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STUDIES ON LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR OF OREOCHROMIS NILOTICUS UNDER CAPTIVITY REARED AT UMUAGWO, IMO STATE NIGERIA

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ABSTRACT

A total of 375 Specimen of *Oreochromis niloticus* (Cichlidaea) with a total length ranging between 5.5cm and 19.9cm, and body weight between 10.5 and 135 grams were analyzed to determine the length-Weight relationship and condition factor of the fish under culture conditions. The fishes were obtained from experimental concrete ponds of Umuagwo, Imo State. The Length –Weight relationship and Condition factors were evaluated in five size classes, representing different stages of fish development and also sexes. In all the cases, growth was observed to be allometric. Juvenile fish (5.0-7.9 cm) and adult (17.0-19.9cm) exhibited negative allometric growth with parabolic equation as $Y= 0.422L^{2.01}$ and $W=0.020L^{2.68}$ respectively. The growth Co-efficient for males was W= 0.170 and $L^{2.45,}$ while that of female W = 0.875 and $L^{-2..680.}$ The combined group of fishes was W=0.077 and $L^{1.434}$. The intermediate size class (8.00-16.9cm) on the other hand exhibited positive allometric growth with parabolic equation $W=0.037L^{6.18}$, with (b>3). In all the groups the length was positively correlated to weight. The Fulton's condition factor K ranged from 1.306 for 17.0-19.9cm size class to 6.581 for 5.0-7.9 cm size class. Chi-square test revealed a non-significant difference $P<0.05$ ($X^2=5$, 70, df 7) in the condition of the fish at various stages of development as well as between sizes. The high values of condition factor could be related to available food organisms in the pond which provided enough food for the growth of the fish.

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Key words: length-weight relationship, Fulton's condition factor, *Oreochromis niloticus*, under captivity.

Introduction

Analysis of growth in Fisheries management is usually designed for predicting the average fish sizes at one point in time and for comparing the well-being of fish under different management strategies. Growth is defined in fish population dynamics as a change in length or weight of the fish over a given time through assimilation of materials from within its environment, including water temperature, quality and available food, organisms and sex of fish (Robert, 1978). The pattern of growth can be divided into four different stages during which a rapid change take place in body shape while changes in the length and weight occur in more linear relationship. As fish nears maturity, much of the energy which had been utilized for growth is diverted to gonadal development. At senility stage of the fish, most of the energy is utilized for maintenance with little incorporated growth. During development fish typically pass through several stages, each of the stages has its own length-weight relationship. Differences in length-weight relationship is attributed to sex, maturity stages, seasons time of the day and changes in the stomach fullness (Bagenal, 1978). A number of studies have been conducted on length-weight relationship and condition factor in some fishes, including *Oreochromis niloticus*. (Abowei et al, (2008), Deekae et al, (2010), Nwadiaro and Okorie (1985), Ajayi (1992), Alfred-Ockiya and Njoku, D.C (1995).

The length –Weight relationship has practical value in Fisheries Biology, because they make it possible to convert length to weight and weight to length (verse versa). Weight parameter is the common index of measurement of production performance, fish yield and sustainability in wild fisheries and aquaculture. It is the form in which fish harvest is separated by fishers without due consideration to length parameter, which is also an important biometric factor in fisheries assessment, when relationship is established between length and weight for any given fish species, conversion from length is easily done. Thus it becomes possible to assign length to weight where the length of a particular species is unavailable. Such data are important in Fisheries research and management of resources.

Le Cren 1951 and Pauly 1983 observed that when the growth coefficient b = 3, the growth is said to isometric, that is growth with changing body proportion and specific gravity change, adding that in most fishes, the different dimensions change with growth. When b is less or greater than 3, the growth is allometric, that is the body proportion as well as specific gravity changes with growth. Within each stage , the coefficient b will often be nearly in contrast throughout the year, while the value of a will often vary seasonally, with time of the day and between habitats, adding that changes in b often occurs between stages of metamorphosis during maturity and major environmental changes.

Studies on condition factor is useful in comparing the relative well-being of fish and is based on hypothesis. According to Bagenal (1978) when growth is nearly isometric, Fulton's condition factor K is satisfactory and may be used to compare different sexes, seasons and habitats. It may also be used when growth is allometric, as well as when the fish are approximately the same length. However, if the length range is large, the relative condition factor could be used.

The condition factor of fishes in the Niger Delta region have been studied; these are by Inyang and Ezenwaji (2004); Ezenwaji and Offiah (2003); Abowei et al, (2008); Chukwu and Deekae (2010b); and Deekae, (2016).

The Fulton's condition factor K compares the average well-being or the condition of the fish (Bagenal, 1978), similarly, the relative condition factor k (Weatherly and Rogers 1978) is a measure of the deviation of a given fish from the average length-weight relationship for its size group and it is suitable for investigation of seasonal changes in the condition of the fish and maturation studies.

This paper deals with length-weight relationship and condition factor of freshwater species, *Oreochromis niloticus* under culture condition. It is aimed at establishing a reliable length-weight conversion factor which would make it possible to convert weight of fish to its corresponding length of fish where length data is unavailable and verse versa. It is further aimed at determining the relative condition of the fish as an index of natural food supply and the state of environmental condition in pond.

Materials and Methods

Fish Sampling: A total of 375 fish specimen of various *sizes* of *Oreochromis niloticus* were sampled to determine the length / weight relationship and condition factor of under culture condition in an experimental pond at Imo Polytechnic Umuagwo Ohaji, Imo State Nigeria. The pond was divided into four quadrant and of all sizes and location. As soon as, the fishes were caught, they were carefully taken to the laboratory where they were sorted into sizes and measurement taken, without damage to the caudal fin. The Total length and Standard length were measured with a Vernier Caliper to the nearest 0.1 centimeters, while the body weight were obtained with Ohaus balance to the nearest 0.1g.

Length/ Weight Relationship

Total length, Standard length as well as body weight relationship were determined for each of the five size classes of *Oreochromis niloticus* as well as male and female individuals, after which they were pooled. The size classes determined were 5.0-7.9cm, 8.0-10.9cm, 11.0-13.9cm, 14.0-16.9cm and 17.0-19.9cm.Regression analysis was done for each size group of fish and a test for significance of difference was conducted before pooling (Le Cren 1951). Length-weight relationship was determined for *Oreochromis niloticus* with reference to methods described by Le Cren (1951), Aramowo, (1983), Pauly (1983), and Njoku (1989).

$W=aL^b$ (Pauly; 1983; Sparre et al., 1989) (1)

Where W= Weight of fish (g)

L= Length of fish (cm)

a= Constant as intercept

b= Slope (exponent as regression co efficient)

3) Condition Factor:

The Fulton's condition factor, K was computed for the various size classes of *Oreochromis niloticus* using the method of Bagenal, (1978)

$$K = \frac{100w}{L^3}$$

K = Fulton's condition factor

W = Weight of fish

L^3 = Cube length of fish

Results

The results of the combined data for male and female *Oreochromis niloticus* is shown in Table 2. The regression values (r) were between 0.4and 0.5 for male and female respectively. When the data was transferred for the various size classes the result is shown in Table 3.

Fulton's condition factor K (Bagenal, 1978) was computed for the five size classes as well as for sexes of *Oreochromis niloticus* under culture condition. The results are summarized in table 4. K values ranged from between 1.30 and 6.531. Statistical evaluation showed that there was insignificant difference in the conditions of various size and sexes of Oreochromis niloticus (P.0.01) (X.70 df7)

Table 1:

Values of growth exponent, the intercepts a and correlation r between total length and body weight of *Oreochromis niloticus* under by size and under culture condition.

Size class (cm)	N	A	B	R	A	R	B
5.0 – 7-9	19	-8.30	2.01	0.393	-0.375	0.422	20.83
8.0 – 10.9	58	-31.00	6.31	0.542	-1.275	0.053	2.78
-11.0 – 10.9	43	-8.77	4.23	0.560	-0.077	0.837	1.42
14.0-16.9	69	-32.00	8.00	0.620	-0.552	0.280	1.000
17.0 – 19.9	10	-48.20	2.00	0.0026	-0.1568	0.027	0.265
Pooled	199	-16.58	2.68	0.490	-1.680	0.010	1.163

Where N = Number of samples

A = Length

B = Weight

a =Intercept

r = regression

b =Slope

Table 2: Values of growth exponent (b), the intercept a and the correlation (r) between total length standard length and body weight by sex of *Oreochromis niloticus* under culture condition (long transformed data).

Sex	N	Standard	T. length	R	A	r	B
Male	87	-56.441 (-1.0475)	8.876 (2.473)	0.436	- 53.74 (-0.769)	10.899	10.899 2.445
Female	89	-60.30 (-1.0567)	8.597 (0.482)	0.560	-47.35 (0.272)	0.533	11.056 (1.937)
Combined Sex	176	-24.56 (-1.126)	4.180 (0.7810)	0.420	-12.56 (-1-112)	0.077	2.880 (1.431)

Table 3: Summary of length – weight relationship by size class of *Oreochromis niloticus* under culture obtained Umuagwo, Imo State.

Size of class (cm)	Regression Equation	Log transformation Version	Parabolic Equations
5.0 – 7.9	r = -8.30 + 2.01TL	Logk = 30.83 logTL $^{-0.0375}$	a = 0.422L$^{2.01}$
8.0 – 10.9	k = 31.0± 6.31TL	Log^{-a} = 2.78logTl $^{-1.275}$	k = 0.053L$^{0.31}$
11.0 – 13.9	f = 6.77 ±4.25Tl	Logf = 1.00logTL$^{0.55}$	H = 0.8571$^{4.23}$
14.0 – 16.9	H = -32.00+8.00TL	Log H= 1.00logTL$^{0.551}$	H = 0.0241$^{8.00}$
17.0 – 19.9	W = -48.20 r = 2.00TL	Log w = 0.265logTL$^{1.568}$	W = 0.027L$^{2.00}$

Table 4: Fulton's condition factor (k) by size class and sex computed for *Oreochromis niloticus* under condition in, Umuagwo, Imo state.

Size of class	N	Mean length	Mean weight	K
5.0 – 7.9	19	7.00	22.40	6.531
8.0 – 10.9	58	9.50	29.0	3.382
11.0 – 13.9	43	11.60	40.9	2.620
14.0 – 16.9	69	15.10	54.8	1.592
17.0 – 19.9	10	18.50	82.7	1.306
Sun total	199			
Sex				
Male	87	11.80	47.9	2.915
Female	89	11.79	47.7	2.966
Combined sex	176			
Grand total	375			

Discussions

The length – weight relationship has practical value in Fisheries biology because it makes it possible to convert length to weight verse versa (Lagler, 1956). According to Bagenal (1978), during development fish typically pass through several stages, each of which may have its own length – weight relationship of *Oreochromis niloticus* under culture condition were evaluated with references to five size classes, each representing a development stage of the fish.

The value of growth exponent 'b' in the length-weight relationship shows that at early stage (larval, fingerlings) and senility stage (old), the fish exhibits negative allometric growth (b = 2.01 and 2.00) respectively. This is opposed to the intermediate stages (juvenile, sexually mature and adult) of development in which the growth is positively allometric (b = 6.31, 4.23 and 8.00) respectively. The overall (pooled) growth exponent 'b' of 2.68 and 2.47 computed for the male and female fish fit favourably with 3.0 and 2.70 reported by Fagade, 1978 for *Tilapia guinenesis* at Lekki Lagos Lagoons. The growth exponent of 6.31 and 8.00 recorded for *Oreochromis* niloticus belonging to 8.0 – 10.9cm and 14.0 – 16.9cm size class appear to be too high and do not fall within the range of b = 2.0 and 4.0 suggested by Le Cren (1951). However, Bagenal; 1978 had observed that the values of growth exponent are usually higher when evaluated in terms of different size classes than pooled values. Generally, the values of length – weight relationship of various classes of *Oreochromis niloticus* under culture condition, computed in this study reflect the different pattern of growth of each development stage of the fish.

According to Robert et al, (1978), the pattern of growth can be divided with at least four different stages namely the larval stage during which rapid growth brings change in the body shape and size, the Juvenile stage which experiences rapid growth in size and body but change in length-weight occurring in a mot linear relationship, at sexual maturity, energy for growth is divided to gonadal development and growth occurs after spanning is completed. At senility (old) stage of the fish, most of the energy is utilized for the maintenance with little growth. The above explanation accounts for the variation in values of the exponent recorded for the various size classes of *Oreochromis niloticus* in captivity. The growth pattern of the fish is generally asymmetrical.

The condition factor, K is a measure of the deviation of a given fish, the average length-weight relationship for its size group (Weatherly, 1973). It is suitable for investigating seasonal changes in the condition of the fish such as food availability and water condition, in the present study, Fulton's condition factor K, ranged from 1.306 for 17.0 – 19.9cm size class to 6.531 for 5.0 – 7.9cm size class.

Except for individuals of 5.0 – 7.9cm size class in which k values of 6.531 was recorded, values of K for other sizes confirmed favourably to values of K reported of Fulton's workers. Oni et al (1983) reported k value of Fulton's condition factor between 0.1-4.03 for *Tilapia zilli*, 1.97 – 3.27 for *Synodontis*, *Schall* and 11.09 – 2.12 for *Alestes nurse*. Ajayi; 1972 had also reported k value in the range of 1.53-2.55 *for Chrysichthys auratus*. The abundance of plankton in the richly fertilized pond supplemented with artificial feedstuff accounts for good condition of

Oreochromis niloticus under culture condition. This may also have accounted for high k values of 6.531 recorded for larval stage of the fish which fed mostly on abundant planktons in the enriched pond. Based on the result of the study, where the Length –Weight relationship has been established of *Oreochromis niloticus*, using the least square regression method and also using Chi-square test X^2 to confirm the authenticity of the result, the Length – Weight can be converted effectively and versa-versa where one of the variable is not known as an index of determining production of the fish.

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