Asian Journal of Research in Zoology

Volume 7, Issue 2, Page 36-41, 2024; Article no.AJRIZ.114036
ISSN: 2582-466X

Size Variation Survey of the Family of Cichlids in Lower River Benue

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJRIZ/2024/v7i2147

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/114036

Original Research Article

Received: 01/01/2024
Accepted: 05/03/2024
Published: 26/03/2024

ABSTRACT

This study was designed to determine the size variations of the family of Cichlids in lower river Benue. The fish samples were collected bimonthly in batches for a period of three months (September- November, 2023). A total of 120 fishes comprising 60 each of Tilapia zilli and Oreochromis niloticus were sampled from fishermen at the Wadata landing site during this period. The fish sampled were transported in an ice-parked plastic container to the Fisheries laboratory in order to keep the integrity of the sample intact prior to analysis. The species were identified using taxonomic keys and morphometric parameters recorded. The results obtained shows the parameters of Oreochromis niloticus and Tilapia zilli as the cichlids species caught. The mean weight (53.70±3.13), mean length (14.09±0.28) and the mean standard length (11.13±0.24) of Tilapia Zilli was observed to be greater than the mean weight (43.01±2.17), mean length (12.83±2.0.21) and mean standard length (10.17±0.81) of Oreochromis niloticus. The results obtained reveals that the morphometry of Tillapia zilli is higher in their Morphometric measurements as compared to Oreochromis niloticus. This study therefore provides valuable information on the morphological characteristics in relation to the body weight of these two Cichlids for the sustainable management of fisheries in Lower River Benue, Makurdi and Nigeria at large.

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Keywords: Size variation; Cichlids; river benue; total length; standard length.

1. INTRODUCTION

The family *Cichlidae*, compromising a diverse group of freshwater fish has a long captivated the attention of researchers due to its remarkable variability in size, morphology, and behaviour. Within the African continent, the lower River Benue stands out as a crucial habitat for numerous cichlid species, offering a unique environment for studying their size variation and its underlying factors.

Cichlids are renowned for their ecological importance, serving as key components of aquatic ecosystems. They contribute to nutrients cycling, trophic dynamics, and even have cultural and economic significance in many regions. Size variation among cichlids species is often linked to various evolutionary forces such as natural selection, genetic drift and environmental factors. Understanding the patterns of sized variation can provide insights into the adaptive strategies of these fish in response to their ecological niches [1].

Size variation within species is very vital in population studies, as it is useful in distinguishing species taxonomically and establishing evolutionary relationships [2]. Size variation provides important clues about the taxonomy, morphology, behavior, and life history of species. The study of variability in size of fish stocks is important in phylogenetics and providing information for subsequent studies on the genetic improvement of stocks.

Studies on size variation of fishes within populations of the same species in the Nigerian territorial waters, has been reported by several authors, Omoniyi and Agbon [3], Solomon, et. al., [4], Oladimeji, et. al., [5], Ukenye, et. al., [6] amongst others. However, there is paucity of information on the size variation of Cichlids in Lower River Benue. This study therefore aims to shed light on the size dynamics of cichlids populations in the Lower River Benue, offering a comprehensive understanding of the ecological and evolutionary processes driving size variation within this iconic family of freshwater fish. Through rigorous fieldwork and interdisciplinary analyses, it is anticipated that this research will advance our knowledge of cichlid biology while also informing conservation strategies for the preservation of aquatic ecosystems in the region.

2. MATERIALS AND METHODS

2.1 Description of Study Area

The study was carried out in the Lower Benue River at Makurdi, Nigeria. Benue River originates in the Adamawa Mountains of the central Cameroun and flows westward for 1,400km until it meets the Niger River about, 450km above the delta, near the city of Lokoja, Nigeria [7]. The Lower River Benue, characterized by its diverse aquatic habitats including rivers, floodplains and tributaries offers a rich setting for studying cichlids diversity and size variation. Its dynamic environmental conditions and unique biogeographical context make it an ideal location for conducting comprehensive surveys of cichlids populations.

2.2 Sample Collection and Method

The fish samples were collected bimonthly in batches for a period of three months (September- November, 2023). A total of 120 fishes comprising 60 each of *Tilapia zilli* and Oreochromis *niloticus* were sampled from landings of artisanal fishermen at Wadata landing site. In order to maintain the integrity of the samples, the fish samples were transported in an ice-parked plastic container prior to commencement of laboratory analysis. In the laboratory, the fish samples were sorted out and identified to specie level using identification keys.

2.3 Morphometric Measurements

Morphometric parameters taken included, standard length (SL), Body weight (BW), Total Body Length (TBL), Dorsal Fin Length (DFL), Caudal Fin Length (CFL), Head Length (HL), Body width (BW), Anal fin length (AFL), Pectoral fin length (PFL) and Pelvic fin length (PFL). Standard Length (SL) was taken from the tip of its snout to the base of its tail fin. Body weight (BW) was measured using a weighing balance and recorded in grams (g) to the nearest 0.01g. The total body length (TL), was taken from the tip of its snout to the end of the tail fin. The dorsal fin length was taken from its base to the tip. The caudal fin length was taken from the caudal region to the end of the fin. The head length was taken from the snout of the mouth to the beginning of the operculum. The anal fin length was taken from the anal region to end of the fin. The pectoral fin length was taken from the

pectoral region to the end. The pelvic fin length was taken from the pelvic region to the end while the body width was taken from the head region to the end of the caudal fin. All length measurement was recorded in centimeter (cm) and was taken using measuring ruler. [8]

2.4 Data Analysis

Descriptive statistics using SPPS version 21 was employed to analyze the data obtained in the study. Similarly, correlation analysis between the parameters was determined using SPPS Version 21. The results for the body weight and standard length were transformed to log of base 10 to normalized them and stabilize the variance.

3. RESULTS

3.1 Weight Variation in the Family *Cichlidae* from Lower River Benue

The summary of weight variation in the family *Cichlidae* in (Table 1) shows that mean weight was highest among *Tilapia zilli* with a mean of 53.70g and a range of 25.20g to 105.60g. The mean weight of *Oreochromis niloticus* was 43.01g and range from 108.60g to 13.60g.

3.2 Length Variation in the Family *Cichlidae* from Lower River Benue

The summary of Total length variation in the family cichlidae in (Table 2) shows that mean length was highest among *Tilapia zilli* with a mean of 14.09cm and a range of 10.50cm to 19.00cm. The mean length of *Oreochromis niloticus* was 12.83cm and range from 9.10cm to 18.00cm.

3.3 Standard Length Variation in the Family Cichlidae from Lower River Benue

The summary of standard-length variation in the family cichlidae in (Table 3) shows that mean standard length was highest among *Tilapia zilli* with a mean of 11.13cm and a range of 8.30cm to 15.20cm. The mean standard length of *Oreochromis niloticus* was 10.17cm and range from 6.00cm to 14.10cm.

Table 1. Weight variations in the family *Cichlidae*

Species	Mean Weight (g)	Maximum weight (g)	Minimum weight (g)
Oreochromis niloticus	43.01 ± 2.17^{b}	108.60	13.60
Tilapia zilli	53.70 ± 3.13^{a}	105.60	25.20
P-Value	0.01	0.01	0.01

**Means in the same row with different superscripts differ significantly*

Table 2. Total length variations in the family *Cichlidae*

Species	Mean length (cm)	Maximum length (cm)	Minimum length (cm)
Oreochromis niloticus	12.83 ± 0.21^{b}	18.00	9.10
Tilapia zilli	14.09 ± 0.28^{a}	19.00	10.50
P-Value	0.00	0.00	0.00

**Means in the same row with different superscripts differ significantly*

Table 3. Standard length variations in the family *Cichlidae*

Species	Mean Stand. Length (cm)	Maximum Stand. Length (cm)	Minimum Stand. Length (cm)
Oreochromis niloticus	10.17 ± 0.18^{b}	14.10	6.00
Tilapia zilli	11.13 ± 0.24^{a}	15.20	8.30
P-Value	0.00	0.00	0.00

**Means in the same row with different superscripts differ significantly*

Table 4. Some morphometric variation in the family *Cichlidae* from lower river benue

Body Parameters	*Oreochromis niloticus*	*Tilapia zilli*	P-Value
Dorsal Fin Length (cm)	7.39 ± 0.16^{b}	8.43 ± 0.22^{a}	0.00
Caudal Fin Length (cm)	2.76 ± 0.12^{a}	2.83 ± 0.06^{a}	0.74
Head Length (cm)	3.51 ± 0.06^{b}	3.84 ± 0.08^{a}	0.00
Pelvic Fin Length (cm)	3.29 ± 0.08^{b}	4.10 ± 0.10^{a}	0.00
Pectoral Fin Length (cm)	3.31 ± 0.07^{a}	3.20 ± 0.09^{a}	0.36
Anal Fin Length (cm)	3.54 ± 0.07^{b}	3.82 ± 0.11^{a}	0.04
K	1.99 ± 0.07^{a}	1.86 ± 0.03^{a}	0.22

**Means in the same row with different superscripts differ significantly*

Table 5. Correlations between size variables and some morphometric parameters in the family *Cichlidae* from lower river benue

Body Parameters	Total Weight	Total Length	Standard Length
Dorsal Fin Length	0.791*	0.912*	0.912*
Caudal Fin Length	0.274*	0.338*	0.342*
Head Length	0.674*	0.857*	0.845*
Pelvic Fin Length	0.642*	0.795*	0.778*
Pectoral Fin Length	0.600*	0.704*	0.698*
Anal Fin Length	0.746*	0.899*	0.869*
K	0.165	-0.330*	-0.306*

**Means in the same row with different superscripts differ significantly*

3.4 Morphometric Variation in the Family *Cichlidae* from Lower River Benue

Selected morphometric characteristics of the family *Cichlidae* are presented in the Table 4. Dorsal fin length (8.43±0.22), head length (3.84±0.08), pelvic fin length (4.10±0.10) and anal fin length (3.82±0.11) of *Tilapia Zilli* were higher than the dorsal fin length (7.39±0.16), head length (3.51±0.06), pelvic fin length (3.29±0.08) and anal fin length (3.54±0.07) of *Oreochromis niloticus*. However, the pectoral fin length (3.31±0.07) and condition factor (1.99±0.07) were higher for *Oreochromis niloticus* compared to *Tilapia Zilli* with pectoral fin length of (3.20±0.09) and condition factor of (1.86±0.03), respectively. Significant differences can be observed in majority of the parameters (dorsal fin length, head length, pelvic fin length and anal fin length).

3.5 Correlations between Size Variables and Some Morphometric Parameters in the Family *Cichlidae*

The correlation of the size variables and the morphometric parameters of the family cichlidae are shown in the Table 5. Significant relationships can be observed in all the parameters except between total weight and the condition factor. All the correlations were observed to be positive.

4. DISCUSSION, CONCLUSION AND RECOMMENDATION

4.1 Discussion

The morphometry parameters measured in this study were observe to vary in these two species except for caudal fin length. The mean values of the morphometric measurements recorded for *T. zilli* were higher compared to that of *Oreochromis niloticus* except for pectoral fin length and condition factor. The present findings corroborate with the reports of Fagbuaro, et. al., [9] who asserted that the morphometry of *Tillapia zilli* has been higher in their measurements as compared to the *Oreochromis niloticus.* The reason for the observe variation in size of these two species may be attributed to the differences in the environmental variables of the study locations where the fish samples were caught, biotic and abiotic factors, feeding regimes / frequency and their interactions.

Within Nigeria, Fagbuaro [10] successfully delineated three clades of *T. Zilli* within three Dams in South-Western Nigeria using differences observed in head length, total length, standard length, pre-pelvic distance and body weight, which he reported higher Morphometry values of *Tilapia Zilli* from the dams which were different from the present study. Similarly, differences in standard length, pre-anal fin length, body depth, peduncle depth and pre-pelvic fin length have been reported for Guinean tilapia (*Coptodon guinensis*) in two locations within the Niger Delta region of Nigeria [11]. The present study shows a significant relationship for all the parameters except between total weight and the condition factor in both species. All the correlations were observed to be positive. This result shows clearly that the growth of *Oreochromis niloticus* and *Tilapia Zilli* in lower Benue River is proportional to the body of the fish. This may be attributed to the hidden factors that are militating against the growth response pattern of the fish in lower Benue River at Makurdi. The variation in the morphological parameters recorded within the same species of Tilapia may be due to the genetic makeup and at the same time linked to the environment which has a fundamental role in the expression of the genes [8].

Condition factor is an important metrics used in fisheries biology to assess the overall health and well-being of fish populations. A higher condition

factor generally, indicates a fish in a better condition, with sufficient energy reserve for growth and reproduction. In the case of *O. niloticus* with a condition factor of 1.99 and *T. zilli* with a condition factor of 1.86, we observe differences in their condition despite being members of the same family, Cichlidae. *O. niloticus* exhibiting a higher condition factor suggests that, on average, individuals of this species may have better energy reserves and overall health compared to *T. zilli*. Several factors could contribute to the observed differences in condition factors between the two species. These may include variations in habitat quality [12,13,14,15], food availability, competition with other species, reproductive status and genetic factors influencing growth rates and body condition. For *O. niloticus*, which has a higher condition factor, this could imply that it is more adept at utilizing available resources efficiently resulting in better growth and condition compared to *T. zilli*. Conversely, *T. zilli* may be facing environmental or ecological constraints that limit it access to resources, leading to lower condition factor as observed in the present study.

This study provides valuable insight on the Morphometry in relation to the body weight of two Cichlids for the sustainable management of fisheries in Makurdi and Nigeria at large.

4.2 Conclusion

The findings of this studies highlight the importance of considering morphometric parameters in assessing the overall fitness, adaptability and ecological niche of fish species. *T. zilli* superior morphometric attributes may confer advantages in terms of swimming performance, maneuverability, feeding efficiency or reproductive success contributing to its competitive edge in certain habitats or environmental conditions. *T. zilli* have revealed significant differences in various morphometric parameters exhibiting superior characteristics compared to O. niloticus. Through meticulous analysis and comparison of key morphological traits, it has become evident that *T. zilli* possesses certain advantages over *O. niloticus* in terms of its morphometric profile.

4.3 Recommendations

Moving forward, continued research into the morphometrics of *T. zilli* and *O. niloticus* as well as other cichlids species is highly recommended. This will contribute to our understanding of the factors driving morphological diversity and ecological interactions within freshwater ecosystems. By elucidating the morphometric advantages of *T. zilli* over *O. niloticus*, these studies lay the groundwork in lower river Benue for targeted conservation efforts and fisheries management strategies aimed at preserving and utilizing the unique biological resources represented by these iconic fish species.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/114036