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Research Article

Length–Weight Relationship and Condition Factor of Guinean Tilapia *Coptodon guineensis* (Günther, 1862) from the New Calabar River and Buguma Creek, Nigeria

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Authors' Contributions
OAO designed the research and wrote the manuscript. IOT and OAO identified fish species. HED and BJ collected the data while NAB, HED and BJ analysed it.

Keywords
Coptodon guineensis, Length-weight relationship, Condition factor, New Calabar River.

Abstract | This research was carried out to investigate the length-weight relationship and condition factor of *Coptodon guineensis* from the New Calabar River and Buguma Creek, Nigeria. Assessments of the length and weight parameters indicated that the total length ranged from 12.4 cm to 29.8 cm with a mean value of 17.84±0.40 and the weight varied between 41g to 640g in subject collected from New Calabar River population. In Buguma Creek, the total length ranged from 10.9 cm to 23.5 cm with a mean value of 14.99 ± 0.26 and the weight was from 21g to 520g. The b value varied between 2.96, which were recorded for New Calabar River population, and 3.28 that was observed for Buguma Creek population. However, the condition factor of *C. guineensis* from Buguma Creek was significantly ($p<0.005$) higher than New Calabar River. These results demonstrate that the well-being of the species was slightly better in Buguma Creek than New Calabar River. Collectively these findings confirmed the ability of the species to thrive in brackish water and freshwater, and that these parameters support the assessment of the well-being of different fish in different locations.

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Introduction

Cichlids are perch-like fish and this family has produced an enormous variety of species in African freshwaters (Holden and Reed, 1972). It is estimated that Africa alone hosts at least 1600 species (Nelson, 2006), but may count up to 3000 species (Kocher, 2004). *Coptodon* is a genus of cichlids native to Africa and is also found in the Middle East. There are currently 31 recognized species in this genus (Dunz and Schliewen, 2013). Formerly included in *Tilapia*, but this genus was separated recently following a molecular phylogenetic by Dunz and Schliewen (2013). *Coptodon guineensis* was formerly and wrongly referred to as *Tilapia melanopleura* in many parts of the world (Philippart and Ruwet, 1982). The *C. guineensis* is easy to separate from other Tilapia species occurring in Nigerian freshwater because of its emarginated caudal fin and prolongation of the rayed part of the dorsal fin (Adesaulu and Sydenham, 2007). The species is being exploited for food and supporting both small-scale subsistence and commercial fisheries. It has been identified as a potential species for aquaculture in Nigeria.

The cichlids *C. guineensis,* is a brackish water eu-

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ryhaline species found along the West coast of Africa (Philippart and Ruwet, 1982), however, like most cichlids the species thrive in freshwater. The body-form reflects the fish habitats to locate food, mates, avoid predators, reduce competition for the same resources at the same time, and promote successful reproduction, growth and development (Ribbink and Lewis, 1981). Different environments have influenced the well-being of fish (Medri *et al*., 1990).

The relationship between length and weight (LWR) along with condition factors are useful parameters for assessing the well-being of individuals and to determine probable variations among different stocks of the same species (King, 2007). Anderson and Neumann (1996) have noted that length and weight assessments provide cornerstones statistics in the foundation of fishery research and management, and this useful tool provides important information concerning the structure and function of fish populations. Cone (1989) has indicated that the relationship between fish weight and length is frequently used to compare the effect of biotic and abiotic factors on the health or well-being of a fish population. Length–weight relationships (LWRs) are crucial for comparing the life histories of fishes among different geographic regions (Hossain *et al*., 2012, 2013).

The length-weight relationship provides means for finding out the condition factors, which indicate the "wellbeing of the fish". This factor is a measure of various ecological and biological factors such as degree of fitness, gonad development and the suitability of the environment with regard to the feeding condition (Mac Gregoer, 1959). In addition, condition factors of different population of the same species provide information on food supply, the timing and duration of breeding (Weatherly, 1972). Many studies have been carried out assessing the length-weight relationship and condition factor of cichlids in Nigeria (Fagade, 1979; Haruna, 2006; Ayoade and Ikulala, 2007; Olopade and Rufai, 2014; Uneke, 2015). However, there is little-to-no information on *C. guineensis*. Therefore, the objective of this study was to provide detailed information on the length-weight relationship and condition factor of *C. guineensis* from two different water bodies.

Materials and Methods

Samplings were conducted at New Calabar River and Buguma Creek in Rivers State, Nigeria (Figure 1). The New Calabar River is situated about 15km from Port Harcourt City, located in Obio-Akpo Local Government Area of Rivers State between longitude 6.8985°E and latitude 4.8888°N of the Greenwich meridian. The New Calabar River is characterized by fresh water whereas Buguma Creek is located southeast of Niger Delta between Longitude 6°47°E and 6°59°E and Latitude 4°31°N and 4°59°N in Asari-Ton Local Government Area Rivers State. The Buguma creek system consists of a main creek channel and associated interconnecting creeks, lying along the coast of Nigeria and it is characterized by brackish water (Ogbeibu and Oribhabor, 2008).

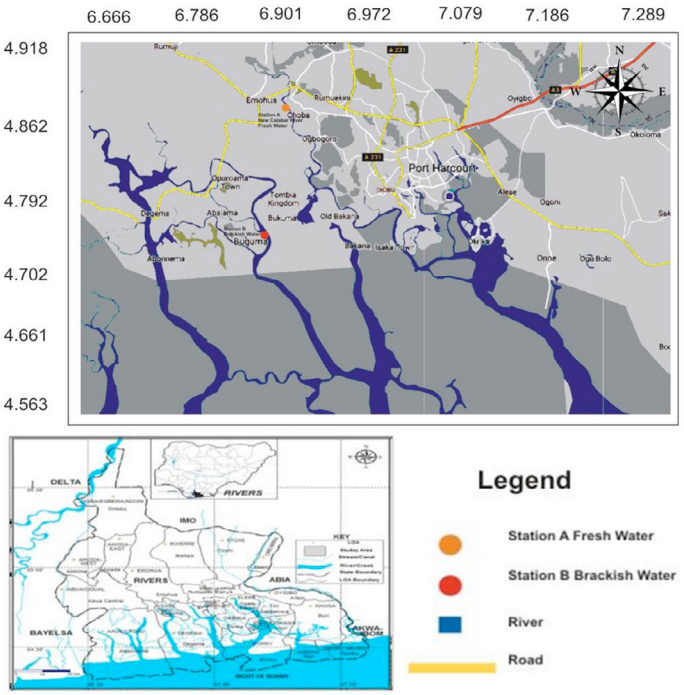

Figure 1: Map of the study sites.

Fish samples were collected monthly between January and July 2007 from the catches of the local fishers using gillnets (mesh size of 19.05, 25.4, 50.8 and 75.6 mm), hooks and cast nets (mesh size of 15 mm and 20 mm) in the two landing sites. Fish samples were pooled after capture, and immediately transported to the laboratory for analysis. In the laboratory, fish specimens were sorted and identified to the species level using the key description, previously reported by Adesulu and Sydenham (2007). Total length (TL), standard length (SL) and total body weight (W) were measured using measuring board and an electronic balance with 0.1 cm and 0.1 g accuracy, respectively.

For each fish sample, parameters such as length (L) in centimeters (cm) and weight (W) in grams (g) were used to estimate length-weight relationship (LWR) formula, *i.e.* W = aLb and transformed to Log W = Log a + b Log L through base 10 logarithm transformation. The LWR was calculated using the expression: $BW = a*(TL)^{b.}$ Parameters *a* and *b* were estimated by linear regression analysis based on natural logarithms: $\ln(W) = \ln(a) + b \ln(L)$.

The condition factor which shows the degree of well-being of the fish in their habitat was determined using the equation (Gomiero and Braga, 2005):

$$K = 100W/L^{b}$$

Where, K is condition factor, W is weight of the fish in gram (g), L is total length of the fish in centimeters (cm), b is value obtained from the length-weight equation.

All statistical analyses were considered significant at a 5% level ($p < 0.05$).

Results

The total length ranged from12.4cm to 29.8cm with a mean value of 82.89 ± 6.86 and the weight varied between 41g and 640g for New Calabar River population. In Buguma Creek, the total length ranged from 10.9cm to 23.5cm with a mean value of 14.99 ± 0.26 and the weight was between 21g and 520g (Table I). Estimates of the coefficient b ranged from 2.96 for New Calabar River population to 3.28 for Buguma Creek population. This shows that the stocks exhibited an allometric growth pattern, while the stock from Buguma Creek showed positive allometric, New Calabar stock revealed negative allometric growth pattern (Table II). A logarithm graph prepared for the two stocks (Figures 2 and 3) showed that a straight-line relationship is a positive correlation between the length and the weight. The coefficients of determination (r^2) of the length-weight relationship regressions ranged from 0.73 for Buguma Creek population to 0.93 for New Calabar River population.

Table I: Size range of *C. guineensis* from Buguma Creek and New Calabar River, Nigeria.

Size	New Calabar River		Buguma Creek	
	Range	Mean ± SE	Range	Mean ± SE
Weight (g)	41 -640	135.03±11.29	21 –520	82.89 ± 6.86
Total length (cm)	12.4-29.8	17.84±0.40	10.9-23.5	14.99 ± 0.26
Standard length (cm)	8.4 - 24.9	13.96±0.38	7.5 - 19.5	11.39 ± 0.23

Table II: Growth pattern of *C. guineensis* from Buguma Creek and New Calabar River, Nigeria.

Location	Regression equation (*LogW=Log a+bLogSL*)	r^2	Growth pattern
Buguma Creek	LogW = -4.63 + 3.28LogSL	0.73	Positive allometry
New Calabar River	LogW = -3.785 + 2.96LogSL	0.93	Negative allometry

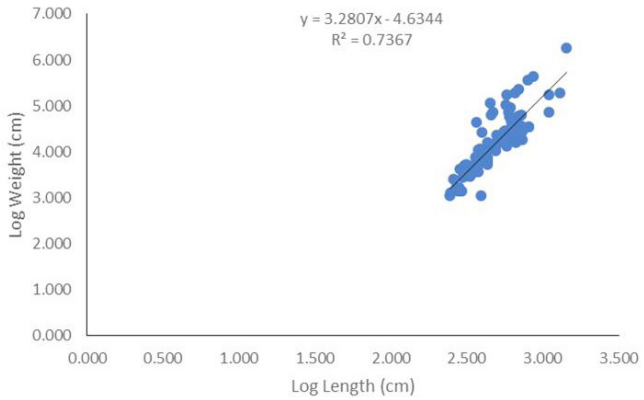

Figure 2: Relationship between log weight and log length of *C. guineensis* in Buguma Creek.

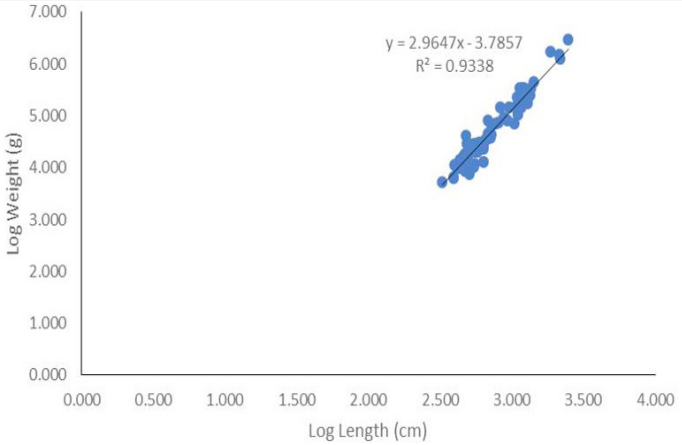

Figure 3: Relationship between log weight and log length of *C. guineensis* in New Calabar River.

Table III: Condition factor for New Calabar River and Buguma Creek.

Location	Condition factor (K)	Range (cm)	F	T	p-value
NC River	2.08 ± 0.03	1.36-3.25	23.82	-1.203	0.23
Buguma Creek	2.19 ± 0.09	0.87-5.52			

The condition factor of *C. guineensis* from New Calabar River ranged from 1.36 to 3.25 with mean value of 2.08 ± 0.03, while condition factor of *C. guineensis* from Buguma Creek ranged from 0.87 to 5.52 with mean value of 2.19±0.09 indicating the Buguma Creek stock (Table III). The condition factor of *C. guineensis* from Buguma Creek was slightly higher than New Calabar River. The test revealed no significant difference in the Buguma stock and New Calabar River stock. The relationship between body weight with condition factor as shown in Figures 4 and 5 were found to be linear and increasing in body weight also with condition factor. The coefficient of correlation between the body weights with condition factor was low as the values of (r^2) were almost the same (0.4) for *C. guineensis* from the two water bodies. This implies 40% changes in body weight can be explained by condition factor.

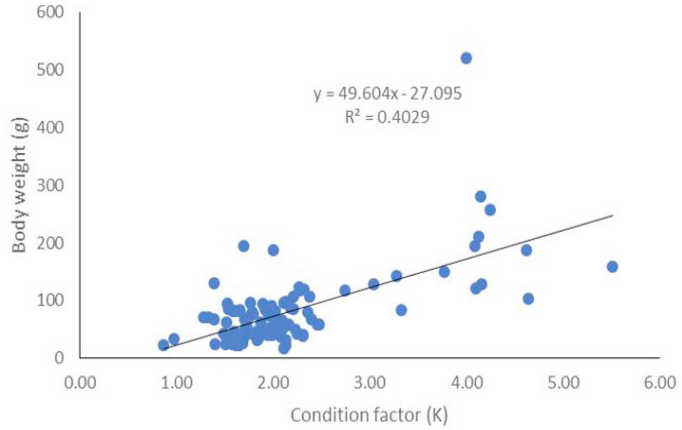

Figure 4: Relationship between condition factor and body weight of *C. guineensis* in New Calabar River.

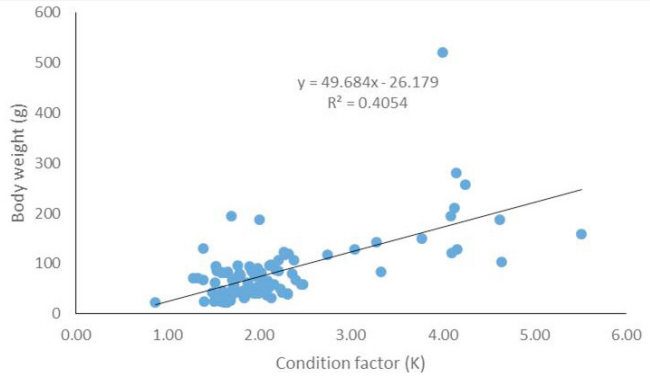

Figure 5: Relationship between condition factor (k) and body weight of *C. guineensis* in Bugama Creek.

Discussion

This study provides for the first time information on the length-weight relationships in *C. guineensis* from the New Calabar River and Buguma Creek. The slope (b) values of the length–weight relationship in both water bodies varied between 2.96 for population from New Calabar River to 3.26 for population from Buguma Creek. The calculated value 'b' of 2.96 in the population from New Calabar River in the present study is similar to the values reported by Naeem *et al.* (2007) for *Orechromics nilotica*. The values of slope 'b' in the two populations were within the expected range of 2.5-3.5 as suggested by Froese (2006). Values of 'b' equal to 3 indicate that the fish grows isometrically; values different from 3 indicate allometric growth, exponent of b<2.5 or to the contrary, an exponent of b>3.5 indicates an over-proportional increase in weight. Both populations could be categorized as display in gallometric growth with a positive allometric growth for *C.guineensis* from Buguma Creek and negative allometric growth for *C.guineensis* from New Calabar River. In line with the findings of this study, Atama *et al.* (2013) reported allometric growth pattern for six species of the cichlid family in River Anambra, Nigeria. Variations in fish growth in terms of length and weight can be explained as an adaptive response to different ecological conditions (Nikolsky, 1963). The variations in the value of the exponent 'b' can be affected by a number of factors including seasonal fluctuations, physiological conditions of the fish at the time of collection, sex, gonadal development and nutritive conditions of the environment as reported by Le Cren (1951) the fishes could grow non-valuable parts such as fins and head at the expense of the valuable trunk.In the present study, the co-efficient of determination (r^2) values, revealed that the moderately value of r^2 of *C. guineensis* were recorded as 0.73 (73% variability) in Buguma creek and very high 0.93 (93 %) in New Calabar River. Andrade and Campos (2002) stressed that the value of the coefficient estimated for a species could vary between stocks and even between areas.

The estimates of the average condition factor ranged from 2.08 ± 0.03 to 2.19 ± 0.09 showing perfect conditions for *C. guineensis* in the two water bodies. The average of value of condition factor obtained in this study is higher than the values reported by Jawad *et al.* (2017) for *C. guineensis* (1.84 ± 0.26) in two lakes in southern Benin, western Africa. The condition factors range (2.08 – 2.19) was in agreement with the range (2.9 – 4.8) recommended as suitable for matured freshwater fish by Bagenal (1978). The condition factor is an index reflecting interaction between biotic and abiotic factors in the physiological conditions of fishes. In this study, the condition factor value was higher in small lengths than in big length. The higher condition factor value obtained in Buguma creek population implies that species was in a better state of growth and health (well-being) in the brackish water. This may be indicative of food abundance, adaptation to the environment and gonadal development (King, 1995).

Conclusion

This study provides information on length–weight relationship of *C. guineensis* from two different water bodies in Nigeria. Results showed a positive allometric growth in the stock from Buguma Creek and negative allometric growth for the stock from New Calabar River. However, the well-being of the species was slightly better in Buguma Creek than New Calabar River. The results of the present study confirmed ability of the species to thrive in brackish water and freshwater.

Conflicts of interest

The authors declare no conflicts of interest.

References

Adesulu, E.A. and Sydenham, D.H.J., 2007. *The fresh water and fisheries of Nigeria*. Macmillan Nigeria Publishers, Lagos, pp. 397.

Anderson, O.R. and Neumann, R.M., 1996. Length, weight and associated structural indices: In *Fisheries techniques* (eds. L.A. Nielsen and D.L. Johnson). American Fisheries Society, Bethesda, MD, pp. 447–482.

Andrade, H.A. and Campos, R.O., 2002. Allometry coefficient variations of the length–weight relationship of skipjack tuna (*Katsuwonus pelamis*) caught in the southwest South Atlantic. *Fish. Res.*, **55**: 307-312. https://doi.org/10.1016/S0165-7836(01)00305-8

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 cichlid (Cichilidae: Perciformis) species of Anambra River, Nigeria. *J. Fish. Aquacul.*, **4**: 82-86.

Ayoade, A.A. and Ikulala, A.A.O., 2007. Length-weight relationship, condition factor and

stomach contents of Hemichromis bimaculatus, *Sarotherodon melanotherson* and *Chromidotilapia guenthsi* (Perciformes: Cichlidae) in Eleiyele Lake, Southwestern Nigeria. *Int. J. Trop. Biol.*, **55**: 969-969.

Bagenal, T.B., 1978. Aspects of fish fecundity. In: *Ecology of freshwater fish production* (ed. S.D. Gerking). Blackwell Scientific Publications, Oxford, pp. 75-101.

Cone, R.S., 1989. The need to reconsider the use of condition indices in fisheries science. *Trans. Am. Fish. Soc.*, **118**: 510-514. https://doi.org/10.1577/1548-8659(1989)118<0511:TNTRTU>2.3.CO;2

Dunz, A.R. and Schliewen, U.K., 2013. Molecular phylogeny and revised classification of the haplotilapiine cichlid fishes formerly referred to as "*Tilapia*". *Mol. Phylogen. Evol,* **68**: 64-80. https://doi.org/10.1016/j.ympev.2013.03.015

Fagade, S.O., 1979. Observation of the biology of two species of Tilapia from the Lagos lagoon Nigeria. *Bull. Inst. Fond Afri. Nore., (Ser. A)*, **41**: 627-658.

Froese, R., 2006. Cube law, condition factor and weight–length relationships: history, meta-analysis and recommendations. *J. appl. Ichthol.,* **22**: 241-253. https://doi.org/10.1111/j.1439-0426.2006.00805.x

Gomiero, L.M. and Braga, F.M.S., 2005. The condition factor of fishes from two river basins in Sao Paulo State, Southeast of Brazil. *Acta Sci. Maringa*, **27**: 73-78.

Bolger, T., and Connolly, P.L., 1989. The suitable of suitable indices for the measurement analysis offish condition. *J. Fish Biol.*, **34**: 171-182. https://doi.org/10.1111/j.1095-8649.1989.tb03300.x

Haruna, M.A., 2006. Length-weight relationship of four fish species (Cichlidae) from Magaga Lake, Kano, Nigeria. *BEST J.*, **3**: 109-111.

Haruna, M. and Bichi, A.H., 2005. Studies on length weight relationship and condition factor of the cichlids of Tomas Lake, Kano, Nigeria. *Biol. Environ. Sci. J. Trop.*, **2**: 94-100.

Holden, M. and Reed, W., 1972. *West African freshwater fish*. London Group Limited, London, pp. 322.

Hossain, M.Y., Rahman, M.M., Miranda, R., Leunda, P.M., Oscoz, J., Jewel, M.A.S. and Ohtomi, J., 2012. Size at first sexual maturity, fecundity, length-weight and length-length relationships of *Puntius sophore* (Cyprinidae) in Bangladeshi waters. *J. appl. Ichthol.*, **28**: 818-822. https://doi.org/10.1111/j.1439-0426.2012.02020.x

Hossain, M.Y., Rahman, M.M., Abdallah, E.M. and Ohtomi, J., 2013. Biometric relationships of the Pool barb *Puntius sophore* (Hamilton 1822) (Cyprinidae) from three major Rivers of Bangladesh. *Sains Malaysiana*, **22**: 1571-1580.

Lecren, E.D., 1951. The length–weight relationship and seasonal cycle in gonad weight and condition in the perch *Perca fluviatilis. J. Anim. Ecol.*, **20**: 201-219. https://doi.org/10.2307/1540

Jawad, L.A., Gnohossou, P., Toussou, A.G. and Ligas, A., 2017. Morphometric relationships of *Coptodon guineensis* and *Sarotherodon melanotheron* (Perciformes, Cichlidae) in Two Lakes of Benin (Western Africa). *Turk. J. Fish. aquat. Sci.*, **17**: 217-221.

King, M., 1995. Fisheries biology assessment and management. Blackwell Science Ltd., London, pp. 341.

King, M., 2007. *Fisheries biology, assessment and management*, 2nd Edition. Blackwell Scientific Publications, Oxford, pp. 381. https://doi.org/10.1002/9781118688038

Kocher, T.D., 2004. Adaptive evolution and explosive speciation, the cichlid fish model. *Nat. Rev. Genet.*, **5**: 288-298. https://doi.org/10.1038/nrg1316

Mac-Gregoer, J.S., 1959. Relation between fish condition and population size in the sardine (*Sardinops cacrulea*). *U.S. Fish. Wild Serv. Fish Bull.,* **60**: 215-230.

Medri, V., Pereira, G. and Leoward, J., 1990. *Growth of Nile tilapia in rivers*. FAO Corporate Document Repository, Rome. Available from: http://www.scielo.br/pdt/rbo/v60n. Accessed on 4/09/2017

Naeem, M., Salam, A. and Khan, M.N., 1992. Morphometric studies of an exotic fish *Oreochromis nilotica* in relation to body size. *Proc. Pakistan Cong. Zool.*, **42**: 599-605.

Nelson, J.S., 2006. *Fishes of the World*. John Wiley and Sons, New York.

Nikolsky, G.V., 1963. *The ecology of fishes* (translated by L. Birkett). Academic Press, London, pp. 352.

Ogbeibu, A.E. and Oribhabor, B.J., 2008. The physical and chemical hydrology of a Niger Delta tidal creek, Nigeria. *Trop. Freshw. Biol.*, **17**: 63-88.

Olopade, O.A. and Rufai, P.O., 2014. Composition, abundance and diversity of the family Cichlidae in Oyan Dam, Ogun State, Nigeria. *Biodiversitas,* **15**: 195-199. https://doi.org/10.13057/biodiv/d150211

Philippart, J.C. and Ruwet J.C., 1982. Ecology and distribution of tilapias. In: *Biology and culture of tilapias* (eds. R.S.V. Pullin and R.H. Lowe-McConnell). International Center for Living Aquatic Resource Management, Manila, pp. 15-59.

Ribbink, A.J. and Lewis, E., 1981. Cichlid distribution in fresh waters in South America and African waters. In: *Cichlid fishes, behaviour, ecology and evolution*, 1st Ed. Chapman & Hall, London, New York, Tokyo.

Uneke, B.I., 2015. Condition factor of tilapia species in Ebonyi River, Southeastern Nigeria. *Int. J. biol. Sci.*, **2**: 33-36.

Weatherly, A.H., 1972. *Growth and ecology of fish populations*. Academic Press, London.