the reservoir environment. This may be due to its omnivorous diet, more efficient energy utilization, or broader tolerance to environmental fluctuations, as supported by Eyo & Akinwumi (2022) and Olopade & Ajani (2021). The relatively low K values in *C. gariepinus*, particularly among males, suggest poorer energy reserves and possible physiological stress, which could be linked to reproductive status, limited prey availability, or intra-species competition.

Comparative studies also highlight regional differences in growth dynamics. For example, a study by Ekelemu *et al*. (2021) in southern Nigeria reported near-isometric growth in *C. gariepinus*, suggesting that geographic and ecological variations play a significant role in shaping fish growth. This reinforces the importance of localized assessments when making fisheries management decisions.

The implications of these findings are significant for fishery sustainability. Negative allometric growth may reflect a trend toward stunted populations, which could compromise yield and economic viability if not properly managed. Furthermore, the health and growth condition of fish serve as indirect indicators of water quality and habitat integrity. Therefore, maintaining optimal environmental conditions through pollution control, regulation of fishing effort, and habitat restoration becomes essential.

CONCLUSION

This study provides important baseline data on the growth patterns and condition of *Clarias gariepinus* and *Oreochromis niloticus* in Sabke Reservoir. The observed negative allometric growth and variation in condition factors reflect the influence of local environmental factors on fish health. These insights underscore the need for regular ecological monitoring and sustainable management practices to enhance fish productivity and preserve the reservoir's aquatic resources.

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