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Variation in the Morphometry Measurements of Two Tilapia Fish Species in Relation to Their Body Weight Obtained from Lower Benue River at Makurdi, Benue State Nigeria

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Abstract

This study examined the morphometry of *Tilapia zilli* and *Oreochromis niloticus* from lower River Benue at Makurdi. Seven morphometry measurements (body weight, standard length, total length, dorsal fin length, caudal fin length, head length and body width) of each captured fish. The mean of morphological parameters of *Tilapia zilli* of body weight, standard length, total length, dorsal fin length, caudal fin length, head length and body width were 12.83 g, 8.00 cm, 9.95 cm, 4.50 cm, 3.19 cm, 2.27 cm and 4.44 cm respectively. Similarly the mean morphometry of *Oreochromis niloticus* was body weight: 15.51 g, standard length: 9.00 cm, total length: 10.76 cm, dorsal fin length: 5.85 cm, caudal fin length: 3.68 cm, head length: 2.67 cm and body width: 4.41 cm. The correlation analysis between morphometry of *Tilapia zilli* was significant between head length and total length only. However, correlation analysis between morphometry of *Oreochromis niloticus* revealed a significant positive correlation between standard length and bodyweight, total length and body weight, standard length and total length, dorsal fin length and body width and head length and dorsal fin length only. There was a strong relationship between log of body weight and standard length using regression analysis with R^2 value of 0.8689 in *Oreochromis niloticus* while a weak relationship was obtained in *Tilapia zilli* with R^2 value of 0.0889 during the study. The study concludes that the two species of the Tilapia are different with different morphological features used in its identification.

Keywords Tilapia; Morphometry; Lower Benue River

Introduction

Tilapia fish is an indigenous African fish that is widely cultivated especially in Asia and the Middle East [1]. It is much appreciated by consumers, being a good and affordable source of protein. *Oreochromis niloticus* (Nile Tilapia) and *Tilapia zilli* are two important fish species found in aquatic environments in Nigeria [2]. Due to their great similarity, the taxonomic relationship between the two fish species is controversial [1]. Although they can be discriminated physiologically, it is very difficult to identify them with meristic index for they have many overlapping characters especially at the juvenile stage [2]. Tilapia belongs to Cichlidae family, and is a warm water fish which is found mostly in Africa [3]. Currently, Tilapia is at least farmed in 85 countries that make it the most extensively farmed finfish worldwide and second in volume only to carps [3]. The general morphology of the Tilapia is a rectangular body-shaped, covered with deep cycloid or cteniod scales. Anterior dorsal fin has spines which are not separated from posterior one that has one spine and 13 fins rays [3]. Tilapias are plastic animals because their growth and maximum obtainable size can be seriously influenced by the physical and biological composition of their environment [4]. The Nile tilapia, *Oreochromis niloticus* is surface breeding omnivore fish. They are the most popular fish for culture in Nigeria and worldwide. They grow fast, mature quickly, and breed easily without inducement. Apart from their special interest for fish biologist and taxonomists, Tilapia contribute significantly to African inland water fisheries and are very good species for aquaculture [5]. Nile tilapia is mostly an African Cichlid native to Burkina Faso, Cameroon, Chad, Cole d'Ivoire, Egypt, Gambia, Ghana, Guinea, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leon, Sudan, Togo, and Uganda. *Oreochromis niloticus* is an important food fish that has been introduced to many different parts of the world by man. In several countries, Nile tilapia has become a problematic invasive species after its introduction [5].

Tilapia is generally considered as a freshwater species but will tolerate brackish conditions. In the wild, it is typically found in waters where temperature ranges in 13.5°C to 330°C (56°F to 910°F). The extended temperature range for this species is however 8°C to 420°C (47°F to 1080°F) [6]. Nile tilapia is principally a day active fish that feeds chiefly on phytoplankton and benthic algae, and also can eat plants and have been introduced to ponds to reduce the amount of aquatic weed. Nile tilapia is an internal mouth brooding species where the female fish will keep egg, larvae and fry protected inside her mouth until the fry is large enough to be released [6]. *Oreochromis niloticus* is the preferred fish for consumption by the local population and accounts for about 37% of the commercial fishery [6]. *Tilapia zilli* is an important as a food fish as well as for aquaculture. *Tilapia zilli* provided 70% of Egypt's fish production [7]. *Tilapia zilli* has a maximum length of 40 cm (SL) and a maximum published weight of 300 grams with a total of 13 to 16 dorsal spines [7]. Adults display a black spot outlined in yellow. Spawning colorations is shiny dark green on top and sides, red and black on the throat and belly, and obvious vertical bands on the sides [7]. Heads turn dark blue to black with blue-green spots. Eggs are green to olive green, sticky, 1 mm to 2 mm in diameter; relatively smaller than eggs of other cichlids [7]. Morphometry can be used to

assess the influence of environmental factors of fish populations. In this regard, it is common to use measurements such as body length, body depth, head length, eye diameter, jaw length of fishes to not only assess fish habitat peculiarities and ecological criteria in water bodies, but also to measure discreteness and relationships among various taxonomic categories [8]. Morphometry variation between stocks can provide a basis for stock structure, and may be applicable for studying short-term, environmentally induced variation geared towards successful fisheries management and are widely used to identify differences between fish populations [1]. It has become a matter of fact that, most consumers of fish were unable to distinguish between *Oreochromis niloticus* and *Tilapia zilli* in their daily consumption of these species in the market arena. This may be as a result of enormous similarities which exist between them. This has led to the consumption of unknown fish species causing in satisfaction or loss of appetite in the consumers. The present investigation is aimed at examining the morphometry and condition factor for morphometric variability between *Oreochromis niloticus* and *Tilapia zilli*.

Material and Methodology

Study area

The study was carried out in Makurdi, the capital of Benue State, Nigeria. The city is located in central Nigeria along the Benue River. The town lies in the guinea savanna vegetative belt on the bank of the second largest river in Nigeria, river Benue. Makurdi is situated at latitude 7015' to 7045' North and Longitude 8015' to 8040' East and 104 meters elevation above the sea level (Figure 1). The river divides the town into North and south Banks and the town covers an area of about 16 Km/m^2. The Benue river constitutes the main source of water supply for the inhabitants of the town. Makurdi is fast becoming a metropolitan centre with attendant health, social, housing and environmental problems.

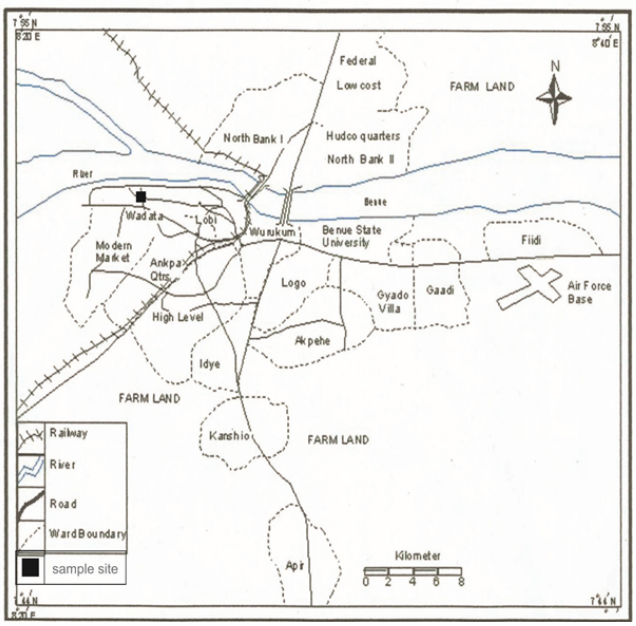

Figure 1: Map of Makurdi showing sample area.

Sampling

The fish species for this study were sampled from fishermen at Wadata fishing market. The fish samples were transported in an ice-parked plastic container in order to keep them fresh immediately to the laboratory. In the laboratory, the fish samples were sorted out and identified to specie using keys [8].

Morphometry measurement

The measurable morphometric characters used were standard length (SL), Body weight (BWT), Total Body Length (TL), Dorsal Fin Length (DL) Caudal Fin Length (CL) Head Length (HL), Body width (BW). Standard Length (SL) was taken along the body axis. The body weight (BWT) was measured using a weighing meter and recorded in grams (g). The total body length (TL), was taken along the anterior-posterior body axis from mouth tip to the end of the caudal fin. The dorsal fin length was taken from the start of the fin to the end by the dorsal side. The caudal fin length was taken from the caudal region to the end of the fin. The head length was taken from the tip of the mouth to the beginning of the operculum, while the body width was taken from the head region to the end of the caudal fin. All length measurement were recorded in centimetre (cm) and were taken using measuring meters.

Data Analysis

The results obtained from the study were subjected to descriptive statistics using SPPS version 21. Similarly correlation analysed 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. It was then plotted using Microsoft word version 13 for regression analysis and R^2 value was determined.

Results

The result in Table 1 is the morphometry of *Tilapia zilli* in Lower Benue River at Wadata in Mkurdi. A perusal at the result indicates a similar trend in Nile Tilapia where the highest mean body weight of 12.83 and head length the lowest with mean value of 2.27 cm. The data in Table 2 is the correlation analysis between morphometry of *Tilapia zilli* in lower Benue River at Makurdi. Correlation was significant between head length and total length only. The data presented in Figure 2 the log weight-length relationship of *Tilapia zilli*. The result revealed very weak relationship between the body weight and the standard length of the fish with an R^2 value of 0.0889. The data presented in Table 3 is the morphometry of *Oreochromis niloticus* in lower Benue River at Wadata fishing market at Makurdi. The body weigh has the highest value of 13.51 g while head length was lowest of 2.67 cm. The data presented in Table 4 is the correlation analysis between morphometry of *Oreochromis niloticus* in lower Benue River at Makurdi. A perusal at the result revealed a significant positive correlation between standard length and bodyweight, total length and body weight, standard length and total length, dorsal fin length and body width and head length and dorsal fin length only. The result in Figure 3 depicts the log of weight-length relationship of the *Orechromis niloticus* with a R^2 value of 0.8689 that reveal a strong relationship between the length and weight of the fish.

	Unit	Mean	Standard deviation	Standard error mean
BDWT	G	12.83	0.98	0.40
SL	Cm	8	0.63	0.26
TL	Cm	9.95	0.78	0.32
DL	Cm	4.5	0.44	0.18
CL	Cm	3.19	0.24	0.09
HL	Cm	2.27	0.42	0.17
BDW	Cm	4.44	0.46	0.19
BDWT=Body weight, SL=Standard Length, TL=Total length, DL=Dorsal fin length,				

Table 1: Morphometry of *Tilapia zilli* in lower Benue River.

Parameter	BDWT	SL	TL	DL	CL	HL	BDW
BDWT	1	0.32	0.61	0.45	0.53	0.37	-0.05
SL	0.32	1	0.81	0.35	0.66	0.78	0.6
TL	0.61	0.81	1	0.71	0.51	0.84*	0.22
DL	0.45	0.35	0.71	1	0.06	0.29	-0.29
CL	0.53	0.66	0.51	-0.06	1	0.5	0.26
HL	0.37	0.78	0.84*	0.29	0.5	1	0.56
BDW	-0.05	0.6	0.22	-0.29	0.26	0.23	1
BDWT=Body weight, SL=Standard Length, TL=Total length, DL=Dorsal fin length, CL=Caudal fin Length, HL=Head Length, BDW=Body Width.							
*Correlation is Significant at 0.05 level (2 tailed).							

Table 2: Correlation analysis between the morphometry measurements of *Tilapia zilli* in lower Benue River.

	Unit	Mean	Standard deviation	Standard error mean
BDWT	G	13.51	1.63	0.67
SL	Cm	9	1.22	0.51
TL	Cm	10.76	1.39	0.57
DL	Cm	5.85	1.31	0.52
CL	Cm	3.68	0.43	0.17
HL	Cm	2.67	0.61	0.25
BDW	Cm	4.41	1.02	0.42
BDWT=Body weight, SL=Standard Length, TL=Total length, DL=Dorsal fin length, CL=Caudal fin Length, HL=Head Length, BDW=Body Width.				

Table 3: Morphometry of *Oreochromis niloticus* in lower Benue River.

Parameter	BDWT	SL	TL	DL	CL	HL	BDW
BDWT	1	0.95**	0.94**	0.13	0.75	0.51	0.27
SL	0.95**	1	0.98**	0.18	0.61	0.54	0.32
TL	0.94**	0.98**	1	0.17	0.63	0.47	0.29
DL	0.13	0.18	0.17	1	0.59	0.79	0.95**
CL	0.75	0.61	0.63	0.59	1	0.67	0.64
HL	0.56	0.54	0.47	0.79	0.67	1	0.92**
BDW	0.27	0.32	0.29	0.95**	0.64	0.92**	1
BDWT=Body weight, SL=Standard Length, TL=Total length, DL=Dorsal fin length, CL=Caudal fin Length, HL=Head Length, BDW = Body Width,							
**Correlation is significant at 0.01 level (2 tailed)							

Table 4: Correlation Analysis between the Morphometry of *Oreochromis niloticus* in lower Benue River.

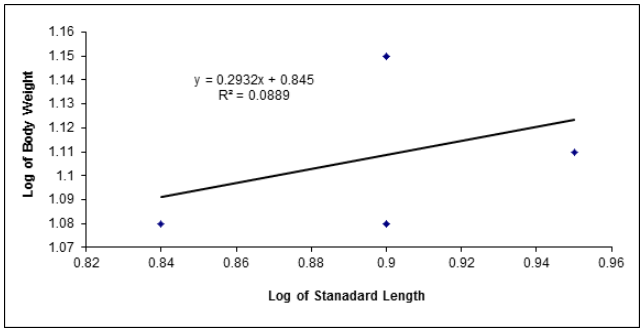

Figure 2: Log of Weight-Length Relationship of *Tilapia zilli*.

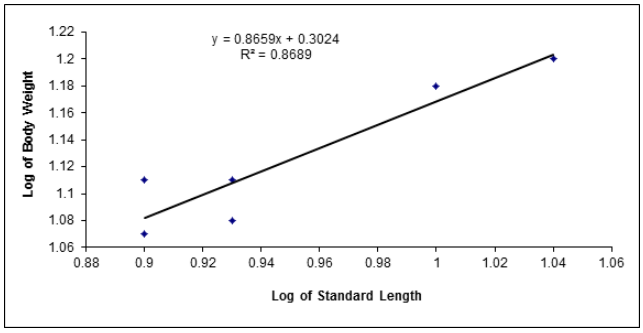

Figure 3: Log of Weight-Length Relationship of *Orechomis niloticus.*

Discussion

The morphometry were: body weight, standard length, total length, dorsal fin length, caudal fin length, head length and body width. All these measurements were different in the two species of the *Cichliadae*. In the *Oreochromis niloticus*, the mean values of the morphometric measurements were slightly higher than that of the *Tilapia zilli* except for the body width. This report differs significantly from the findings of an earlier study that reported the morphometry of *Tillapia zilli* has been higher in their measurements as compared to the *Oreochromis niloticus* [9]. Similarly the morphometry of *Tilapia zilli* from three different dams in three different states in South western Nigeria were higher as compared to the result of the present study [10]. The reason for the wide variation in morphometry of the same species may be due to the variation in the environmental variables in the study locations where the fish samples were obtained and the unknown factors that may be impacting negatively on the fish species. Nevertheless, the mean total length and body weight of *Orechromis niloticus* and *Tilapia zilli* from a tropical water supply reservoir in Abuja Nigeria differs slightly from the report of this present investigation [11]. Similarly the result of the total length and body weight of *Orechromis niloticus* from Ibiekuma stream in Ekpoma, Edo state Nigeria disagree with the result of this study [8]. This variation may be due to the different ecological factors at the different ecosystems locations with their different environmental qualities.

In this present investigation correlation was significant between standard length and body weight, total length and body weight, total length and standard length, dorsal fin length and body weight and between head length and body width in *Oreochromis niloticus* . The results indicate clearly that the growth of *Oreochromis niloticus* in lower Benue River is proportional to the body of the fish. All the same a different situation was observed in *Tilapia zilli* where correlation was significant between total length and head length only. 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. The result of log of weight-length relationship of *Oreochromis niloticus* of this study conforms to the result of an earlier study that reported a strong relationship between the body weight and standard length [8,9]. However the log-weight relationship of *Tillpia zilli* of this study differs from the ones obtained by other studies where the studies reported a strong relationship as compared to this study that reported a weak relationship [9]. This study provides insight on the morphological characteristics in relation to the body weight of two *Cichlidae* for the sustainable management of fishery in Makurdi and Nigeria at large.

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