COMPARATIVE BIOMETRIC VARIATIONS OF TWO *CICHLIDAE*: *Oreochromis niloticus* AND *Tilapia zillii* FROM A DAM IN SOUTHWESTERN NIGERIA

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ABSTRACT

The present study is designed to evaluate the biometric variation of two Cichlidae: *Oreochromis niloticus* and *Tilapia zillii* from a dam in Ado-Ekiti Nigeria. The mean of their total lengths were 20.10±1.30, 21.15±1.24 and 20.17±1.34, 20.42±1.85 while the mean of the body weights were 164.70±26.30, 167.80±26.30 and 170.20±31.84, 162.20±33.24 for females and males of *Oreochromis niloticus* and *Tilapia zillii* respectively. There was a strong positive correlation (r) between the mean total length and the body weight (BW) and depth at anus (BDA) but not with other body indices in both females and males of *Oreochromis niloticus* and *Tilapia zillii*. Additionally, the values of regression coefficient obtained for the total length and body weight relationship are less than 3 in both male and female which means that they exhibited allometric growth during their development. The variations in the morphology of the two species of tilapia collected for the research may be the result of their inheritance, competition for food and other physical materials in the water body, size variations, weight or other unseen environmentally induced factors.

KEYWORDS: Tilapia; Oreochromis niloticus; Tilapia zillii; Biometric; Variation; Nigeria

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INTRODUCTION

Tilapia which has been one of the culturable species in Africa, and other parts of the world is made up of three genera of the fish belonging to the family *Cichlidae* which are *Oreochromis*, *Sarotherodon* and *Tilapia.* All the species of Tilapia are recommended by the Food and Agricultural Organization as culturable species because of their capabilities in contributing to the increased production of animal protein for man (FAO, 2011, Yakubu and Okunselabor, 2011). Tilapia culture has increased substantially throughout the World and has become the second most important food fishes Worldwide (Watanabe, *et.al.*2002, Duan *et. al.*2005). Species of *Tilapia* especially *Oreochromis niloticus* and *Tilapia zillii* possess range of attributes that make them ideal for aquaculture practices among which are: they are easy to culture and grow rapidly, reproduce easily, adapt to a wide range of environmental conditions and accept artificial feeds easily. They have good tasting flesh with a mild flavour, are widely accepted as food fish, are used in many cuisines, and their consumption is not restricted by religion observers.

It is known that many animal and plant species are subdivided into morphologically and genetically distinct groups, which can be grouped as races or subspecies. Most of such groups are believed to have adapted to different ecological conditions through different selection regimes acting on geographically separated populations (Largiader *et. al.* 1994). Therefore Morphometric and meristic variation which remains the simplest and most direct way among methods of species identification between animal stocks can used to distinguish these two species of *Cichlid* in a dam. Morphometric analysis refers to the quantitative analysis of form, a concept which involves both size and shape (Carpenter *et. al.* 1996). Generally, as it has been observed that the body shape of an organism is determined by both genetic and environmental factors, fish have been reported to exhibit a large component of environmentally induced morphological variations. Phenotypic variation has been widely used by Ichthyologists to differentiate among species and even among populations within a species (Njoku and Keke 2003).

In Nigeria, there are having been dearth of reports on comparative assessments of morphometric differentiation of Tilapia species such as *Tilapia zillii*, *Sarotherodon* species and *Oreochromis niloticus* within the same environment. The comparative study of morphology variation of two species of Tilapia: *T. ziIIii* and *O. niloticus* from a reservoir in southwestern part of Nigeria has not been reported before. Therefore, this research work was aimed at comparing the morphological indices and meristic traits of *T.zillii* and *O. niloticus* from Ureje dam, in Ado-Ekiti, Southwestern, Nigeria.

MATERIALS AND METHODS

Description of Sample Sites

The samples of *Oreochromis niloticus and Tilapia zillii* were collected from Ureje dam, Ado-Ekiti, Ekiti State, Nigeria. The Ado-Ekiti Ureje dam reservoir was constructed by damming the Ureje River in Ado-Ekiti in 1958 for the supply of water for domestic uses and production of fish for Ado-Ekiti community and the environs (Agbeyo, 1976). The full capacity of the reservoir contains about 47 million gallons of water (Ebisemiju, 1993). It is situated on an undulating plane of an average height of about 440 m above sea level and surrounded by highlands. The dam lies between latitude 7^o 37' north and longitude 5^o 13' east of the equator.

Collections and Identification of Fish Specimen

Oreochromis niloticus and *Tilapia zillii* were selected from the samples of *Cichlidae* collected weekly from the dam between May and August, 2015. The fish samples were collected by Fishermen with the aid of cast netting of 3.5 mm mesh size. The samples were transported to the Post graduate laboratory

of Zoology Department, Ekiti State University, Ado- Ekiti for the practical. The *Cichlidae* samples were sorted into different samples and sexes. The *O. niloticus and T. zillii* were identified using the standard key by Olaosebikan and Raji (1998).

Morphometric and Meristic Features

Thirty-two (32) morphological measurements were made on each of 116 *O.niloticus* and 24 *T.zillii* collected. The data collected include TL=Total length; distance between the anterior tip of the fish and the most posterior tip of the caudal fin, SL=Standard length; was determined using a ruler, by measuring the length from the tip of the mouth to the beginning of the tail, BW=Body weight, BDA=Body depth at anus, CPD=Caudal peduncle depth, HL=Head length, PRDFL=Pre dorsal fin length, HD=Head depth, PRVFL=Pre ventral fin length, VDOL=Distance between ventral and dorsal fins origin, ADFEL=Distance between anal and dorsal fins ends, DFBL=Dorsal fin based length, VOAEFL=Distance between the ventral fin origin and end of anal fin, SPDAEFL=Distance between the first spine of the dorsal fin and the end of anal fin, VEAOFL=Distance between ventral fin end and anal fin origin, DVCFL=Distance between dorsal and ventral caudal fin origin, DEDCFL=Distance between dorsal fin end and dorsal caudal fin origin, AEVCFL=Distance between anal fin end and ventral caudal fin origin, DEVCFL=Distance between dorsal fin end and ventral caudal fin origin, AEDCFL=Distance between anal fin end and dorsal caudal fin origin, ED=Eye diameter, SNL=Snout length, PCFL=Pelvic fin length, PCFL=Pectoral fin length, DFR= Dorsal fin rays, AFR=Anal fin rays, PCFR= Pelvic fin rays, PEFR= Pectoral fin rays, CFR=Caudal fin rays, SDF=Length of the spine of dorsal fin, SPEF=Length of the spine of pectoral fin, SAF=Length of the spine of anal fin, SPCF=Length of the spine of Pelvic fin**.** Measurements and counts were made on the fish with head turning left and morphometric traits were taken and determined to the nearest centimeter on a measuring board. Body weight was taken using electronic weighting balance (Electric Balance Model of Shanghai Jingtian J72101N).

Length-Weight Relationship

This relationship was determined following Le Cren (1951) in which the Length-weight relationship was expressed as:

$$W = aLb$$

Where:

W = Weight in gram (g), L = length in (cm), a= a constant being the initial growth index, and b = growth coefficient. Constant 'a' represents the point at which the regression line intercepts the y-axis and 'b' the slope of the regression line.

Data Analysis

Data on mean weight, standard length, total length and other morphometric parameters were analysed by using regression analysis.

RESULTS AND DISCUSSION

For the study, a total of one hundred and forty fish were collected. The collection made up of one hundred and sixteen *Oreochromis niloticus* (88 females and 28 males) and twenty four *Tilapia zillii* (9 females and 15 males). The mean and relationship between total length of males and females' morphological characteristics and meristics traits of *O. niloticus* and *T. zillii* are shown in Table1. The mean body weights are 164.7±26.30 and 167.8±29.32 in females of *O. niloticus* and *T. zillii* respectively. In the males of *O. niloticus* and *T. zillii* the mean weight are 170.2±31.84 and 162.2±33.24 respectively. The relationship between the weight and the total of the body showed that Y= 14.43 x – 125.4, Y= 17.61 x – 204.7 and Y= 20.56 x- 255.7, Y= 15.85x- 161.6 for females and males of *O. niloticus* and *T. zillii* respectively. The mean values of head diameter (HD) are 5.49±0.49, 5.67±1.65 and 5.94±0.72, 10.83±3.22 for females and males of *O. niloticus* and *T. zillii* respectively. The relationship between the head diameter and the total length in females and males of *O. niloticus* and *T. zillii* showed that Y= 0.79 x +1.69, Y= 0.04 x + 4.694 and and Y= 0.167 x + 2.459, Y= 0.13 x +2.93 in females and males of *O. niloticus* and *T. zillii* respectively. In all other morphometrics analyses, SL, BDA, VOAEFL, DVCFL, AEDCFL, DEDCFL showed there were relationship between them and total length of the body. Morphometric and meristic features are used as they still remain dependable tools to characterize fish species on the field and they are sensitive to any environmental changes (Fryer and Iles, 1972). Studies on the morphometric and meristic characters of fisheries provide substantial information with regard to the exact nature of stocks and their geographical distributions. Morphological differences are recorded within the same species and even in different sexes of species due to interactive genetic and environmental effects. The knowledge of exact genetically and environmentally controlling characters is essential for the identifications of species of a genus and population within a species. (Kumar *et al* 2014). The morphometric characteristics of the samples of *O. niloticus* and *T. zillii* are determined to find their relationship with the total length either to indicate a linear relationship or not. Among the 18 morphometric characters considered in this study, the relationship between body weights and standard lengths showed high values of r, meaning the body weights are highly correlated with total lengths of both male and female of *O. niloticus* and *T. zillii.* The relationship of the body weights with total length showed that r=0.71, 0.74 and r = 0.86, 0.88 for females and males *O. niloticus* and *T. zillii respectively*. Standard length (r=0.91, 0.84, and 0.81, 0.84). The b values on length-weight relationships are 1.80, 2.05 and 2.51, 2.04 for females and males of *O.niloticus* and *T. zillii* respectively. There was no strong relationship between the total length and the head diameter of both species except in the female *O. niloticus.* The results are further shown in figures 1, 2, 3 and 4.

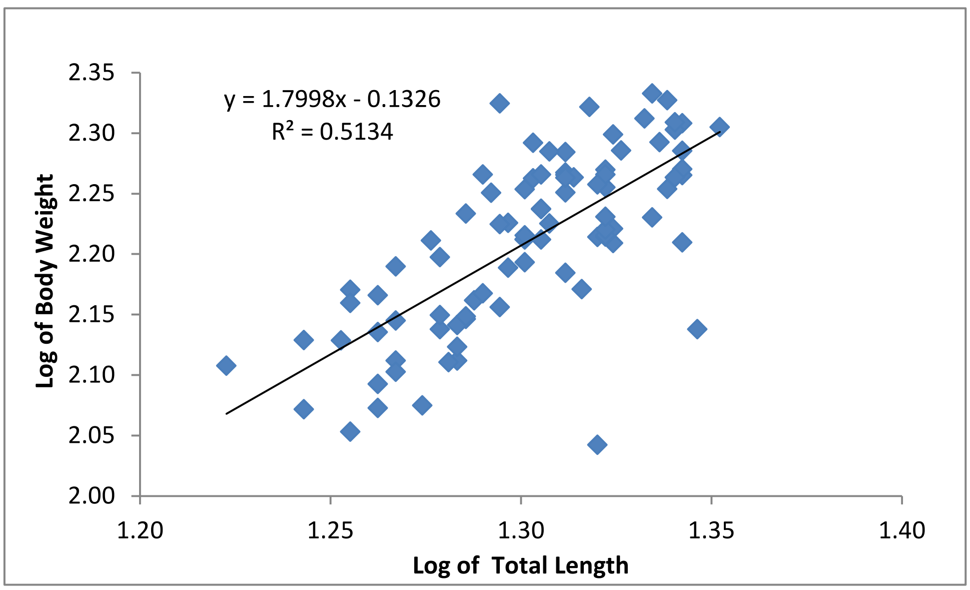

Fig 1: Relationship between the log of body weight and log of total length of female *O. niloticus.*

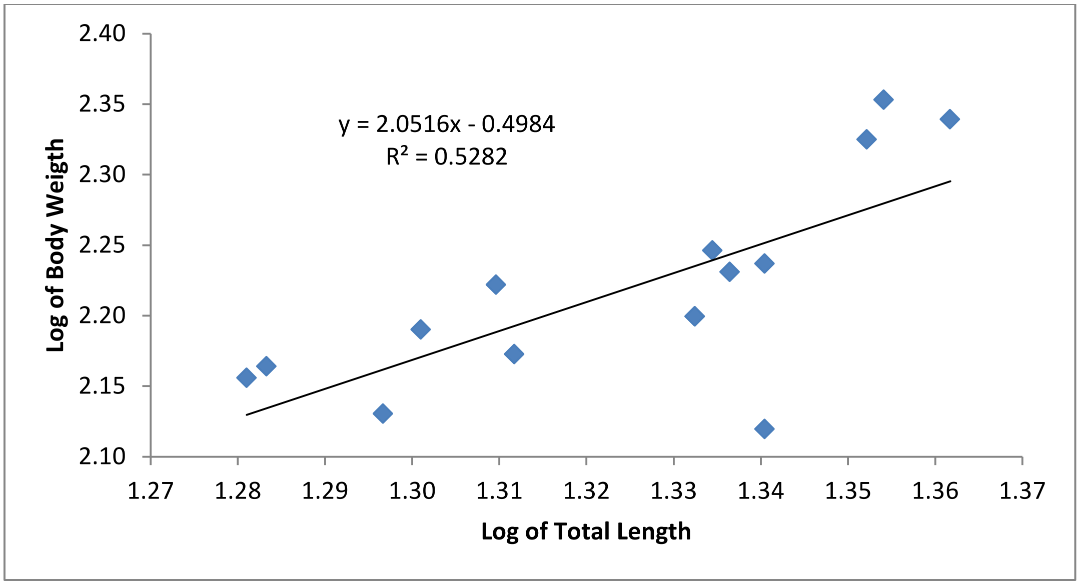

Fig 2: Relationship between the log of body weight and log of total length of female *T . zillii.*

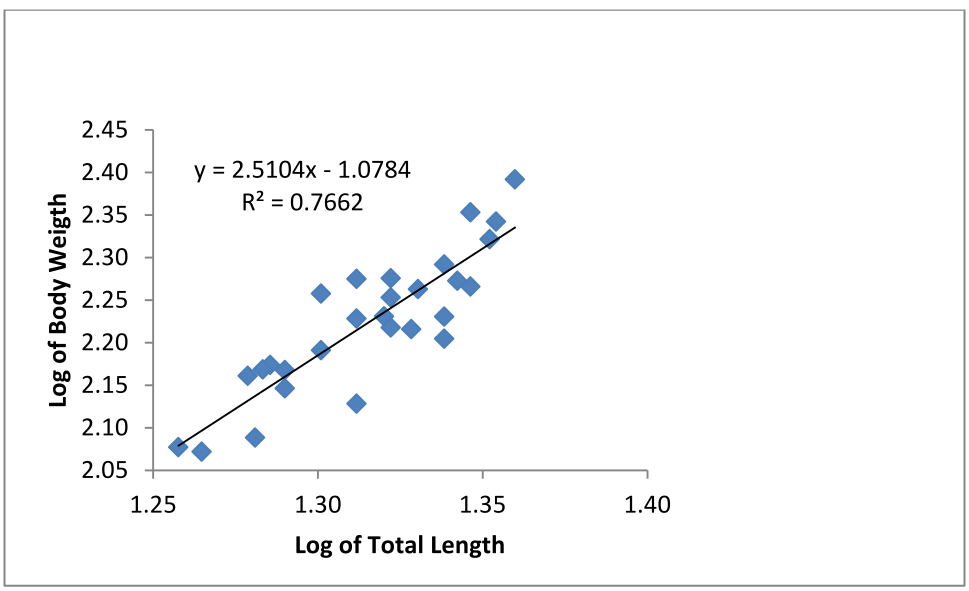

Fig 3: Relationship between the log of body weight and log of total length of male *O. niloticus.*

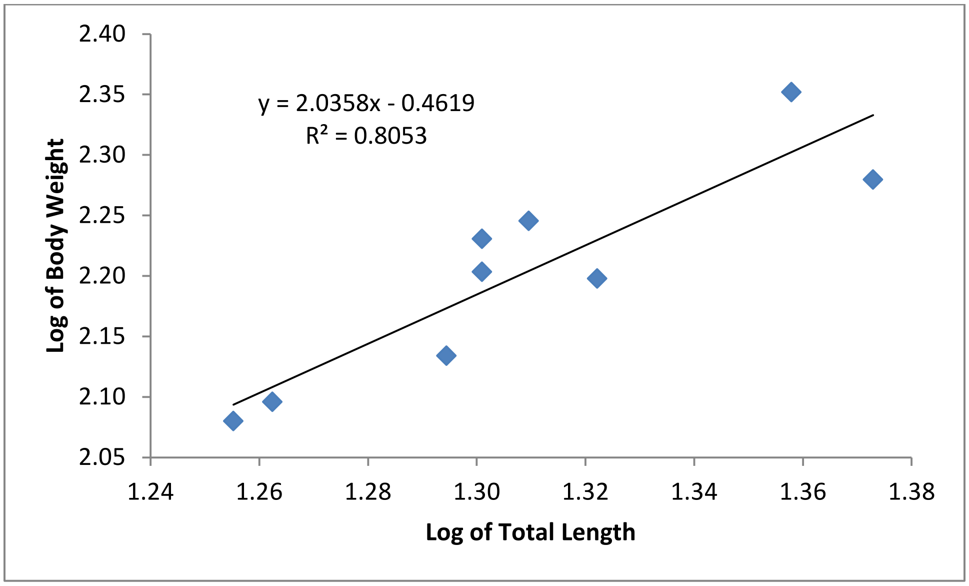

Fig 4: Relationship between the log of body weight and log of total length of male *T . zillii.*

The length-weight of fish is important in fishery biology as it allows the estimation of the average weight of the fish of a given length group by establishing a relationship between the two. Through this relationship, the relative well being of the fish population can be assessed. According to Beyer (1987), length-weight relationship of fish also indicates the robustness, the general well-being and regional companion of fishes. The estimated parameters of (b) in the two species females and males of *O.niloticus* and *T.zillii* examined are found to be within the range of 2.5-3.5. The results recorded in this work conform to 2.5-3.5 predicted for fish by Froese (2006) or between 2 and 4 by (Bagena and Tesch, 1978). The result reported in this work is also considered to be similar to what Fagbuaro, (2015), Kosai *et al* (2014),Olurin and Aderibigbe (2006) and others reported on tilapia species. A value significantly larger or smaller than 3.0 indicates different allometric growth (Tesch, 1971). A value less than 3.0 shows that the fish become lighter (negative allometric) or greater than 3.0 indicates that the fish become heavier (positive allometric) for a particular length as it increases in size (Zafa *et al*., 2003). Le Cren, (1951) and Fagbenro *et. al.* (1991) stated that obedience to the cube law (isometric growth, b=3) was rare in the majority of fishes but in these two species of tilapia, showed that the weight increases as the length increases. The relationship can be influenced by several factors such as sex, gonad maturity, health of the fish, seasonal effect, degree of stomach fullness, preservation techniques, and differences in the observation length ranges of the specimen weight (Tesch, 1971).

Table 1 further show that meristic traits (DFR, AFR, PEFR, PCFR, CFR and CPD) which indicate that no correlation between them and the total length of both male and female *O. niloticus* and *T. zillii* occur. The fin rays of the all the fins are constant in both females and males of *O. niloticus* and *T.zillii.* The fairly constant numbers of the fin rays observed in this work in both *O. niloticus* and *T. zillii* agreed with the reports of Reed *et.al.* (1967), Holden and Reed, (1972), Omoniyi and Agbon, (2008) that fin rays of the tribe *Tilapiini* do not vary much. Some species of saltwater and freshwater fish races have been reported to have variations in their fin rays as found in freshwater races of Sticklebacks Ikusemiju,(1975). The fairly constant values of fin rays observed in the population of the two species agreed with the findings/reports of Holden and Reed (1972) that fin rays of the tribe Tilapiini does not vary much. The species of fish either freshwater or marine with variations in fin rays are reported to have also been caused by environmental factors such as temperature fluctuation, salinity of the water body or any other factor. According to Huet (1949), the variations in the fin are related to both temperature and salinity. The present study provides information on the morphological characteristics, growth, weight and other component of fish population which will be useful for fishery Biologists and Managers for sustainable fishery management of Cichlidae in Nigeria.

REFERENCES

Agbeyo, A. 1976: *Water supply to Ado-Ekiti research* report to Department of Geography, University of Ibadan, Ibadan. Pp 88.

Bagenal, T.B. and Tesch, F.W. 1978: Age and growth. In Bagenal T. (ed). *Methods for assessment of fish in freshwaters,* 3rd Edition, IBP Handbook No 3 Oxford: Blackwell Scientific Publications, Pg 101-136

Beyer J.E. 1987: Length-weight relationships part 1: Computing the mean weight of the fish of a given length class *Fishbyte* 5: 11-13

Carpenter, K,E,H,Y; Summer, H.J. and Marcus L.F. 1996: Converting truss interland mark distance to Cartesian coordinates. In Marcus L.F.; Corti, M. Aloy, A.Naylor G. and Slice D.E, Eds *Advances in Morphometric* ATO ASI series A life Science, New York Plenum publ. 284: 103-111

Duan, Z.H., Yi,M.H. and Wang, Z.G. 2005:Thin layer hot-air drying of bighead Carp. *Fiseries Sci.* Vol.32 No 6:29-32

Ebisemiju, F. S. 1993*: Ado-Ekiti region, definition, location extent and setting In: Ado-Ekiti region, geographical analysis and master plan* (Edited by Ebisemiju, F.S., Alphs Printers, Lagos (1-2)

Fagbenro, O.A. Olaniran T.S and Esan A.O. 1991: Some aspect of the biology of the catfish, *Heterobranchus bidorsalis* Geoffrey Saint-Hallare, 1809 (Clariidae) in River Ogbese, Nigeria *Jour. of Afri. Zoo.* 105: 363-372

Fagbuaro O. 2015: Morphometric characteristics and meristic traits of *Tilapia zillii* from three major dams of a southwestern state, Nigeria *Cont. Jour. Biological Sciencs* 8(1) 1-7

FAO, 2011: The State World fisheries and Aquaculture, Food and Agriculture Organisation Rome; Italy.

Freyer G. and Iles, T.D 1972: *The Cichlid fish of the great lakes of Africa*. Oliver and Boyd. Edinburgh 641pg.

Froese R. 2006: Cube law; condition factor and weight length relationship: history, meta-analysis and recommendations. *Jour. Appli, Icthyol.* 22: 241-53

Holden M. and Reed W. 1972: *West Africa freshwater fishes* longman Goup Ltd. Harlow UK

Huet M.J. 1949: Racial divergence in fin rays variation patterns in *Gasterosteus aculeatus Jour. Genet.* 49: 783-191

Ikusemiju, K. 1975: A comparative racial study of Catfish, *Chysichthys nigrodigitatus* (Lacepede) from Lagos and Lekki lagoon, Nigeria. *Bull.I.F.A.N. T* 37 Ser A4: 887-898.

Kara,C. Alp, A and Gurlek, M.E. 2011: Morphological variations of the trouts (*Salmo trutta* and *Salmo platycephalus*) in the rivers of Ceyhan, Sehan and Euphrates, Turkey. *Turkish Jour. of Fisheries and Aquatic Sci* 11: 77-85.

Kosai P, Sathavorasmith, P., JiraungKoorskul K and JiraungKoorskul, W. 2014: Morphometric characters of Nile Tilapia (*Oreochromis niloticus)* in Thailand *Walailak Jour. Sci. and Tech.* 11 (10): 857-863

Kumar V.V, Reddy A.D, Choudhury S.R, Balakrishna, C.H, Satyanaryan, Y., Nagesh, T.S and Das S.K 2014: Morphometry and meristics counts of Bombay duck, Harpodon nehereus (Hamilton, 1822) along Sunderban region of west Bengal, India Proceeding of the Int. Academy pf Ecol. And Environment Sci. 4(3) 95-105

Largiader, C.R. Klingenberg CP and Zimmerman M. 1994: Morphometric variation in a hybrid zone of two subspecies of /genus cistae (*Heteroptera gerriadae*) in the Maritime Alps. *Jour. Evolution Biol*.7: 697-712.

Le Cren E.D. (1951): The length-weight relationship and seasonal cycle in gonad weight and conditions in the pearch *Perca fluvialilis. Joour. Animal Ecol.* 20(2) 201-219

Olaosebikan, B.D. and Raji, A. 1998: *Field guide to Nigeria freshwater fishes*. Decency Printers and Stationary Ltd. Ilorin, Nigeria. 105pp.

Olurin K.B and Aderibigbe, O.A. 2006: Length-weight relationship and condition factor pond reared juvenile *Oreochromis niloticus World Jour. Zool.* 11: 871-9

Omoniyi I.T and Agbon A.O. 2008: Morphometric variations in *Sarotherodon melanotheron* (Pisces: Cichlidae) from Brackish and freshwater habitats in South-Western Nigeria. *West Africa Jour. of Applied Ecol.* Vol 12: 01-05.

Njoku D.C. and Keke I.R. 2003: A comparative study on Water Quality Criteria of Demli river in Jos, Pleateau State of Nigeria. *ASSET series* A, 3: 143- 153.

Reed, W. Burchard, J. Hopsen, A.J.,Jenness, J. and Yaro, I. 1967: *Fish and* Fisheries of Northern Nigeria. Gaskiyya Corporation Zaria 226Pp.

Scheiner, S.M. 1993: Genetics and evolution of phenotypic plasticity. *Annual Rev. of Ecol. Syst.* 24: 35-68.

Tesch, F.W 1971: Age and growth In *Methods of Assessment of Fish Production in Freshwaters* (ed). Ricker, W.E Oxford Scientific Publications Pp 99-130

Watanable W.O. Losordo T.M. and Fitzsimmons K. 2002: Tilapia production systems in the Americas Technological advances trends and challenges *Rev. Fish Sci* Vol. 10 (3) : 465-498.

Yakubu, A.and Okunsebor, S.A. 2011: Morphometric differentiation of two Nigerian fish species (*Oreochromis niloticus* and *Lates niloticus*) using principal components and discriminant analysis. Int. *J. Morph*. 29:429-34.

Zafar, M, Mussadeleq, Y Akhter, S. and Sultan A. 2003: Weight-length and condition factor relationship of Thaila, *Catla catla* from Rawal Dam Islamabad, Pakistan. *Pakistan Jour. of Bio.l Sci.* 6(17): 1532-1534.

Table1:The mean and the relationship between males and females morphological and meristics traits of *Oreochromis niloticus* and *Tilapia zillii*

Morphometric Characters	*Oreochromis niloticus* Female				*Tilapia zillii* female				*Oreochromis niloticus* Male				*Tilapia zillii* male			
	X	a	b	r	*X*	a	b	r	*X*	a	b	R	*X*	a	b	r
BW	164.7±26.30	-125.4	14.43	0.71	167.8±29.32	-204.7	17.61	0.74	170.2± 31.84	-225.7	20.56	0.86	162.2 ±33.24	-161.6	15.85	0.88
SL	16.3±0.98	1.36	0.73	0.91	16.17±0.99	2.78	0.67	0.84	16.51 ±1.08	2.48	0.65	0.81	16.38±1.46	2.78	0.67	0.84
BD	9.54±0.98	2.01	0.37	0.57	9.51±0.53	4.52	0.24	0.55	9.63 ±0.54	3.57	0.29	0.72	9.06 ±0.98	2.69	0.31	0.59
HL	5.39±0.35	2.63	0.14	0.51	5.15 ±0.39	5.88	-0.03	-0.12	5.53 ±0.38	1.79	0.18	0.64	5.28 ±0.29	3.29	0.10	0.58
HD	5.49±0,49	1.69	0.19	0.50	5.67 ±1.65	4.69	0.05	0.12	5.94 ±0.72	2.46	0.17	0.31	10.83 ±3.22	2.93	0.13	0.34
ED	1.29±0.05	1.42	-0.00	-0.05	1.4±0.16	0.32	0.05	0.43	1.33 ±0.10	0.76	0.03	0.25	1.26 ±0.19	0.32	0.05	0.43
SNL	0.12±0.05	-0.09	0.01	0.39	0.12± 0.04	0.03	0.00	0.13	0.14 ±0.05	0.00	0.01	0.18	0.17 ±0.05	0.09	0.00	0.11
VOAEFL	8.67±0.75	0.96	0.11	0.52	3.18 ± 0.41	0.19	0.14	0.43	3.22 ±0.36	-0.45	0.18	0.65	3.19 ±0.33	-0.14	0.163	0.89
DVCFL	2.97±0.03	0.63	0.12	0.53	2.82 ±0.30	2.26	0.03	0.10	3.01 ±0.23	0.51	0.12	0.69	2.81 ±0.57	-1.61	0.22	0.69
AEDCFL	3.71±0.33	0.58	0.16	0.62	3.5 ±0.47	0.37	0.15	0.38	3.6 ±0.35	-0.81	0.21	0.83	3.53 ±0.36	0.52	0.15	0.76
DEDCFL	3.66±0.34	0.73	0.15	0.56	2.23 ±0.42	1.57	0.09	0.33	2.13 ±0.20	0.08	0.17	0.79	2.18 ±0.33	-1.05	0.23	0.79
AEVCFL	2.32±1.20	0.57	0.08	0.33	2.14 ±0.27	-1.06	0.15	0.71	2.43 ±0.65	-0.24	0.13	0.27	2.23 ±0.33	-1.18	0.17	0.72
DFR	27.0±0.5	24.6	0.12	0.13	27.1 ±2.08	17.31	0.46	0.27	27.0 ±0.61	25.50	0.07	0.16	26.22 ±2.33	10.94	0.75	0.59
AFR	1.3±0.10	12.1	0.05	0.04	11.87±1.13	5.64	0.29	0.32	11.71 ±1.65	7.17	0.22	0.18	11.11 ±1.36	5.75	0.26	0.35
PEFR	11±0.10	11.8	-0.04	0.00	11.2 ±1.52	8.30	-0.08	-0.07	11.64 ±0.95	9.18	0.12	0.16	10.67±1.73	17.99	-0.52	-0.58
PCFR	7.0±1.0	5.65	0.05	0.04	6.6 ±1.35	11.73	-0.03	0.00	6.07 ±0.26	7.37	-0.06	-0.32	10.67 ±1.73	2.85	0.38	0.41
CFR	16±0.20	15.66	0.00	0.00	15.45 ±1.30	18.16	-0.13	-0.12	16.64 ±2.34	14.48	0.10	0.06	16.85 ±1.90	7.98	0.44	0.42
CPD	3.47±0.04	0.99	0.12	0.45	3.41 ±0.50	0.49	0.18	0.45	3.20 ±0.49	3.74	-0.03	-0.07	3.41 ±0.50	2.10	0.06	0.23

Note: correlation coefficient (r), intercept (a), regression coefficient (b), mean (*X*)
BW=Body weight, SL=Standard length, BD=Body depth, HL=Head length, HD=Head depth, ED=Eye diameter, SNL=Snout length, VOAEFL=Distance between the ventral fin origin and end of anal fin, DVCFL= Distance between dorsal and ventral caudal fin origin, DEDCFL=Distance between dorsal fin end and dorsal caudal fin origin, AEDCFL=Distance between anal fin end and dorsal caudal fin origin, AEVCFL=Distance between anal fin end and ventral caudal fin origin, DFR= Dorsal fin rays, AFR=Anal fin rays, PCFR= Pelvic fin rays, PEFR= Pectoral fin rays, CFR= Caudal fin rays.