LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR OF FIVE FISH SPECIES FROM A TROPICAL WATER SUPPLY RESERVOIR IN ABUJA, NIGERIA

DAN-KISHIYA, A. S.

Department of Biological Sciences, University of Abuja, P.M.B 117, Abuja, Nigeria

E-mail: adankishiya@yahoo.com

ABSTRACT

Study on length-weight relationship and condition factor of *Tilapia zilli, Tilapia mariae, Oreochromis niloticus, Barbus occidentalis* and *Barilius loati* from Lower Usuma Reservoir in Abuja was conducted from July 2009 to June 2010 using static fleets of graded gillnets consisting of nine multifilament nets of 25.4, 38.1, 50.8, 63.5, 76.2, 88.9, 101.6, 127.0 and 177.8mm stretched meshes. Each net measured 30m long and 3m deep, with 210/3 twine used for the first eight meshes and 210/6 for the 177.8mm mesh. The nets were set at the shore, surface and bottom of the Reservoir. Two thousand four hundred and fifty two (2,452) fish samples were collected for identification and morphometric measurements in the laboratory. The results obtained showed that the growth pattern of the fishes was negatively allometric with b values range of between 1.4 and 2.3 obtained at $P<0.001$. There was strong correlation between the length and weight of all the species except *Tilapia mariae* which was weakly correlated. The condition factor (K) range of between 1.06 and 2.02 was an indication that the fishes were thriving very well in the Reservoir.

Keywords: Length-weight relationship, Condition factor, Fish species, Reservoir

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INTRODUCTION

Fish is a high quality food, apart from its protein contents; it is also reach in vitamins and contains variable quantities of fat and minerals for human health (Bard *et al.*, 1976). Fish oil contains vitamins A, D, E and K which have been successfully used in controlling coronary heart diseases, arthritis, atherosclerosis, asthma, auto immune deficiency diseases and cancer (Bhuiyan *et al*., 1993). Fish is often recommended for cardio-vascular disease patients because of its unique fat, which is composed mainly of Omega- 3 polyunsaturated fatty acid. In addition to its nutritious flesh, vitamins A and D present in fish oil is important especially in infants and children (Fasakin, 2006). Fish also supplies to the body, a range of inorganic minerals such as Phosphorus, Fluorine, Potassium, Iron, Zinc, Magnesium, Copper and in marine species Iodine as well as vitamins A and B complex (Adeniyi *et al*., 2010) .The proximate composition, nutritive values and mineral composition of fishes in Nigeria has been documented (Olatunde, 1980; Abdullahi and Abolude, 2006; Dankishiya and Kabir, 2006; Abdulkarim and Abdullahi, 2009). Knowledge of length-weight and condition factor (K) of fishes is important in the study of fisheries biology. The condition factor in fish serves as an indicator of physiological state of the fish in relation to its welfare (Le Cren, 1951) and also provides information when comparing two populations living in certain feeding density, climate and other conditions (Weatherly and Gills, 1987). Thus, condition factor is important in understanding the life cycle of fish species and it contributes to adequate management of these species, hence, maintaining the equilibrium in the ecosystem (Imam *et al*., 2010). This study aimed at length-weight relationship and condition factor analyses of *Tilapia zilli, Tilapia mariae, Oreochromis niloticus, Barbus occidentalis* and *Barilius loati* from Lower Usuma Reservoir in Abuja, Nigeria.

MATERIALS AND METHODS

Study Area

Lower Usuma Reservoir is located in Bwari Area council in Abuja the federal capital territory of Nigeria. Abuja is located in the center of Nigeria with a land area of 8,000 square kilometers. It lies between the latitude of $8^{o}25''$ and $9^{o}25''$N and longitude $6^{o}45''$ and 7^{o} $45''$E.

Length – weight relationship

The analysis of length-weight data is aimed at describing mathematically the relationship between length and weight to enable conversion of one to another. It also measures the variation from the expected weight for length of individual fish. Calculations for males and females fish species was done separately and also combined using the conventional formula described by Le-Cren (1951) as follows:

$W = al^b$ ---------- (1)

The above equation (1) and data were transformed in to logarithms before the calculations were made. Therefore equation (1) becomes:

Log W = log a + b log L ---------- (2)

Where W = weight of fish in grams

L = Total length of fish in centimeter

a = constant

b = an exponent.

The 95% confidence interval, CI of 'b' was computed using the equation:

CI = b ± (1.96 x SE)----------(3)

Where SE is the standard error of 'b'.

Condition factor (K)

The condition factors (K) were also calculated for individual fish species for each month using the conventional formulae described by Worthington and Richardo (1930) as:

$$K = \frac{W \times 100}{L^3} \quad \text{---------- (4)}$$

Where K = the condition factor

W = weight of fish in grams

L = Total length of fish in cm.

Le -Cren (1951) noted that condition is related to both sex sizes. Therefore, calculation was made for males and females separately and their statistical differences were obtained.

RESULTS

Length-Weight Relationship

The length-weight relationships of the fish species from the Reservoir are presented in Table 1. The 95% confidence interval values of the exponent 'b' in the relationship varied between 2.2 and 2.3 for *Tilapia zilli*, 1.4 and 1.6 for *Tilapia mariae. Oreochromis niloticus* had values that range between 2.1 to 2.3 while *Barbus occidentalis and Barilius loati* had values that range between 1.9 to 2.2 and 2.3 to 2.4, respectively. Analysis of both the males and females separately and combined showed that all the species exhibited negative allometric growth pattern. Their 'b' values were less than 3. There was strong correlation between the length and the weight of all the species except *Tilapia mariae* which was weakly correlated.

Condition factor (K)

The mean condition factors (K) of all species studied are shown in Table 2, while the monthly condition factor for each species is presented in Figures 1 to 4. There were differences in the condition factors for the males and females as well as combined sexes and the monthly factor for each fish species studied. As shown in the Table, the condition factor for the 5 species recorded range between 1.06 and 2.02. *Tilapia zilli* had a range of 1.96 – 2.02 with a monthly range of 1.43 – 2.55 (Figure 1). Also, *Tilapia mariae* had a range of 1.82 – 1.94 with a monthly range of 1.55 – 2.85 (Figure 2). Others were *Oreochromis niloticus, Barbus occidentalis* and *Barilius loati* with mean K- values of 1.87 – 1.93, 1.24 – 1.31 and 1.06 while there monthly values range between 1.52 – 2.2 (Figure 3), 1.04 – 1.52 (Figure 4) and 0.82 – 1.58, respectively.

Table 1: Length-weight Regression Analysis of Fish species in Lower Usuma Reservoir

Fish species	N	Sex	a	b	95% CI for b	r	Significance of r	Pattern
Tilapia zilli	601	M	0.541	2.301	2.279-2.323	0.844	0.001	Negative allometric
	604	F	0.552	2.275	2.251-2.299	0.861	"	Negative allometric
	1205	M+F	0.545	2.291	2.279-2.303	0.857	"	Negative allometric
Tilapia mariae	120	M	0.700	1.570	1.541-1.599	0.536	"	Negative allometric
	234	F	0.730	1.442	1.422-1.462	0.543	"	Negative allometric
	354	M+F	0.720	1.486	1.470-1.502	0.539	"	Negative allometric
Oreochromis	236	M	0.539	2.328	2.295-2.361	0.861	0.001	Negative allometric
niloticus	298	F	0.577	2.198	2.165-2.231	0.862	"	Negative allometric
	534	M+F	0.559	2.259	2.249-2.269	0.866	"	Negative allometric
Barbus	81	M	0.684	1.945	1.908-1.982	0.700	"	Negative allometric
occidentalis	225	F	0.640	2.168	2.144-2.192	0.740	"	Negative allometric
	306	M+F	0.650	2.11	2.088-2.132	0.731	"	Negative allometric
Barilius loati	53	M+F	0.617	2.333	2.294-2.372	0.785	"	Negative allometric

* N = Number of sample size; a and b = regression coefficients; CI = confidence interval; r = correlation coefficient

Table 2. Mean condition factor (K) of five fish species from Lower Usuma Reservoir

Fish species	N	Sex	Mean K	Mean TL(cm)	Mean W(gm)	STD	SE
Tilapia zilli	601	M	2.02	10.397	22.747	0.26	0.011
	604	F	1.96	11.490	29.733	0.29	0.012
	1205	M+F	2.00	10.945	26.249	0.28	0.008
Tilapia	120	M	1.82	7.360	7.215	0.16	0.015
mariae	234	F	1.94	7.465	8.063	0.15	0.010
	354	M+F	1.90	7.429	7.776	0.16	0.009
Oreochromis	236	M	1.93	10.742	23.891	0.25	0.016
niloticus	298	F	1.87	11.944	31.942	0.29	0.017
	534	M+F	1.91	11.413	28.384	0.12	0.005
Barbus	81	M	1.31	10.021	13.233	0.17	0.019
occidentalis	225	F	1.24	10.266	13.406	0.19	0.013
	306	M+F	1.26	10.201	13.361	0.18	0.010
Barilius loati	53	M+F	1.06	12.102	18.759	0.14	0.019

* N = Number of sample size; K= Condition factor; TL= total length; W= weight; STD= standard deviation; SE= standard error

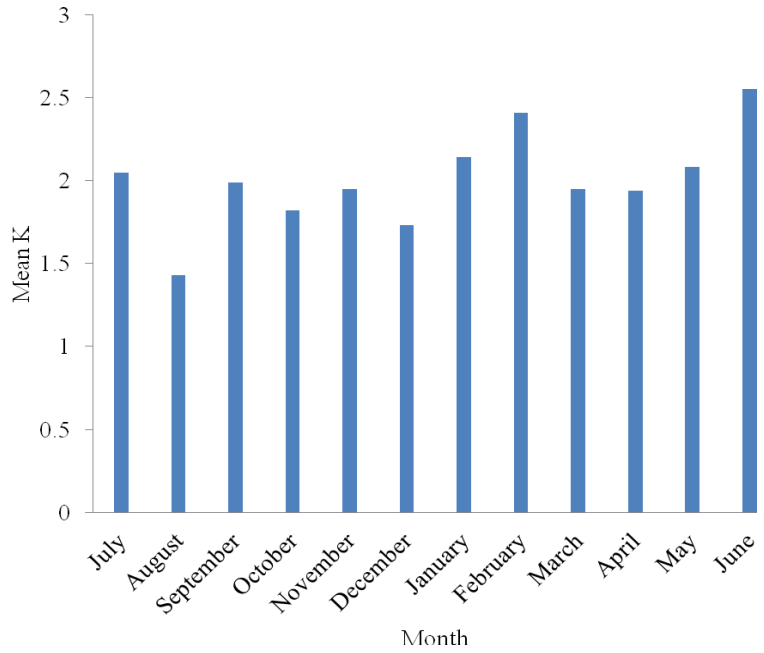

Figure 1. Mean Monthly Variation in the Condition Factor (K) of *Tilapia zilli* both sexes combined.

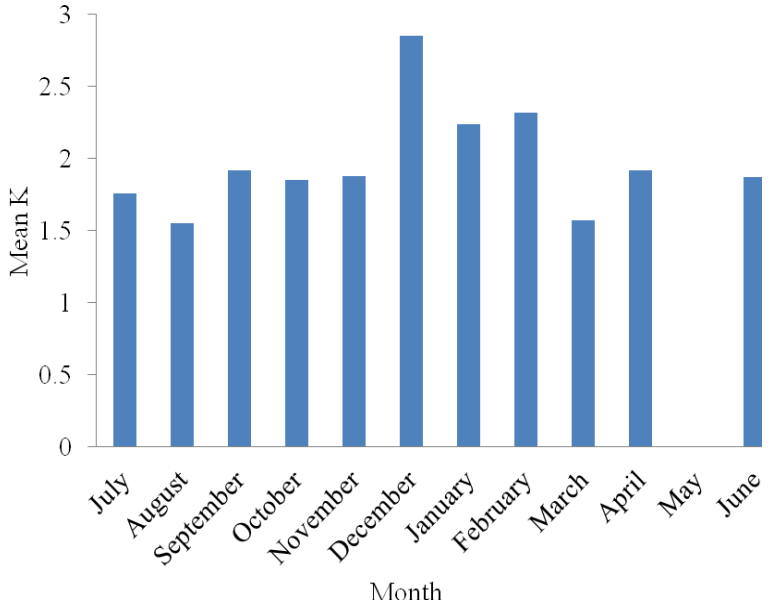

Figure 2. Mean Monthly Variation in the Condition Factor (K) of *Tilapia mariae* both sexes combined.

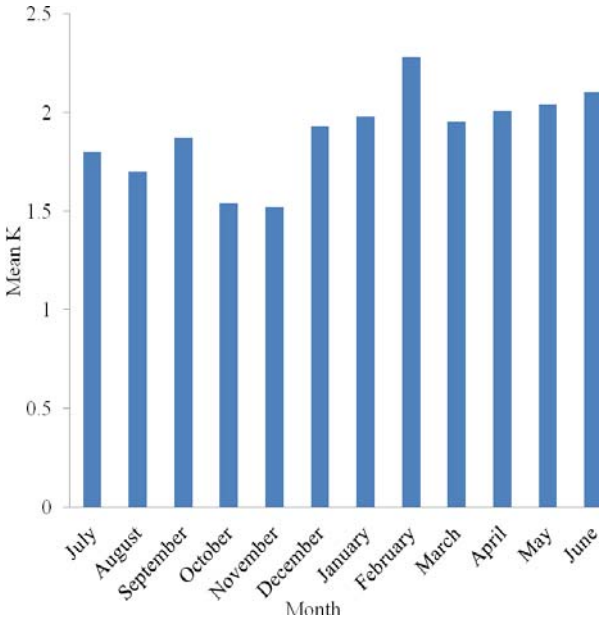

Figure 3. Mean monthly variation in the condition factor (K) of *Oreochromis niloticus* both sexes combined.

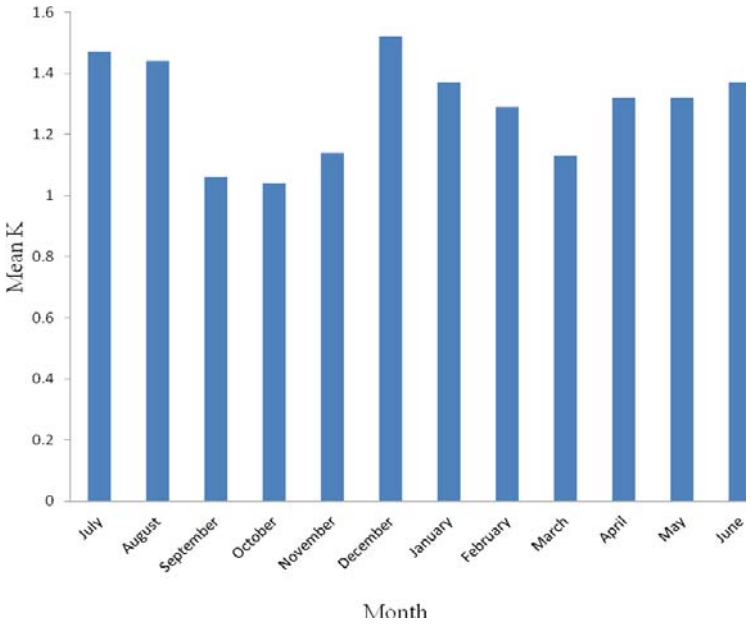

Figure 4. Mean Monthly Variation in the Condition Factor (K) of *Barbus occidentalis* both sexes combined.

DISCUSSION

Length-weight relationship

The effective management of any fishery requires considerable knowledge of population parameters such as length-weight relationship. This relationship is very important in fisheries biology because it allow estimation of average weight of the fish of a given length group (Beyer, 1987), assess the well-being of individuals and to determine possible differences between separate unit stocks of the same species (King, 2007). The relationship is also important in fisheries management for comparative growth studies (Moutopoulos and Stergiou, 2002). Also Pauly (1993) stated that length-weight relationship (LWR) provides valuable information on the habitat where the fish lives while Kulbicki *et al*. (2005) stressed the importance of LWR in modeling aquatic ecosystems. The result of the present study showed that the growth of the species in the Reservoir was allometric. This means that the fishes do not grow symmetrically (Tesh, 1968) or the fish becomes thinner with increase in length (King, 1996). This was similar with documented works from Inland water bodies in Nigeria. Notable among them includes the findings of Olatunde (1984) in commercial fish landings in Zaria central market and Abowei and Hart (2009) in an investigation of some morphometric parameters of 10 fin fish species of Lower Nun River in Niger Delta. Also Ibrahim *et al*. (2009) observed allometric growth pattern in Kontagora Reservoir while Ude *et al.* (2011) made similar findings in an evaluation of length-weight relationship of fish species of Ebonyi River. The b values in length- weight relationships determine the growth pattern of the fish species. When b is equal to 3 or close to 3, growth in the fish is said to be isometric i.e. fish becomes more robust with increasing length (Bagenal and Tesch, 1978). Similarly when b is far less or greater than 3, growth in the fish is allometric i.e. the fish becomes thinner with increase in length (King, 1996). The Cichlids (*Tilapia zilli, Tilapia mariae, and Oreochromis niloticus*) in the present study had b value range of between 1.4 and 2.3. This was similar with the findings of Imam *et al.* (2010) with a recorded range of between 1.4 and 2.5 in Wasai Reservoir in Kano. *Barbus occidentalis* and *Barilius loati* belongs to the fish family Cyprinidae and had a b- value range of between 1.9 and 2.3 and this value agreed with the findings of Ibrahim *et al.* (2012) from Kontagora Reservoir in Niger state with a maximum b-value of 2.8 for Cyprinids. However the b-values recorded for all the species in the

present study is below the documented values of 2.5 to 3.5 for tropical fish species (Gayannilo and Pauly, 1997).

Condition factor (K)

The relationship of length-weight can be use in the estimation of condition factor (K) of fish species. In fisheries science, the condition factor is used in order to compare the condition, fatness or wellbeing of fish (Ahmed *et al.*, 2011). It is based on the hypothesis that heavier fish of a particular length are in a better physiological condition (Bagenal and Tesch, 1978). Condition factor is also a useful index for monitoring of feeding intensity, age and growth rates in fish (Ndimele *et al*., 2010). It is strongly influence by both biotic and a biotic environmental conditions and can be use as an index to assess the status of the aquatic ecosystem in which fish live (Anene, 2005). The condition factors (K) of the species in the present study was similar to what was obtained in other tropical water bodies. For example in Nigeria, a range of between 0.49 - 1.48 was recorded by Nwadiaro and Okorie (1985) in Oguta Lake. Also Kumolu-Johnson and Ndimele (2011) obtained a K-value of between 0.91 and 8.46 from Ologe Lagoon in Lagos. But Ibrahim *et al.* (2012) recorded a mean K-value of 1.98 ± 0.35 in Kontagora Reservoir in Niger State. While in sudan Ahmed *et al.* (2011) recorded a K-value range of 0.506 and 3.415. The mean K-values of species sampled had there value greater than 1 which was an indication that the fish species were doing well in the Reservoir even though is less than the 2.9 to 4.8 reported by Bagenal and Tesch (1978) for mature fresh water fish fresh body weight which was attributed to variation in weight of individual fish sampled.

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