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COMPARATIVE ASSESSMENT OF LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR OF SOME FISH SPECIES FROM MAIRUA RESERVOIR, KATSINA, NIGERIA

Sadauki, M.A., Bichi, A.H., Umaru, J., and Idris, M. A
Department of Fisheries and Aquaculture, Faculty of Renewable Natural Resources, Federal University Dutsin-Ma, Katsina State, Nigeria
***Email of Corresponding Author:** midris@fudutsinma.edu.ng Tel. 08069220805

ABSTRACT
This study examined the length-weight relationship and (LWRs) and condition factor of three economically important freshwater fish species from Mairua reservoir, Funtua, Katsina, Nigeria, namely Clarias gariepinus, Bagrus bayad and Oreochromis niloticus. In total, 486 specimens of all three fish species were collected from three landing site of the reservoir from June 2024 to November 2025. The fish were identified and separated before being transported alive to the Fisheries and Aquaculture laboratory of the Federal University Dutsin-Ma, Katsina State. At the laboratory, the length was measured to the nearest centimeter using a ruler while a sensitive weighing scale was used to measure the weight in grams. The results showed that all the three species have a negative allometric growth but C. gariepinus have the highest b-value (2.76) followed by O. niloticus (2.07) and lastly B. bayad (1.228). There is no significant difference in the mean body weight among the species (P = 0.640). More so, O. niloticus (1.88 ± 0.54) have significantly higher condition factor, followed by B. bayad (1.40 ± 1.25) while C. gariepinus has the lowest K value, (0.77 ± 0.56) with a p value of P= 0.01. Major fish species of Mairua reservoir are experiencing inadequate nutrition, adverse environmental conditions and poor physiological conditions leading to very low reproduction rate of the fishes and in turn halt fishing activity of the area. Therefore, there may be need for the water quality parameters analysis of both the water and soil basement of Mairua reservoir, Funtua, Katsina State, Nigeria.

Keywords: Condition factor, growth pattern, length-weight relationship, Mairua reservoir, Fish species

1.0 INTRODUCTION
The study of fisheries biology necessitates knowledge of the length-weight relationship and condition factor (K) of fishes; it is crucial to obtain the link between total length and other body weight in order to stabilize the taxonomic characteristics of the species (Sadauki *et al.,* 2024). Fish are vital to a country's development because they are a major source of essential nutrients, including high-quality protein and lipids (macronutrients) as well as vitamins and minerals (micronutrients) (FAO, 2020; Zakiya and Ahmed, 2025). The application of length and weight analysis in fish biology is significant since it is used to evaluate fish growth. This approach is frequently quicker and more practical than weighing each fish separately. It gives information about the health and life cycle changes of fish. Length-weight connections vary with life cycle events such as growth, metamorphosis, and the commencement of maturity, just as other morphometric characteristics (Nandita *et al.,* 2024). According to Abubakar *et al.* (2024), growth is an irreversible increase in the dry mass of biological matter and a basic characteristic of all living things. Therefore, a comprehensive understanding of the length-weight connection is essential for the effective management of fishery resources, including fish species (Sadauki *et al.,* 2023). This relationship is crucial because it enables the estimation of individual well-being, the measurement of average fish weight within a certain length group, and the determination of variation among distinct units of fish stocks belonging to the same species (Getso *et al.,* 2017). Additionally, this relationship is helpful for comparative growth studies in fisheries management (Sadauki *et al.,* 2023; Sadauki *et al.,* 2024). Length-weight relationship provides useful information on the aquatic medium and also aquatic ecosystems modelling (Sadauki *et al.,* 2023). Additionally, the importance of condition factor in determination and comparison of living condition, fatness or wellbeing of fish species has been reported by (Sadauki *et al.,* 2023). A helpful indicator for monitoring fish growth rates, age, and feeding intensity is the condition factor (Sadauki *et al*., 2023; Sadauki *et al.,* 2024). It can be used to evaluate the condition of an aquatic ecosystem and is

heavily impacted by both biotic and abiotic environmental elements (Sadauki *et al.,* 2023). Furthermore, LWRs can be used to differentiate small taxonomic units, as population level variations often occur across different localities (Zakiya *et al.,* 2024; Zakiya and Ahmed, 2025). To evaluate the health or condition of individual fish, estimate biomass from length data, convert length-based growth models into weight-based models for stock assessments, and compare biometric and morphological traits across species or populations from various geographic regions or time periods, fisheries researchers heavily rely on LWR parameters ('a' and 'b') (Zakiya and Ahmed, 2025). These parameters similarly shed light on reproductive biology, stock composition, mortality, longevity, maturation, and general fishery management approaches (Lubich *et al.,* 2021; Zakiya and Ahmed, 2025). Fish length-to-weight ratios are generally recognized as essential instruments in fisheries science, especially in the ecology of population dynamics and resource management, according to Salele *et al*. (2023). Length-weight ratios are essential tools in fish biology, ecology, physiology, assessment, and conservation (Dambatta *et al.,* 2021; Salele *et al.,* 2023). The length-weight relationship is widely used in aquatic biology to determine growth features associated with length measures and to convert length measurements into weight (Prem *et al.,* 2022; Salele *et al.,* 2023). Numerous factors, such as fish sex, species, maturity stage, and season, might contribute to variation in condition parameters (Famoofo and Abdul, 2020). In ichthyological investigations, the condition factor (K) is used to compare the "condition" of fish, such as whether they are healthy or fat (Salele *et al.,* 2023). There is lack of available information on length-weight relationship and condition factor (K) of *C. gariepinus*, *B. bayad*, and *O. niloticus* in the study area. This scarcity of species-specific data poses challenges for developing effective management and conservation strategies. To address this gap, the present study was carried out with the aim of assessing the growth pattern of the three species of fish inhabiting the Mairua reservoir in Funtua, Katsina, Nigeria. The results will offer crucial baseline data to support sustainable fisheries management and conservation efforts, aiding to the sustainable exploitation and protection of these species.

2.0 Material and Methods

2.1 Study area

Mairua Reservoir is situated approximately 733 meters above sea level in the Funtua Local Government Area of Katsina State, between latitudes 11º34'N and latitude 11º36' 0 N of the equator and longitudes 7º14'E and 7º15'E of the Greenwich meridian. The reservoir cuts across farmlands, residential and industrial areas with several farmlands and commercial activities taken place along its bank with both residential and municipal wastes is dumped into the reservoir (Sadauki *et al.,* 2024). The Mairua reservoir falls under the Northern-Guinea Savannah Zone, with a vegetation consisting of broad-leaved species with tall tussock grasses of guinea affinities mixed up with fine-leaved species of thorny trees with continuous short and feathery grass cover (Sadauki *et al.,* 2024).

2.2 Sample Collection and Identification of fish samples

A total of four hundred and eighty-six (486) fish species comprising three (3) species (*C. gariepinus*, *B. bayad*, and *O. niloticus*), were collected randomly from three different landing sites or stations from the selected study areas namely, locations A, B, and C from June 2024 to November 2025, using nets of varying mesh sizes (25mm-100mm), hook and lines, traps, cast the net as well as gill net. The experimental live fish samples were transported alive to the Fisheries and Aquaculture laboratory of the Federal University Dutsin-Ma, Katsina State, in a plastic vessel filled with water for identification and examination as describe by Sadauki *et al.* (2022). *C. gariepinus, B. bayad, and O. niloticus* were identified based on the description of Olaosebikan and Raji (2013).

2.3 Determination of the Sex, length and Weigh of Fish

The sexes of the *C. gariepinus*, *B. bayad*, and *O. niloticus* were determined through physical inspection of the urinary system. Males are long or swollen, whereas females become round and reddish as adults. Visual observation of the male gonads and female ovaries is confirmation (Sadauki *et al.*, 2022).

2.4 Length-weight relationship Determination
The length-weight relationship of the fish samples was determined using the conventional formula described by Froese (2006) as applied by Sadauki *et al.* (2023); Abubakar *et al* (2024); Sadauki *et al.* (2024); Dauda *et al.* (2025):

$W = aLb$

Where: W = weight of fish in grams L = length of fish in centimetres a = exponent describing the rate of change of weight with length (the intercept of the regression line on the Y-axis) b = the slope of the regression line (also referred to as the allometric coefficient). To determine the relationship, the equation and data were logarithmically transformed:

$\text{Log } W = \log a + b \text{ Log } L$

Where: W = weight of fish in grams L = length of fish in centimetres a = constant b = exponent

2.5 Condition factor Determination
The condition factor (K) of individual fish was determined using the conventional formula fulton's condition factor as described by Abubakar *et al*. (2024); Sadauki *et al*. (2024); Dauda *et al*. (2025); $K = (W \times 100) / L^3$

Where: K = condition factor W = weight of fish in grams L = length of fish in centimetres

2.6 Data analysis
The data for length, weight and condition factor were presented using mean±standard error. The length-weight relationship was evaluated using linear regression analysis and the slope of the regression was taken as the growth exponent (b). All the analysis was done using IBM SPSS version 27.

3.0 RESULTS AND DISCUSSIONS

3.1 Results

Table 1 compares three fish species (*B. bayad*, *C. gariepinus*, and *O. niloticus*) across three parameters: Total Length (cm), Body Weight (g) and Condition Factor (K). Each value is presented as mean ± standard error (SE). *B. bayad* (27.33 ± 4.76) have significantly higher Total Length, Followed by *C. gariepinus* (24.99 ± 6.93 cm) and *O. niloticus* (19.19 ± 3.35) is the lowest with a p value of P = 0.00, *B. bayad* has the longest average body length, followed by *C. gariepinus*, and then *O. niloticus*. There is no significant difference in the mean body weight among the species (*P* = 0.640). More so, *O. niloticus* (1.88 ± 0.54) have significantly higher condition factor, followed by *B. bayad* (1.40 ± 1.25) while *C. gariepinus* has the lowest K value, (0.77 ± 0.56) with a p value of P = 0.00.

Table 1: Length, Weight (Mean±SE) and condition factor of some fish species from Mairua reservoir

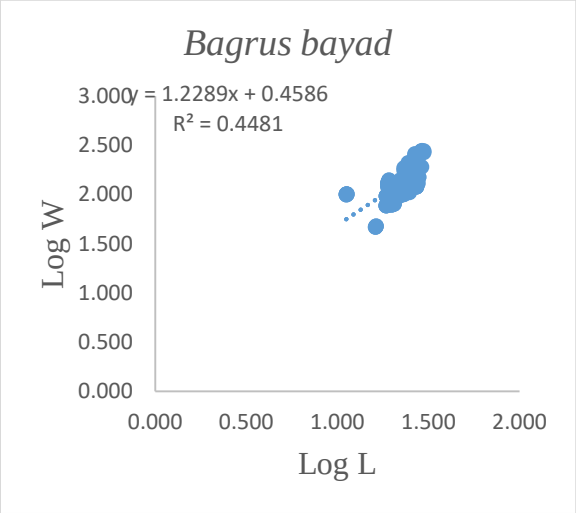
Fish species	Total length (cm)	Weight (g)	Condition factor (K)
Bagrus bayad	27.33±4.76[a]	136.58±49.78	1.40±1.25[b]
Clarias gariepinus	24.99±6.93[b]	138.96±123.54	0.77±0.56[c]
O.niloticus	19.19±3.35[c]	130.83±45.01	1.88±0.54[a]
Fvalue	104.2	0.429	68.05
P	0.00	0.640	0.00

Values with different letters as superscript in each row indicate significant difference (P<0.01).

Table 2 summarizes the Length-Weight Relationship (LWR) of (*B. bayad*, *C. gariepinus*, and *O. niloticus*). All the three species have a negative allometric growth but *C. gariepinus* have the highest b-value (2.76) followed by *O. niloticus* (2.07) and lastly *B. bayad* (1.228).

Table 2: Length- Weight relationship of some fish species from Mairua reservoir

Species	A	B	R^2	Growth type	LWR Equation
B. bayad	0.458	1.228	0.448	Negative Allometric	LogW=1.228LogTL=-0.45
C. gariepinus	1.83	2.76	0.842	Negative Allometric	LogW =2.76Log TL=-1.83
O.niloticus	0.56	2.07	0.91	Negative Allometric	LogW =2.07Log TL=-0.56



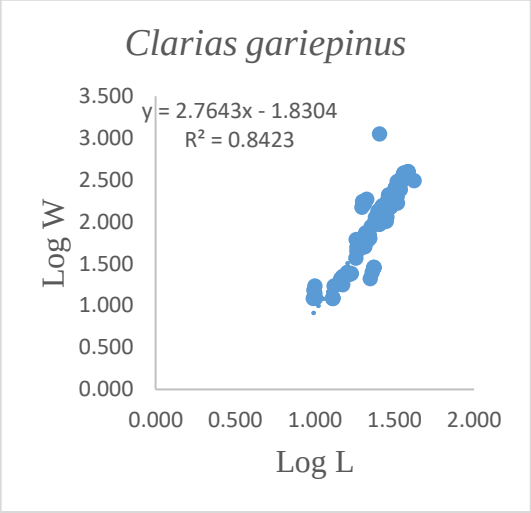


Figure 1: L/W relationship of *B.bayad* from Mairua **Figure 2**: L/W relationship of *C. gariepinus* from Mairua

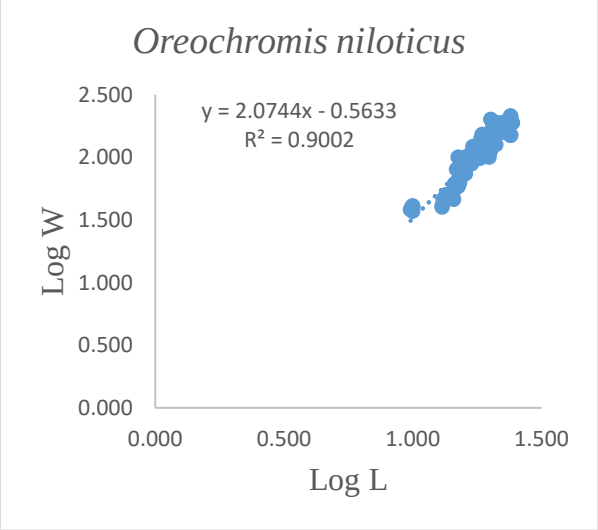


Figure 3: L/W relationship of *O. niloticus* from Mairua

3.2 Discussion

Depending on life history traits, the length-weight relationship varied from species to species. According to Le Cren (1951) and Vu Viet and Tu Hoang (2025), the condition factor represents the health and growth performance of species in connection to the biological and physical changes in environmental elements. The primary determinant of species expansion is thought to be the availability of food (Vu Viet and Tu Hoang, 2025). According to Vu Viet and Tu Hoang (2025), each population's condition factor varies seasonally or annually and is also influenced by the species' life span. The condition factor, a crucial

measure of fish well-being that reflects feeding success, habitat suitability, reproductive status, and general health, is similarly impacted by seasonal variations in temperature and food availability (Sardi *et al.,* 2023; Essa *et al.,* 2025). Fish LWRs provide a valuable indicator for evaluating overall fitness in aquatic environments, and they differ among species due to genetic variables, physiological changes like spawning, and environmental differences (Essa *et al.,* 2025). The growth pattern of the fish species is determined by the b values in length-weight correlations. An ideal fish would typically have an isometric value of 3.0, maintaining dimensional equality. Only a few times has this value been noted. An allometric growth pattern is indicated by a b value of 3.0 or higher. For a given length, a b value less than 3.0 indicates that the fish develop lighter (negative allometric), while a b value more than 3.0 indicates that the fish become heavier (positive allometric) (Sadauki *et al.,* 2024). Fish species from Mairua Reservoir, including *C. gariepinus, O. niloticus*, and *B. bayad*, were studied for their length-weight connection. The results showed a negative allometric pattern of growth. According to the current study, *C. gariepinus* (b = 2.76), *O. niloticus* (b = 2.07), and *B. bayad* (b = 1.228) all showed negative allometric growth, indicate that as they grow, their bodies become more elongated. This implies that weight increases do not correspond with increases in body length. The negative allometric development trend of fish indicated that the rise in body weight was less than the cube of body length, according to Abubakar *et al*. (2024). Negative allometric growth patterns in freshwater fish species were documented by Auta et al. (2025), Dauda *et al*. (2025), Essa *et al*. (2025), Zakiya and Ahmed (2025), Abubakar *et al*. (2024), Salele *et al*. (2023), Kumari *et al*. (2019), and Dan Kishiya *et al*. (2018). According to this survey negative allometric growth can be indicative of environmental stressors or suboptimal feeding conditions. The differences in the correlation coefficient (r^2) could be due to the more linear growth before sexual maturity and more weight increase after sexual maturity. The current investigation discovered that *C. gariepinus* (r = 0.842), *O. niloticus* (r = 0.91), and *B. bayad* (r = 0.448). The coefficient of determination r^2 for length-weight relationship was high for *O. niloticus* and for *C. gariepinus*, indicating that the length increased with increase in weight of fish at the reservoir. These results is in good agreement with the finding of previous researchers (Getso *et al*., 2018; Salele *et al*., 2023; Abubakar *et al*., 2024; Essa *et al*., 2025; Auta *et al*., 2025; Dauda *et al*., 2025). In the present investigation, the mean condition factor calculated from the equation $K = 100\ W/L^3$ was 1.40±1.25; 0.77±0.56; and 1.88±0.54 in combined sexes for *B. bayad, C. gariepinus and O. niloticus* respectively. These values are less than those documented by Bagenal and Tesch (1978) (2.9–4.8) for matured fresh water fish. The K values for the three fish species in the present study were found to be inconsistent with the value of 'K' for *C. gariepinus* being < 1.0 while, the 'K' values *B. bayad*, and *O. niloticus* were > 1.0. The results showed that the fish species with 'K' value < 1.0 were not in an ideal physiological condition in the Mairua reservoir in Katsina State North-western Nigeria, on the other hand, fish species with 'K' value > 1.0 indicates that these fish species are in excellent condition. These variations may be due to many environmental and biological variables as well as sampling features, such as size ranges, the number of specimens sampled, etc. A similar finding has been reported by other researchers from different water bodies (Getso *et al.,* 2018; Salele *et al.,* 2023; Abubakar *et al.,* 2024; Zakiya and Ahmed, 2025).

4.0 CONCLUSION AND RECOMMENDATION

4.1 Conclusion

This study provided the first data on the length-weight relationship and condition factor of three commercial fish species in Mairua reservoir, with negative allometric growth observed in three species. The condition factor values of studied species were 1.88 for *O. niloticus* followed by *B. bayad* (1.40) while *C. gariepinus* has the lowest K value, (0.77). The condition factor of the reservoir is not suitable for the growth and development of the fish (*C. gariepinus*). Major fish species of Mairua reservoir are experiencing inadequate nutrition, adverse environmental conditions and poor physiological conditions leading to very low reproduction rate of the fishes and in turn halt fishing activity of the area. Therefore, there may be need for the water quality parameters analysis of both the water and soil basement of Mairua reservoir, Funtua, Katsina State, Nigeria.

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