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Length-weight relationship and condition factor of *Tilapia zillii* (Gervais, 1884) in *Oyan* Lake, Abeokuta, Southwest Nigeria

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Abstract
Length-weight relationship parameters and condition factor of *Tilapia zillii* in Oyan Lake, Abeokuta, Southwest Nigeria were estimated. The fish catch of the artisanal fishermen operating in the lake were sampled. Fish samples were collected on monthly basis from January to December, 2012. Gears used were cast nets, gillnets and traps. Total length (cm) and weight (g) of the fish samples were measured and their sexes determined. Data obtained were analysed based on sexes and combined using descriptive and regression statistics. Student t-test was employed to test the hypothesis that there is no significant difference (α = 0.05) between the means (total length and weight) of male and female fish. Statistical results revealed that the population of *T. zillii* in the water body comprised of fish with modal total length of 17.0 cm. The mean total length and weight of male were statistically higher ($p<0.05$) than female fish. Monthly condition factor was highest in March for male (2.49) and April for female fish (2.14). No significant difference was observed between the mean condition factors of male and female fish. Length-weight analysis depicted negative allometric growth pattern with b-values of 2.90, 2.83 and 2.87 for male, female and combined sexes respectively. Results of Student t-test showed that estimated b-values for male, female and combined sexes were not statistically different ($p>0.05$) from 3. It can be concluded that Oyan Lake system provides aquatic habitat conducive for good growth of *T. zillii* in the lake.

Key words: **Oyan Lake, Artisanal fisheries, Sex ratio, Isometric.**

Introduction

Lakes are major water sources and are very diverse both in term of sizes and fisheries potentials. Oyan Lake, a man-made lake, is a major source of fish supply in Abeokuta and Lagos metropolis through artisanal fisheries. The lake was primarily constructed to supply domestic water to Ogun and Lagos States. However, the lake is used for fishing as secondary purpose. *Tilapia zillii* is one of the major commercial cichlids found in the lake. Other cichlids in the lake are *Oreochromis niloticus, Tilapia mariae, Tilapia, macrocephala, Sarotherodon galileaus, Hemichromis fasciatus* (Ikenweiwe *et al*., 2007).

Length-weight relationships of freshwater fishes are useful in fisheries biology studies (Beyer, 1987; Garcia *et. al*., 1989; Sparre and Venema, 1992; Haimovici and Velasco, 2000). These relationships also enable computation of condition indexes (Bolger and Connoly, 1989);

to provide information on the stock composition, life span, age at maturity, life span, growth and production (Bolger and Connoly, 1989; King, 1996; Diaz *et al*., 2000). The condition factor allows for comparisons of species growth, trajectories between fish from different areas, seasons and between sexes (Bagenal, 1978 and Froese, 2006).

The study was necessitated by the observation of many small sized and few big species of *T. zilli* in the catches of the fishermen's landings. This paper aims to provide information on length-weight relationship and condition factor of *T. zillii* in Oyan Lake. Hence, this work can serve an input into the further study of population dynamics of this fish species in the lake.

Materials and Methods

Study area

This study was carried out in Oyan Lake, Abeokuta, Southwest Nigeria. Oyan Lake is a tropical man-made lake located on latitude 7º 15′ 30″ N and longitude 3º 15′ 20″ E at an elevation of 60 m above sea level (Figure 1). The lake also supplies water for irrigation of arable farm lands along its wetlands and has potential to generate electricity. Since its inception, artisanal fisheries have been a major activity in the lake, supplying fresh fish to Abeokuta and Lagos.

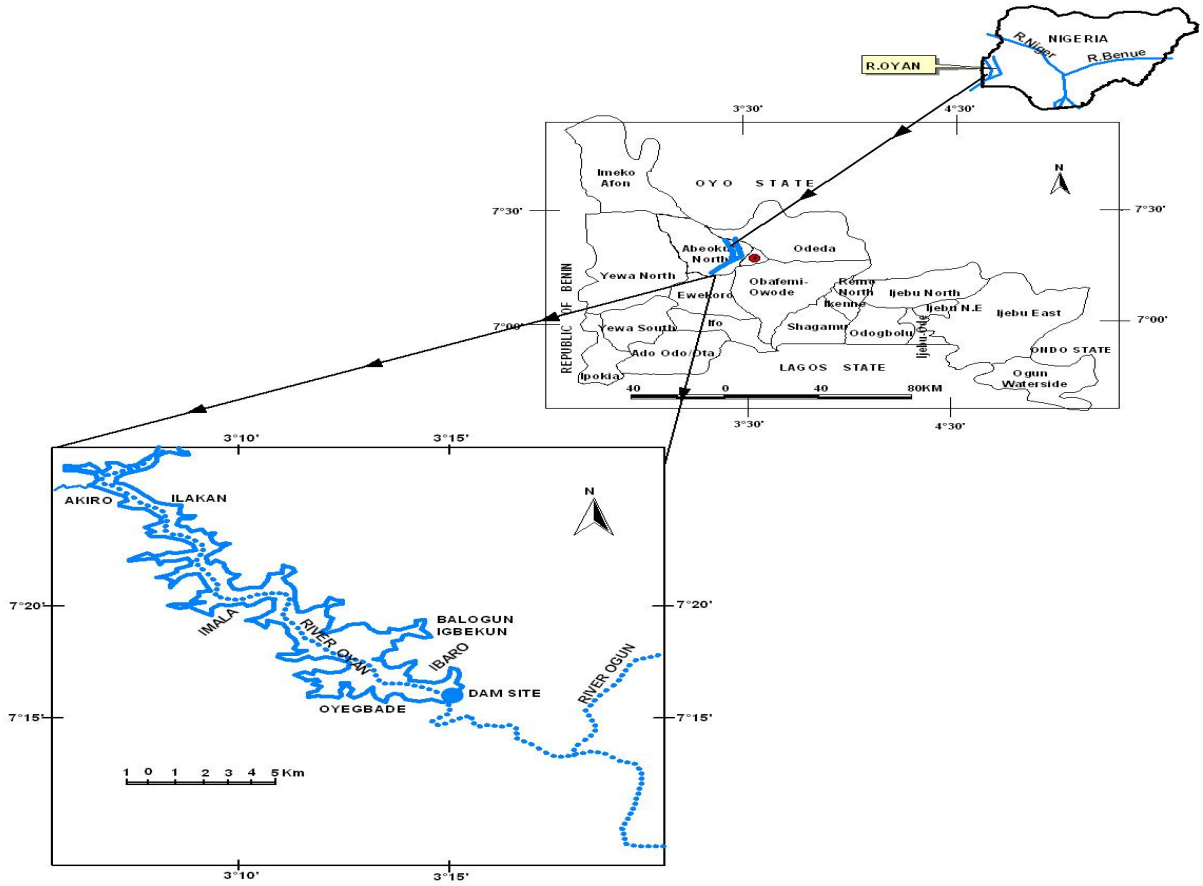

Figure 1: Map of Oyan Lake, Abeokuta, Southwest Nigeria

Data collection

The fish samples were collected for a period of twelve months (January to December, 2012). Fishing gears used were cast net, gillnets and traps with non-return valves. Fish catches from the fishermen operating in the lake were assessed and sorted into species. The description given by Reed *et al*., (1967), Holden and Reed (1972) and Olaosebikan and Raji (1998) were used to identify *Tilapia zillii* among the fish species. Measurements taken from individual fish were total length and weight as recommended by Sparre and Venema (1992). Measurements of the lengths and weight were taken to the nearest 0.1 cm and 0.1 g respectively. Measuring board was used to measure total length while on top loading balance (model OB-3000) was used for weight. Fish samples were separated into different sexes by visual examination of the genital pore; male species were characterized by pointed genital papillae.

Data analysis

Scatter diagram was employed to examine the relationship between the length and weight; detected outliers were removed according to Quinn and Keough (2002) and Froese (2006). Length-weight relationship parameters (a and b) of *T. zillii* in the lake were estimated by linear regression using logarithmic equation logW = loga + b*logL (Zar, 1984; Sparre and Venema, 1992), where W = weight (g), L = total length (cm), a = y-intercept and b = slope of the graph. The data of length-weight relationship of *T. zillii* in the lake were analyzed for male, female and combined sexes. Sex ratio of male to female fish was also determined. The monthly condition factors of male, female and combined sexes were determined by using the formula: $K = 100^* (Wt/L^3)$ (Le Cren, 1951) and Bagenal, 1978);

Where K = condition factor

Wt = weight of the fish (g)

L = total length (cm).

Student t-test was used to test the null hypothesis (H_o) that the means (total length and weight) of male and female fish are homogeneous ($\alpha = 0.05$). The b-values for the male, female and combined sexes were tested if they were significantly different from the isometric growth (b = 3) (Sokal and Rohlf, 1981).

Results and Discussion

In the study, a total of nine hundred and three specimens were sampled consisting of four hundred and eighty males and four hundred and twenty-three females as shown in Table 1. Observed sex ratio of male:female was 1:0.88. The sex ratio observed in Oyan Lake indicated more males than females in the lake system. This observation corroborated the findings of Oso *et al.* (2013), El-Kasheif *et al.* (2013), Mahomoud *et al*. (2011) and El-Sawy (2006). Fryer and Iles (1972) reported that it is common in African lakes that male cichlids dominate because they exhibit more growth than females.

Table 1: Length-weight relationship parameters of *Tilapia zilli* in Oyan Lake, Southwest Nigeria.

Tilapia zilli	n	Total Length (cm)			Weight (g)			k	a	b	R^2
		Min	Max	Mean	Min	Max	Mean				
Male	480	10.5	40	19.7±0.22	21	1396	183.5±7.75	2.02±0.02	-1.58	2.9	0.94
Female	423	10.2	37.8	18.6±0.19	18	1090	146.6±4.90	2.07±0.02	-1.48	2.83	0.89
Combined	903	10.2	40	19.7±0.15	18	1396	166.2±4.75	2.05±0.01	-1.53	2.87	0.92

The range of total length and weight observed in the study were 10.2 – 40 cm and 18 – 1396 g respectively. Imam *et al.* (2010) reported highest values of 20 cm (total length) and 72 g (weight) in Wasai reservoir, Kano and 16.1 cm in Wudil River, Kano (Abdullahi *et al.,* 2014). The variation observed in total length and weight might be as a result of age of the fish, type of gear used and availability of food in different ecological systems. The average total length (19.7 ± 0.15 cm) and weight (183.50 ± 7.74 g) recorded for male *T. zillii* was higher than that of female fish. The result of student t-test showed that average total length and weight of male *T. zillii* in Oyan Lake were significantly higher ($p<0.05$) than that of female. However, significantly higher ($p<0.05$) average condition factor was observed in female *T. zillii* (2.07 ± 0.02) than male fish (2.02 ± 0.020) while 2.05 ± 0.01 was obtained for combined sexes.

Monthly condition factor for male fish ranged from 1.94 in September to 2.49 (March), while that of female was between 1.92 (February) and 2.19 (April) as shown in Figure 2. In combined sexes, the condition factor was highest in March (2.16) and least in February and September (1.96). In the wet season, observed mean condition factor of male (2.00) was statistically higher ($p<0.05$) compared with that of female fish (2.10). However, condition factor of male *T. zillii* (2.08) in Oyan Lake was not significantly different from female (2.01) in the dry season. High condition factor observed in March (male and combined sexes) and April (female) suggested readily available natural food in the lake system which might be as result of influx of nutrients into the lake system; these months coincided with the on-set of rains. The condition factor of *T. zilli* showed no regular pattern during the study period. Dan-kishiya (2013) reported higher condition factor in male compared with female fish in a tropical reservoir; while Anene (2005) observed higher value in female than male fish. Meye (2012) observed no variation in condition factor between male and female *T. zillii* in River Orogbodo, Nigeria. Kumolu-Johnson and Ndimele (2011) reported 3.76 in Ologe lagoon, Nigeria. The condition factor of 2.63 and 3.4 (Imam *et al*., 2010) were obtained during the dry and wet seasons respectively. Documented study on condition factor of other cichlid fish species was 2.09 for *Oreochromis niloticus* (Odulate *et al.,* 2013), while Anene (2005) reported 5.27, 5.38 and 4.58 for *Tilapia cabre, Tilapia mariae* and *Chromilodotilapia guntheri* respectively.

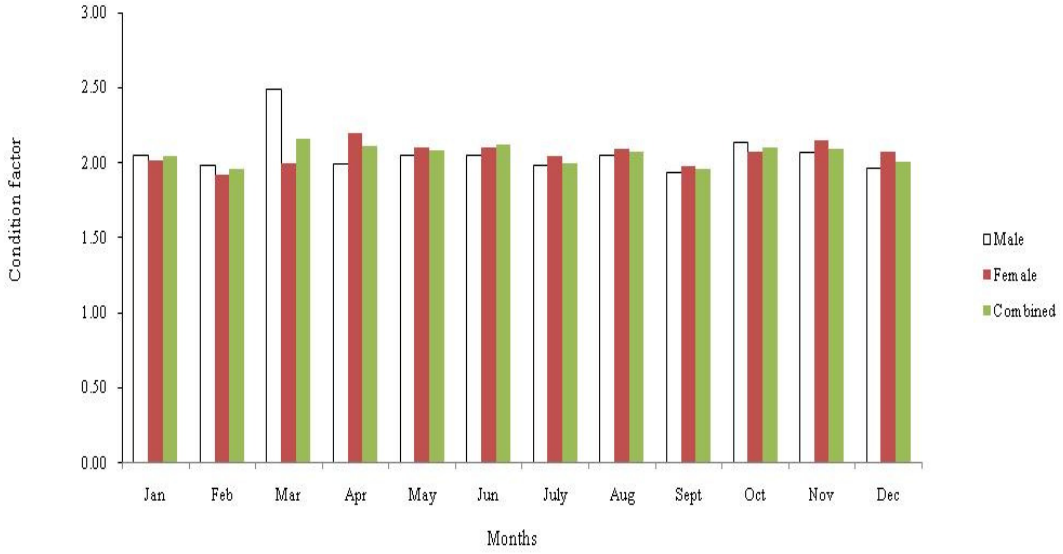

Figure 2: Monthly condition factor of *Tilapia zilli* in Oyan Lake, Southwest, Nigeria.

T. zillii in Wasai river recorded b-value of 2.5 (wet season) and 1.53 in dry season (Imam *et al.*, 2010). Fish species in the same family with *T. zillii* were observed to have b-value of 1.4 (*Orechromis niloticus*) and 2.0 (*Hemichromis bimaculatus*) by Imam, 2010. Ayoade and Ikulala (2007) reported 2.14 (*H. bimaculatus*), 3.34 (*C. guentheri*) and 2.8 (*Sarotherodon melanotheron*) in Eleyele Lake, Nigeria. King (1996) reported 3.17 for *T. mariae* in Qua Ibeo River, 2.85 (Iba-Oku Stream) and 2.58 in Ikpa River, Nigeria.

Results of regression analysis for male, female and combined sexes are graphically depicted in Figures 3, 4 and 5 respectively. Though estimated b-values for male, female and combined sexes indicated negative allometric growth but were not statistically

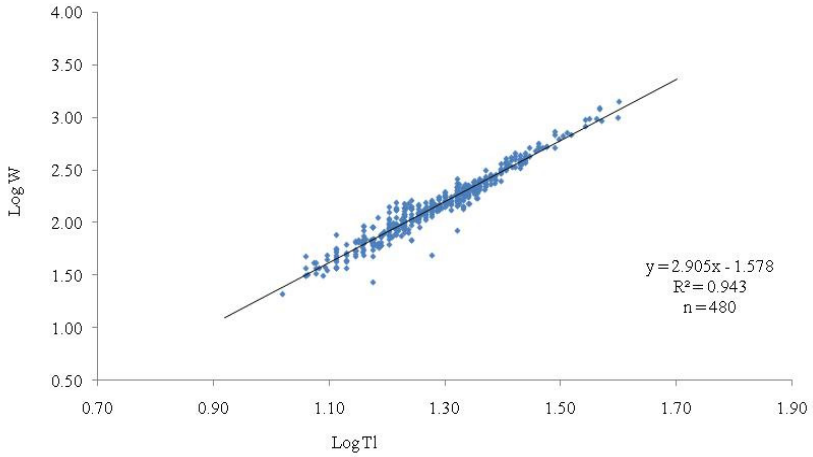

Figure 3: Length-weight relationship of male *Tilapia zilli* in Oyan Lake, Southwest, Nigeria.

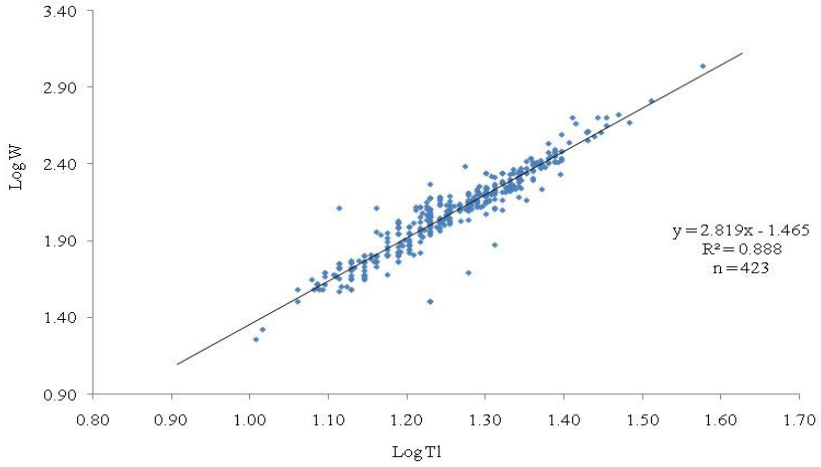

Figure 4: Length-weight relationship of female *Tilapia zilli* in Oyan Lake, Southwest, Nigeria.

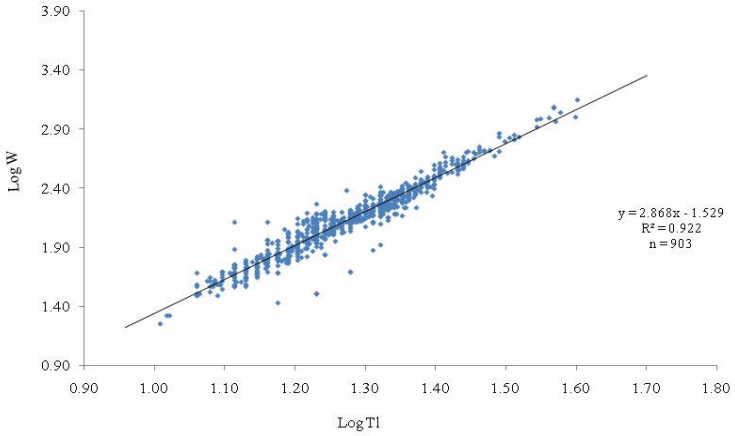

Figure 5: Length-weight relationship of *Tilapia zilli* (combined) in Oyan Lake, Southwest, Nigeria.

different ($p>0.05$) from 3 (isometric growth). Strong positive correlation (r) (0.97, 0.94 and 0.96) was observed between total length and weight for male, female and combined sexes with high value of co-efficient of determination (R^2) respectively (Table 1). It might be concluded that Oyan Lake system provides natural aquatic habitat conducive for good growth of the fish species. Therefore, management efforts should be geared towards sustainable growth and development of *T. zilli* in the lake.

References

Abdullahi, J. M., Fagwalawa, L. D. and Abdulkarim, F. (2014). Length-weight relationship and condition factor of two fish species (*Bagrus Bayad* and *Tilapia zilli*) of Wudil River, Kano, Nigeria. *Aquatic Biology Research*, 2 (1): 13-16.

Anene, A. (2005). Condition factor of four cichlid species of a man-made lake in Imo State, South Eastern Nigeria. *Turkish Journal of Fisheries and Aquatic Sciences*, 5: 43-47.

Ayoade, A. A.and Ikulala, A. O. O., (2007). Length-weight relationship, condition factor and stomach contents of *Hemichromis bimaculatus*, *Sarotherodon melanotheron* and *Chromidotilapia guentheri* (Perciformes: Cichlidae) in Eleyele Lake, South-Western Nigeria. *International Journal of Tropical Biology*, 55 (3&4): 969-977.

Bagenal, T. B., (1978). *Methods of assessment of fish production in freshwaters*. IBP Handbook Blackwell Scientific Publication, Oxford, England. 365pp.

Beyer, J. E. (1987). On length-weight relationships. Part I: Computing the mean weight of the fish of a given length class. *Fishbyte*, 5: 11- 13.

Bolger, T. and Connolly, P.L. (1989). Selection of suitable indices for the measurement and analysis of fish condition. *Journal of Fish Biology*, 34(2): 171–182.

Dan-kishiya, A. S. (2013). Length-weight relationship and condition factor of five fish species from a tropical water supply reservoir in Abuja, Nigeria. *American Journal of Research Communication*, 1(9): 175-187.

Diaz, L. S., Roa, A., Garcia, C. B., Acero, A. and Navas, G. (2000). Length-weight relationships of demersal fishes from the upper continental slope off Colombia. *International Center for Living Aquatic Resources Management Quarterly*, 23 (3): 23–25.

El-Kasheif, M. A., Shalloof, K. A. S. and Authman, M. M. N. (2013). Studies on some reproductive characters of tilapia species in Damietta branch of the River Nile, Egypt. *Journal of Fisheries and Aquatic Science*, 8 (2): 323-339.

El-Sawy, W. M. T. (2006). Some biological aspects of dominant fish population in Lake Edku in relation to prevailing environmental conditions. M.Sc. Thesis, Faculty of Science, Zagazig University, Egypt.

Froese, R. (2006). Cube law, condition factor and weight-length relationships: history, meta-analysis and recommendations. *Journal of Applied Ichthyology*, 22: 241-253.

Fryer, G. and Iles, I. D. (1974). *The cichlid fishes of the great lakes of Africa*. Edinburgh: Oliver and Boyd, Edinburg, Scotland.

Garcia, C. B., Buarte, J. O., Sandoval, N., Von Schiller, D. and Najavas, P. (1989). Length-weight relationships of demersal fishes from the Gulf of Salamanca, Colombia. *Fishbyte*, 21: 30–32.

Haimovici, M. and Velasco, G., (2000). Length-weight relationship of marine fishes from southern Brazil. *International Center for Living Aquatic Resources Management Quarterly*, 23 (1): 14–16.

Holden, M. And Reed, W. (1972). West African Freshwater Fishes. London Group Limited, London. 322 p.

Ikenweiwe, N. B., Otubusin, S. O., Omoniyi, I. T. and Odulate, D. O. (2007). A survey of fish profile of commercial importance in Oyan Lake, Southwestern Nigeria. *Applied Tropical Agriculture*, 12 (1 & 2): 107-113.

Imam, T. S. (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.

Jamu, D. M. and Ayinla, A. O. (2003). Potential for the development of Aquaculture in Africa. *Naga*, 693: 9 – 13.

King, R. P. (1996). Length-weight relationships of Nigerian freshwater fishes. *Fishbyte*, 19 (4): 49–52.

Kumolu-Johnson C. A. and Ndimele, P. E. (2011). Length-weight relationships of nine fish species from Ologe Lagoon, Lagos, Nigeria. *African Journal of Biotechnology*, 10 (2): 241-243.

Le Cren, E. D. (1951): The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). *Journal of Animal Ecology*, 20: 201-219.

Mahomoud, W. F., Amin, A. M. M., Ramadan, A. M., Elboray, K. F., EL-Halfawy, M. M. K. O. (2011). Reproductive biology and some observation on the age, growth and management of *Tilapia zilli* (Gervais, 1848) from Lake Timsah, Egypt. *Journal of Fisheries and Aquaculture*, 3 (2): 16-26.

Meye, J. A. (2012). Length-weight relationship and condition factor of *Tilapia zilli* (Gervais, 1848) from River Orogbodo, Delta State, Nigeria. *Journal of Aquatic Sciences*, 27 (2): 149-158.

Obasohan, E. E., Obasohan, E. E., Imaseun, J. A. and Isidahome, C. E. (2012). Preliminary studies of the length-weight relationships and condition factor of five fish species from Ibiekuma stream, Ekpoma, Edo State, Nigeria. *Journal of Agricultural Research and Development*, 2 (3): 061-069.

Odulate, D. O., Ikenweiwei, N. B., Abdul, W. O. and Abdulsalami, S. A. (2013): Length-weight relationships and condition factor of *Oreochromis niloticus* (Linnaeus) in Oyan Lake, Southwest Nigeria. *Environtropica*, (9&10): 90-96.

Offem, B. O., Akegbejo-Samsons, Y. and Omoniyi, I. T. (2009): Fish Composition and Abundance in the Wetlands of the Cross River, Nigeria. *Aquatic Ecology*, 432: 1155–1166.

Olaosebikan, R.D. and Raji, A. (1998). Field guide to Nigerian freshwater fishes. Federal College of Freshwater Fisheries Technology, New Bussa, Nigeria. 106p.

Oso, J. A., Ogunleye, O. A., Idowu, E. O. and Majolagbe, F. A. (2013). Gonado-somatic index, sex ratio and fecundity of *Tilapia zilli* in the tropical reservoir, Southwest Nigeria. *Journal of Biology*, 1 (2): 42-45.

Quinn, G. P. and Keough, M. J. (2002). *Experimental design and data analysis for biologist.* Cambridge University Press, 537p.

Reed, W., Burchard, J., Hopson, A. J., Jenness, J. and Yaro, I. (1967). Fish and Fisheries of Northern Nigeria. Ministry of Agriculture, Zaria, Northern Nigeria. 226p.

Sokal, R. R. and Rohlf, F. J. (1998). *Biometry*. W.H. Freeman & Co., San Francisco, USA.

Sparre, P. and Venema, S. C. (1992). Introduction to tropical fish stock assessment. Part 1. Manual. FAO Fisheries Technical Paper No. 306/1 Revision 1. Rome, FAO. 376p.

Welcomme, R. L. (2003). River Fisheries in Africa. The relationship of flow regimes. *NAGA,* 26: 23-25.

Zar, J. H. (1984): Biostatistical Analysis. Prentice Hall, New Jersey. 718p.