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SPECIES COMPOSITION, SIZE DISTRIBUTION, CONDITION FACTOR AND GROWTH PATTERN OF CICHLIDS FROM ZOBE RESERVOIR, DUTSIN-MA, KATSINA STATE, NIGERIA.

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ABSTRACT

The species composition, size distribution, condition factor and growth pattern of cichlids from Zobe reservoir Dutsin-Ma, Katsina State was investigated between August and November 2022, with a view to understanding the distribution and well-being of cichlids in the water body. One hundred (100) cichlids were sampled from two (2) major landing sites (Makera and Garhi) of the reservoir, the fish were identified and separated before being transported in an ice box to the laboratory Biology Laboratory of the Federal University Dutsin-ma. 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 four species were identified; *Oreochromis niloticus* (40), *Oreochromis aureus* (21), *Sarotherodon galilaeus* (21) and *Coptodon zilli* (18). The mean total length and weight were significantly higher ($P<0.05$) in *O. niloticus* compared to other species. The least was observed in *O. aureus* although it was not different significantly compared with *C. zilli* and *S. galilaeus.* The condition factor (K) of >1 was obtained in all the species with *O. niloticus* having the highest value of 2.26 which was significantly higher than 1.48 observed in *O. aureus.* All the species showed negative allometric growth, however, *C. Zilli* and *O. aureus* were very close to isometric growth with b values of 2.96 and 2.85 respectively. Although negative allometric growth was observed in all the species, the K values of >1 showed that all the cichlids in the Zobe reservoir are healthy and in good biological condition.

Keywords: Growth pattern, Condition factor, length-weight relationship, Tilapia, Zobe reservoir

INTRODUCTION

Essential amino acids, fatty acids, and micronutrients are some of the many nutrients that fish contribute to a balanced diet. It is crucial for the development of a country as well, as a source of livelihood for many people (Dauda *et al*., 2016; Ubaid *et al*., 2020). According to Ross *et al*. (2003), the inland water fisheries sector has a significant impact on a nation's economy, culture, and diet. In Nigeria, over 65% of fish produced is from artisanal sector mainly from inland fisheries (Dauda *et al*., 2021) with Tilapia as a major family from Nigeria waters. The name "tilapia" refers to about 100 different species of cichlids fish which are mostly freshwater and sometimes brackish water fish that live in ponds, lakes, rivers, and occasionally narrow streams (Dauda *et al*., 2014). They have historically played significant roles in African artisanal fisheries and are gaining importance in aquaculture (Dunz and Schliewen 2013; Dambatta *et al*., 2021; Dauda *et al*., 2022). Tilapia is referred to as a plastic animal because the physical and biological characteristics of its habitat can have a significant impact on its growth and overall development, as it affects many other fish species too (Olurin and Aderibigbe, 2006).

According to Getso *et al*. (2017), fish length-to-weight ratios are widely acknowledged as crucial tools in fisheries science, particularly in the ecology of population dynamics and resource management. In fish biology, ecology, physiology, assessment, and conservation, length-weight ratios are vital instruments (Dambatta *et al*., 2021). In aquatic biology, the length-weight connection is frequently employed to translate length measurements into weight and to find growth traits connected to these variables (Prem *et al.*, 2022). The condition factor shows the level of nutrition and sexual development as well as the relative degree of hardiness or health status of the fish (Dambatta *et al*., 2021). Variability in condition parameters can be caused by a variety of factors, including fish sex, species, maturation stage and season (Famoofo and Abdul, 2020). The condition factor (K) is used in ichthyological studies to compare the "condition" of fish, such as whether it is fat or healthy (Jenyo-Oni- *et al*., 2014). On the principle that heavier fish of a given length is in a better physiological state, the condition Factor was developed. Additionally, it can be used to track fish age, feeding frequency, and growth rate (Ujjania *et al*., 2012). According to Olurin and Aderibigbe (2006), when a fish's length grows in proportion to its weight, this is called isometric growth. The regression coefficient for isometric growth is 3, whereas values higher or lower than 3 indicate allometric growth. Zobe Reservoir is an important deep earth structure in the southern part of the Dutsin-Ma Local Government Area in Katsina State and it is one of the biggest water body in the state. The reservoir was created for irrigation, water supply and power generation. Agricultural wastes and other organic debris which might lead to pollution and affect the well-being of fish are introduced into this reservoir, especially during the wet season (Sadauki *et al*., 2022). Zobe reservoir is abundant in fisheries resources with the tilapia family being the most abundant (Nababa *et al*., 2022), but there is a paucity of information on their well-being, hence this study investigated species composition, size distribution, condition factor and growth pattern of cichlids with with an intent of providing baseline information on the well-being of cichlids in this reservoir.

MATERIALS AND METHODS

Study Area

Zobe reservoir is an earth-fill structure on the coordinates 12°23'18" N (latitude) and 7°28'29" E (longitude) in Dutsin-Ma LGA of Katsina State (Fig 1). The dam has a depth of 48 m, a length of 360 m with a base width of 2,750 m. The reservoir has a storage capacity of 179 Mca, as it is impounded from two major rivers Karaduwa and Gada (Dasuki *et al*., 2014: Sadauki *et al*., 2022). The primary purposes of the dam are the provision of portable drinking water and irrigation, while the secondary purposes are for fishing and other domestic activities.

Sample collection

A total of one hundred (100) Cichlids (Tilapia species) were randomly sampled from (2) two major landing sites (Makera and Garhi) of Zobe reservoir. The samples were transported in an ice box from the landing sites to the Biology laboratory of the Federal University Dutsin-ma. Using the field guide to Nigerian freshwater fish by Olaosebikan and Raji (2013), the specimens were taxonomically identified. Following identification, the fish samples were separated into species, and measurements of length and weight were taken. The length was measured to the nearest centimetre using a ruler while a sensitive weighing scale was used to measure the weight in grams.

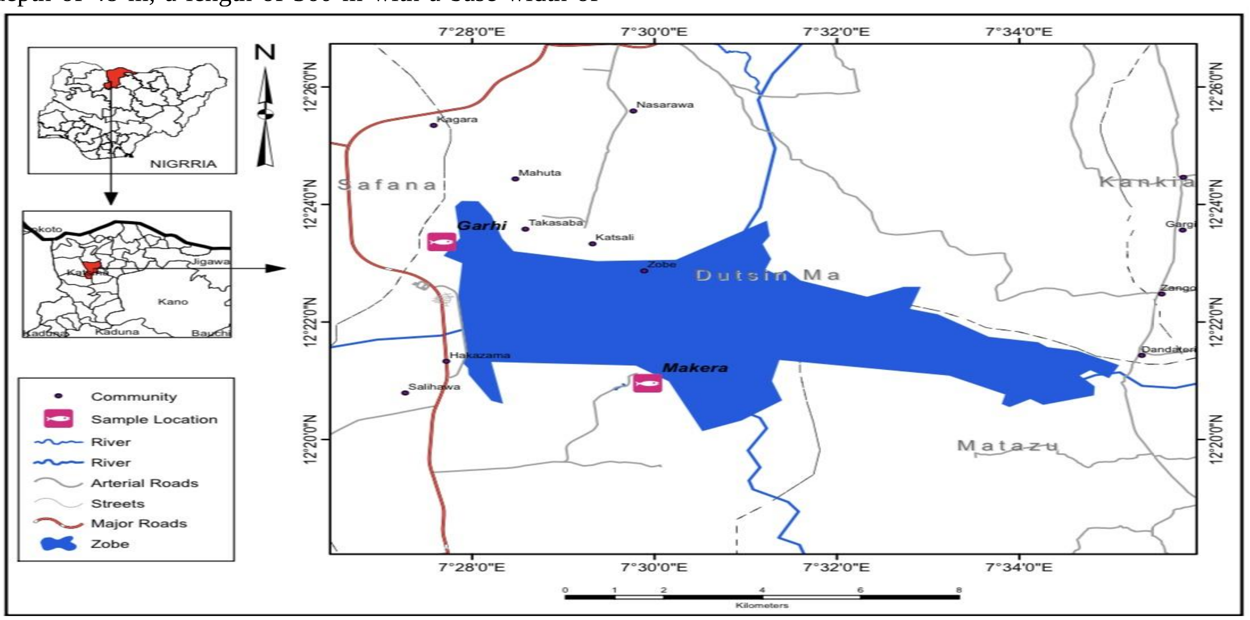

Figure 1: Map of Zobe reservoir showing the sampling stations

Condition factor

The condition factor K was evaluated using Fulton's index as described by Jenyo-Oni *et al*. (2014).

$$K= \frac{W \times 100}{L^3}$$

Where: K=Condition factor; W = Weight of the fish (g); L^3 = cubed Fish's total length (cm)

Growth pattern (Length-weight relationship)

The formula $W= aL^b$ was used to express the relationship between the length (L) and weight (W) of the fish samples (Pauly, 1993). The formula was transformed into a natural logarithmic form

LogW = Loga + bLogL, LogW was regressed against LogL and the slope of the graph (b) gave the growth exponent.

Statistical Analysis

The data for weight, length and condition factor were presented as mean±standard error while analysis of variance (ANOVA) was used to compare the parameters among the identified species and where a significant difference was observed ($P<0.05$), Tukey's HSD test was used as a follow-up test to separate the means. The analysis was carried out with IBM SPSS version 23. The growth exponent was obtained from regression analysis using Microsoft office excel 2016 version.

RESULTS

Composition, Size and Condition Factor of Tilapia

The result of the fish composition is shown in table 1. Four species of cichlids; *Oreochromis aureus*, *Coptodon zilli*, *Sarotherodon galilaeus* and *Oreochromis niloticus* were identified, with *O. niloticus* as the most abundant representing 40% of the sample. The *O. niloticus* had the highest total length and weight, 21.96±0.97 cm and 231.83±26.56 g respectively which were different significantly ($P<0.05$) from all other species (Table 2). The least condition factor (K) was 1.48 in *O. aureus* and it was significantly lower ($P<0.05$) than 2.26 obtained in *O. niloticus*.

Growth pattern

The results of the Length - Weight relationship of the sampled fish species is presented in Table 3 and Figures 2,3,4 and 5. The coefficient of regression (R^2) varied from 0.64 in *O. niloticus* to 0.94 *C. zilli*, the intercept a, also varied from 0.64 in *O. niloticus* to 1.69 in *O. aureus while* the growth exponent b, varied from 1.85 in *O. niloticus* to 2.96 in *C. zilli*. All the fish species had negative allometric growth ($b<3$) although *C. Zilli* and *O. aureus* were very close to isometric growth patterns.

Table 1: Composition of Tilapia species in Zobe reservoir

Fish species	Abundance	Percentage
Oreochromis aureus	21	21
Coptodon Zilli	18	18
Sarotherodon galilaeus	21	21
Oreochromis niloticus	40	40
Total	**100**	**100**

Table 2: Size composition (Mean±SE) **and condition factor of Tilapia species from Zobe reservoir**

Fish species	Total length (cm)	Weight (g)	Condition factor (K)
Oreochromis aureus	$8.97±0.52^{b}$	$12.11±1.92^{b}$	$1.48±0.07^{b}$
Coptodon Zilli	$9.46±0.71^{b}$	$20.99±4.55^{b}$	$1.98±0.14^{ab}$
Sarotherodon galilaeus	$10.20±1.27^{b}$	$26.51±6.72^{b}$	$1.96±0.20^{ab}$
Oreochromis niloticus	$21.96±0.97^{a}$	$231.83±26.56^{a}$	$2.26±0.31^{a}$
Fvalue	46.49	58.15	3.61
P	0.00	0.00	0.05

Values with different letters as superscripts in each column indicate significant differences ($P<0.05$).

Table 3: Length- Weight relationship of Tilapia species from Zobe reservoir

Species	**A**	**B**	R^2	**Growth type**	**LWR Equation**
O. aureus	1.69	2.85	0.92	Negative Allometric	LogW = 2.8482LogTL − 1.6942
C.zilli	1.67	2.96	0.94	Negative Allometric	LogW = 2.9571Log TL − 1.6747
S. galileaus	1.24	2.47	0.90	Negative Allometric	LogW = 2.4731Log TL −1.2432
O. niloticus	0.64	1.85	0.64	Negative Allometric	LogW =1.845 Log TL − 0.1403

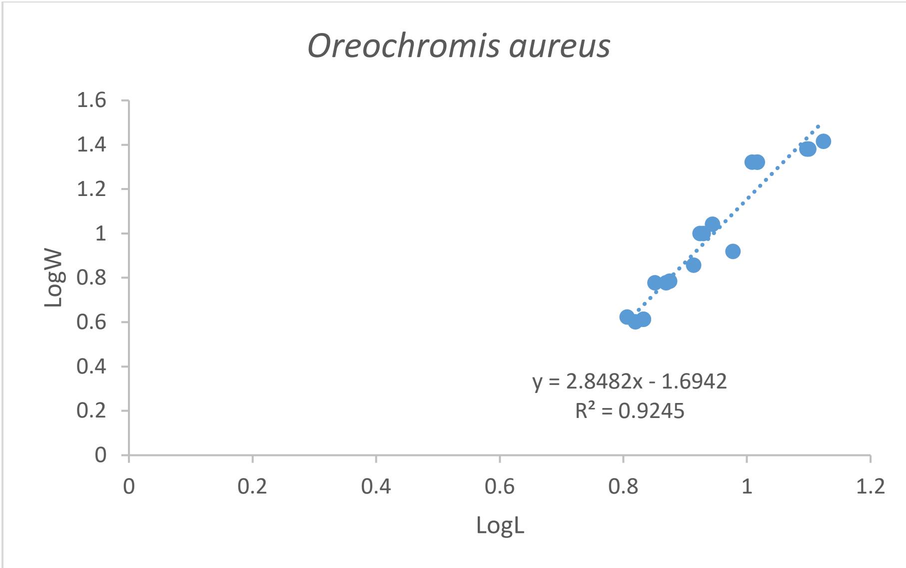

Figure 2: Length- Weight relationship of *Oreochromis aureus* from Zobe reservoir

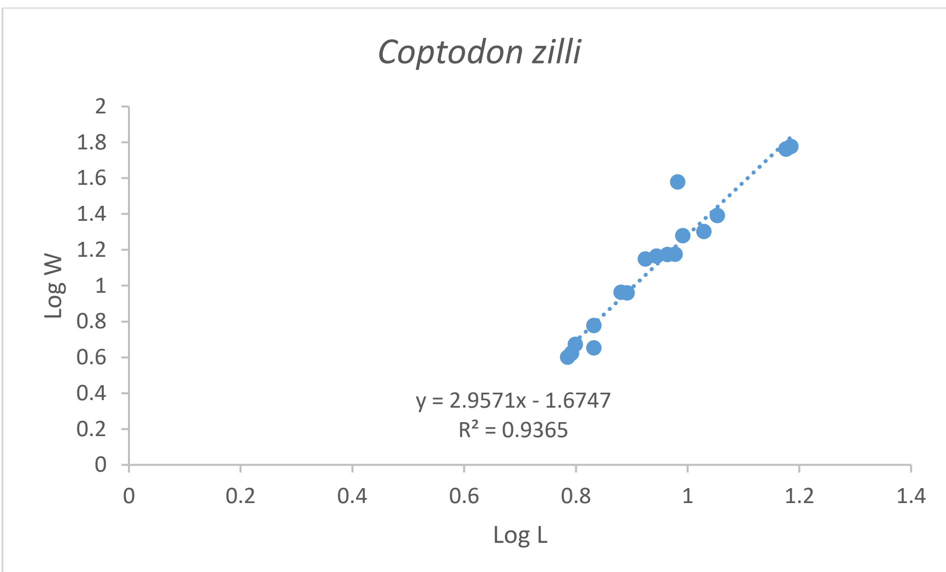

Figure 3: Length- Weight relationship of *Coptodon zilli* from Zobe reservoir

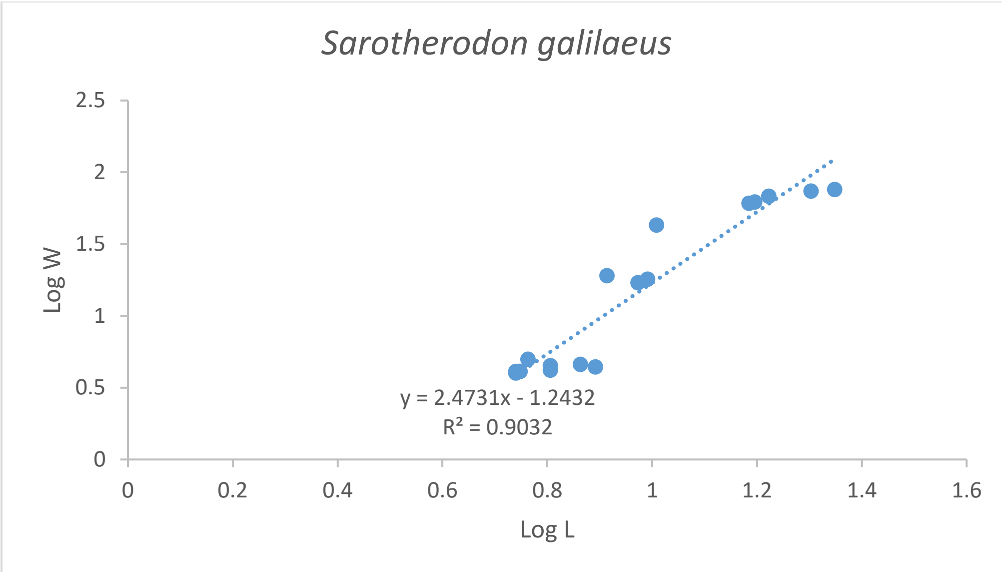

Figure 4: Length- Weight relationship of *Sarotherodon galilaues* from Zobe reservoir

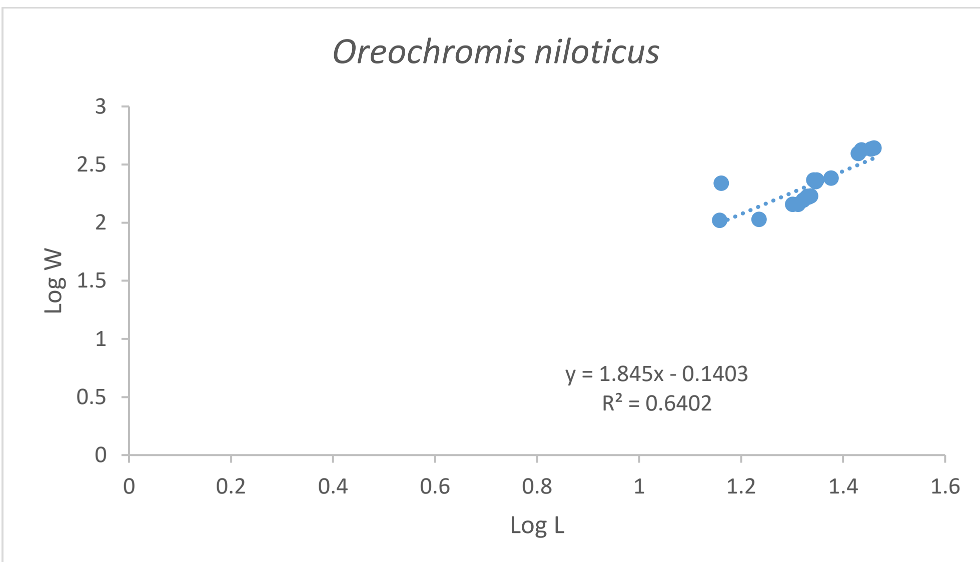

Figure 5 : Length- Weight relationship of *Oreochromis* niloticus from Zobe reservoir

DISCUSSION

In this study, *Oreochromis niloticus* is the most dominant species among the cichlids (Cichlidae) in the Zobe reservoir. This agrees with the findings of Ahmad *et al.* (2014) and Nababa *et al.* (2022) who also reported *Oreochromis niloticus* to have the highest number of individuals among the cichlids in the Zobe reservoir. The dominance of *O. niloticus* is not surprising as it has been noted to be the most important species from the family and it is also very important to the aquaculture sector (Dauda *et al.*, 2014). This might be due to its ability to grow fast and tolerate adverse condition compared to other species in the family. The size distribution of the Tilapia species in the study area showed *Orechromis niloticus* to be the biggest and *Oreochromis aureus* as the smallest of all the four species observed. The fast growth rate of *O.niloticus* observed compared to other cichlids has been one of the reasons why it is a choice species for aquaculture (Dauda *et al.*, 2014) . This finding is similar to that of Popoola *et al.* (2022) in Jos, where *O. aureus* was the smallest among the cichlids found. Damabtta *et al*., (2021) also reported a similar size range for O. *niloticus* in Wudil River, Kano State, Nigeria.

The use of biological indices in stock assessment is crucial because they allow for the estimation of stock biomass and the comparison of fish populations across different geographical areas. Such knowledge might improve fish species management, conservation, and culture (Jenyo-Oni *et al*., 2014). According to Fafioye and Ayodele (2018), the length-weight relationship (LWR) is a crucial tool for learning about animal growth patterns and development. The growth coefficient or *b* value is used to determine the growth pattern of fish. The length-weight relationship of sampled fish species showed a negative allometric growth pattern having b values of less than 3.0 ranging from *Coptodon zilli* (2.96) to *Oreochromis niloticus* (1.85). This finding is similar to that of Olufeagba *et al*., (2015) who observed a negative allometric growth pattern in the cichlids species found in Kainji Lake, except *T. zilli* which has a positive allometric growth pattern. This also agrees with the findings of Jenyo-Oni *et al*., (2014), who also found negative allometric growth in two cichlids species *Coptodon zillii and Oreochromis niloticus* found in lower Ogun River wetlands, Lagos, Nigeria. The findings also corroborate with Getso *et al*., (2017) in their study of *Oreochromis niloticus* from Wudil River in Kano, Nigeria. In line with the findings of this study, Soyinka and Ebigbo, (2012); Imam *et al*., (2010) and Niyonkuru and Laleye (2012) reported negative allometric growth for various cichlid fish species from diverse bodies of water. Based on the idea that bigger fish of a certain length are in a better physiological state, the condition factor (K) is a measure of the fish's level of well-being (Atama *et al*., 2013). All the identified cichlids in the Zobe reservoir have K values greater than 1, indicating a good physiological status (Jenyo-Oni *et al*., 2014). The highest value of 2.26±0.31 observed in *O. niloticus* in this study is similar to that reported for *O. niloticus* in Wudil River, Kano State Nigeria by Dambatta *et al*., (2021). The least value observed in *O. aureus* (1.48) is also not a reflection of a bad physiological state, as K value of greater than 1 is generally regarded as good physiological state (Jenyo-Oni *et al*., 2014). This indicated that the condition of the Zobe reservoir is good for all the Tilapia species although, might be more favourable and conducive to *Oreochromis niloticus.* These findings disagree with the findings of Atama *et al*. (2013) who found *Coptodon zilli* to have the best condition factor in Anambra River, Nigeria and Olubunmi *et al*. (2017) who reported *Coptodon zilli* to have the best condition factor among the cichlids in Eleyele Lake, Oyo State Nigeria. As well as Badr El-Bokhty and Fetouh (2023), who reported a higher condition factor for *Oreochromis aureus* from El-Salam Canal, Egypt.

CONCLUSION

The research revealed that there are four speccies of cichlids in Zobe reservoir with *O. niloticus* as the most abundant and the biggest in size, both length and weight. All the observed cichlids have negative allometric pattern, although the *O. aureus* and *C. zilli* are very close to isometric growth pattern. The condition factor was greater than 1 for all the species with *O. niloticus* having the highest condition factor indicating it is the best in terms of wellness in the water body.

REFERENCES

Ahmad, M., Shagari, F.U. and Sani, A.N. (2014). Fish biodiversity and fishing methods of some water bodies in Katsina State of Nigeria. *International Journal of Fisheries and Aquatic Studies* 1(6): 218-221

Atama, C. I., Okeke, O. C., Ekeh, F. N., Ezenwaji, N. E., Onah, I. E., Ivoke, N., Onoja, U. S. and Eyo, J.E. (2013). Length-Weight Relationship and Condition Factor of Six Cichlids (Cichilidae: Perciformis) Species of Anambra River, Nigeria. *Journal of Fisheries and Aquaculture* 4 (2): 82-86.

Dambatta, M.A., Sogbesan, A.O. Dauda A.B. and Haruna M.A. (2021). Length-Weight Relationship and Feeding Habit of *Oreochromis niloticus* in Wudil River, Kano State, Nigeria. *Global Journal of Science Frontier Research:D Agriculture and Veterinary* 21 (2):30-41. https://journalofscience.org/index.php/GJSFR/article/view/2923/2784.

Dasuki A., Dauda A.B., Oshoke J.O., Tiri G.D. And Bichi A.H. (2014): A Survey Of Artisanal Fisheries of Makera Zone of Zobe Reservoir, Katsina State. In: Proceedings, 29th Annual Conference of Fisheries Society of Nigeria (Fison), held between 24th – 29th November 2014 at Royal Choice Inn Ltd, Gondo Aluor Road, Old GRA, Lobi Quarters, Makurdi, Benue State Nigeria, 2-5.

Dauda, A. B., Yakubu, S. O., and Oke, A. O. (2014). Curbing the menace of prolific breeding in "aquatic chicken"(Tilapia): A way out to improve fish production in Nigeria. *New York Science Journal 7*(4): 112-118.

Dauda, A.B., Oladele, A.H. and Elaigwu, A.M. (2016). Awareness of Nutritive Value of Cultured Fish among Inhabitants of Selected Peri-Urban Local Government Areas in Katsina State, Nigeria. *African Journal of Fisheries and Aquatic Resources Management* 1: 61-66

Dauda, A.B. Dogo, M.T. and Abdulkareem H.O. (2021). Socio-economic status of fisherfolks and fishing activities in Dutsin-Ma reservoir, Katsina State, Nigeria. In: Akinrotimi O.A. (edited), Book of Proceedings 36th Annual conference of the Fisheries Society of Nigeria, Garden City 2021, held between 24th and 29th October 2021 at Ebitimi Banigo Auditorium, University of Port Harcourt, Choba Rivers State, 706 - 712.

Dauda, A. B., Ajadi, A., Bashir, Z. and Ikpe, J. (2022). Frequency of Water Change on Growth Performance, Nutrient Utilization and Liver Histology of Nile Tilapia (Oreochromis niloticus, Linnaeus, 1758). *Asian Journal of Fisheries and Aquatic Research*, *16*(2): 42-50. https://doi.org/10.9734/ajfar/2022/v16i230370

Dunz, A. R. and Schliewen, U.K. (2013). Molecular phylogeny and revised classification of the haplotilapiine cichlid fishes formerly referred to as "Tilapia". *Journal of Molecular Phylogenetic Evolution* 68(1):64–80. DOI: https://doi.org/10.1016/j.ympev.2013.03.015

El-Bokhty, E.E.B and Fetouh, M.A. (2023). Some biological aspects of *Oreochromis niloticus* and *Oreochromis aureus* caught by trammel nets from El-Salam Canal, Egypt. *Egyptian Journal of Aquatic Biology & Fisheries* 27 (1): 167 – 177

Fafioye, O. and Ayodele, O. (2018). Length-Weight Relationship and Condition Factor of Four Commercial Fish Species of Oyan Lake, Nigeria. *Examines Marine Biology & Oceanography*. 2 (4):227-230. DOI: https://doi.org/10.31031/EIMBO.2018.02.000543

Famoofo, O. O. and Abdul, W. O. (2020). Biometry, condition factors and length-weight relationships of sixteen fish species in Iwopin fresh-water ecotype of Lekki Lagoon, Ogun State, Southwest Nigeria. *Heliyon* 6 (1) e02957 https://doi.org/10.1016/j.heliyon.2019.e02957

Getso, B.U., Abdullahi, J. M. and Yola, I. A. (2017). Length-weight relationship and condition factor of Clarias gariepinus and Oreochromis niloticus of Wudil River, Kano, Nigeria. *Journal of Tropical Agriculture, Food, Environment and Extension.* 16 (1): 1-4. DOI: https://dx.doi.org/10.4314/as.v16il.1

Imam, T. S., Bala, U., Balarabe, M. L. and Oyeyi, T. I. (2010): Length-Weight relationship and condition Factor of Four Fish Species from Wasai Reservoir in Kano, Nigeria. *African Journal of General Agriculture* 6 (3): 125 - 130

Jenyo-oni, A., Abbas, A. H. and Dauda, A. B. (2014). Investigation of biological condition of fish species in lower Ogun River wetlands, Lagos, Nigeria. *International Journal of Biological and Chemical Science* 8(2):705-710. DOI: http://dx.doi.org/10.4314/ijbcs.v8i2.27

Popoola MO, Schedel FDB, Hebert PD, Schliewen UK. (2022). First DNA barcode library for the ichthyofauna of the Jos Plateau (Nigeria) with comments on potential undescribed fish species. *PeerJ* 10:e13049 https://doi.org/10.7717/peerj.13049

Nababa, A. S., Bichi, A.H. And Sogbesan, O. A . (2022) Itchthyofaunal Composition, Abundance, and Diversity Indices in Zobe Reservoir of Katsina State, Nigeria. UMYU Scientifica. 1 (1): 42 – 48 DOI: https://doi.org/10.56919/usci.1122.007

Olaosebikan. B.D. and Raji. A. (2013). Field Guide to Nigerian Freshwater Fishes. New Bussa, Nigeria: Federal College of Freshwater Fisheries Technology.

Olubunmi, A., Folake, B. A. and Omokhafe, O. I. (2017). Biology of Length- Weight Relationship and Condition Factor of Some Cichlids in Eleyele Lake, Oyo State, Nigeria. *Journal of Fisheries and Aquaculture Development*: JFAD-122. DOI:10.29011/JFAD-122/100022

Olufeagba, S. O., Aladele, S. E., Okomoda, V. T., Sifau, M. O., Ajayi, D.A., Oduoye, O. T., Bolatito, O. A., Nden, D. S., Fabunmi-tolase, A. S. and Hassan. T. (2015). Morphological variation of cichlids from Kainji Lake. *International Journal of Aquaculture* 5(26): 1-10

Olurin, K.B. and Aderibigbe, O. A. (2006). Length-Weight Relationship and Condition Factor of

Pond Reared Juvenile *Oreochromis niloticus*. *Journal of Zoology* 1:82-85.

Pauly, D. (1993). Linear regressions in fisheries research. *Journal of the Fisheries Research Board of Canada*. 30: 409-434.

Prem, K., Kailasam, M., Sundaray, J. K. and Ghoshal, T. K. (2022). Chapter 22 - Sustainable fisheries/aquaculture of Hilsa, *Tenualosa ilisha* in changing and dynamic riverine ecosystem of India and its neighborhood. In: Ecological Significance of River Ecosystems, Elsevier. 455-480. DOI: https://doi.org/10.1016/B978-0-323-85045-2.00010-8.

Ross, N., Islam, M. and Thilsted, S. H. (2003). Small indigenous fish species in Bangladesh: contribution to vitamin A, calcium and iron intakes. *Journal of Nutrition* 133:4021–4026.

Sadauki, M.A., Bichi, A.H., Dauda, A.B. and Geidam, M.B. (2022). Assessment of Water Quality Parameters of Zobe and Ajiwa Reservoirs, Katsina State, Nigeria. *African Scientist* 23: 9 – 18.

Soyinka O. A. and Olufemi O. and Ebigbo C. H. (2012). Species Diversity and Growth Pattern of the fish fauna of Epe Lagoon, Nigeria. *Journal of Fisheries and Aquatic Science* (7) 392-401. DOI: https://doi.org/10.3923/jfas.2012.392.401

Ubaid, Q., Zahoor, M., Shakir, A. M. and Shahid, G. (2020). Health benefits of eating fish National Bureau of Fish Genetic Resources SMART AGRIPOST - FISHERIES:38 - 42

Ujjania, N. C., Kohli, M. P. S., and Sharma, L. L. (2012). Length-weight relationship and condition factors of Indian major carps (*C. catla*, *L. rohita and C. mrigala*) in Mahi Bajaj Sagar, India. *Research Journal of Biology 2*(1): 30-36.

Niyonkuru C. and Lalaye P. A. (2012). A Comparative Ecological Approach of the Length–Weight Relationships and Condition Factor of *Sarotherodon Melanotheron* (Rüppell, 1852) and *Tilapia guineensis* (Bleeker 1862) in Lakes Nokoué and Ahémé (Bénin, West Africa). *International Journal of Business, Humanities and Technology* 2(3): 41–50.