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Length-Weight Relationship, Condition Factor and Sex Ratio of African Mudcatfish (*Clarias gariepinus*) Reared in Indoor Water Recirculation System Tanks

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Abstract: Length-weight relationship, condition factor and sex ratio of 152 specimens of African mud-catfish (*Clarias gariepinus*) reared in indoor water recirculation system tanks were studied. The parameters "a" and "b" of the length-weight relationship were estimated using the formula $W = al^b$ while the condition factor was calculated from the equation $K = W100\ L^{-3}$. The "b" values for the males, females and combined sexes were 1.2713, 2.8412 and 1.8776, respectively. The species exhibited negative allometric growth. The average "K" value for the males was 0.6948±0.2494, females 0.6953±0.0969 while the combined sexes was 0.6540±0.1907 and there was no significant difference among the sexes. The sex ratio of males to females was 1:1.08 and was not significantly different from the expected 1:1 ratio. The determination of "b" and "k" of cultured fish can be useful tools in assessing the well being, growth performance and feed utilization in culture systems.

Key words: Length-weight relationship, condition factor, sex ratio, African mud-catfish, culture, water recirculation system

INTRODUCTION

African catfish (*Clarias gariepinus*) is a tropical fish occurring in fresh water habitat. It is widely cultured in Africa and other parts of the world as a valuable food fish. This is due to its very hardy nature and hence the development of intensive culture systems for commercial culture purposes. In Nigeria, the species is the primary fish cultured commercially in intensive indoor water recirculation systems and is highly priced ranging from N350 kg^{-1} (US $2.70) at farm gate to N 800 kg^{-1} (US $ 6.20) at the open market.

Length-Weight Relationship (LWR) is of great importance in fishery assessments (Garcia *et al*., 1998; Haimovici and Velasco, 2000) and in conjunction with age data can give information on the stock composition, age at maturity, life span, mortality, growth and production (Beyer, 1987; Bolger and Connoly, 1989; King, 1996a, b; Diaz *et al*., 2000). Length-weight is also an important factor in brood fish production as reported by Ricker (1968), King (1996a), Kulbicki *et al*. (1993), Garcia *et al*. (1998) and Haimovici and Velasco (2000).

The condition factor often referred to as the "K factor" provides information on well being of a fish and is usually influenced by age of fish, sex, season, maturity stages, etc. Fish specimens of a given length exhibiting higher weight are said to be in a better condition. The condition factors of gravid females are usually higher but decreases after the eggs are shed. Fulton proposed the use of a mathematical formula for quantifying the condition of fish as $K = 100W\ L^{-3}$.

The objective of this study, was to determine the length-weight relationship, condition factor and sex ratio of a sample of *C. gariepinus* cultured in intensive system. The data obtained will provide baseline information for broodstock selection and development.

MATERIALS AND METHODS

Specimens of *C. gariepinus* were obtained from a private farm in Lagos State operating an indoor water recirculation fish culture system (Dutch model). They were reared for six months in $3m^3$ fibreglass tank at a stocking density of 300-fish m^{-3}. The fish were fed imported extruded fish feed (42% crude protein) at 3% body weight. One hundred and fifty two fish were harvested randomly for this study using a scoop net. The Total Length (TL), Standard Length (SL) and Head Length

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(HL) were taken to the nearest 0.1cm using a measuring board. The body weight was also taken to the nearest 0.01g using a sensitive balance while sex was recorded for all the fish sampled.

The LWR was estimated using the equation $W = al^b$ where W = body weight, L = total length in centimeters while "a" and "b" are regression constant and regression coefficient respectively (Ricker, 1973). The values of constant "a" and "b" were estimated from log transformed values of length and weight ie log w = log a + b log l. The analysis was carried out using Microsoft Excel.

The condition factor was calculated using the formula by Pauly (1983). A chi-squared test was carried out on the observed male and female specimens to show whether the proportions deviated significantly from the expected 1:1 ratio.

RESULTS

Length-weight relationship, condition factor and sex ratio of 152 specimens of *C gariepinus* reared in water recirculation system were determined. The total length ranged from 27.5-43.3 cm while the weight ranged from 138.56-500.43g. The scatter diagrams of the LWR for the males, females and combined sexes are presented in Fig. 1-3, respectively. The value of "b" for the female was 2.8412 while that of the male was 1.2713. The correlation coefficients ("r") were 0.5631, 0.9110 and 0.7043 for the males, females and combined sexes respectively (Table 1). The equations for the LWR of *C gariepinus* in this study were:

Males: Log W = 0.4852 +1.2713 Log L (r = 0.5631)
Females: Log W = - 1.9161 + 2 .8412 Log L (r = 0.9110)
Combined
sexes: Log W = - 0.4458 +1.8776 Log L (r = 0.7043)

The condition factor for male ranged from 0.372 to 1.804 while the females ranged from 0.427 to 0.868. Average "K" value for the males was 0.6948±0.2494; females 0.6953±0.0969 while the combined sexes was 0.6540±0.1907 (Table 1).

The sex ratio of 152 specimens of *C gariepinus* examined showed that males constituted 48.03% (73) and females 51.97% (79) giving a sex ratio of 1: 1.08 male: female ratio.

A chi-squared test carried out on the observed male and female specimens showed that there was no significant difference from the expected 1:1 ratio. Details of the result is presented in Table 2.

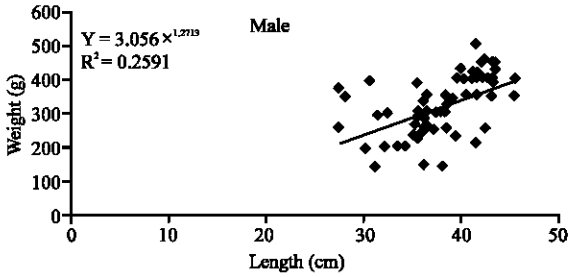

Fig. 1: Length-weight relationship of *C. gariepinus* males reared in water recirculation system

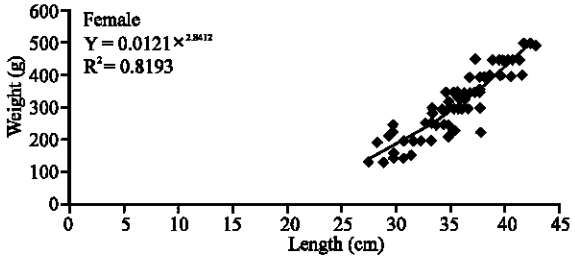

Fig. 2: Length-weight relationship of *C. gariepinus* females reared in water recirculation system

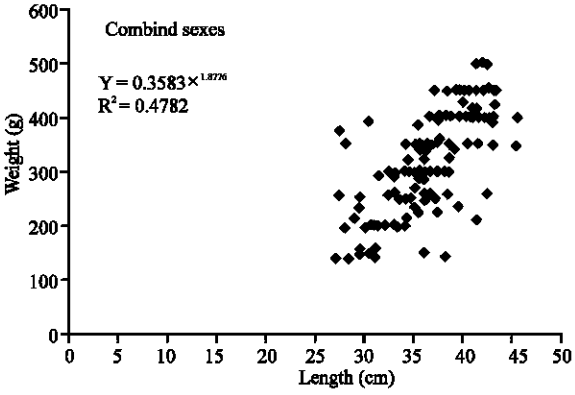

Fig. 3: Length-weight relationship of combined sexes of *C. gariepinus* reared in water recirculation system

Hypothesis:

Ho : Male to female ratio is 1: 1
Hi : Male to female ratio is not 1:1
$\alpha = 0.05$

If Ho is true, we will accept the following number in each category.

TS = 0.2368, df 2-1, k=2
The q(0.05) with 1 degree of freedom = 3.84

Table 1: Regression co-efficient of *C gariepinus* reared in water recirculation system

Sex	Mean condition factor ("K")	Regression constant ("a")	Regression co-efficient ("b")	Correlation co-efficient ("r)
Male	0.6948±0.2494	0.4852	1.2713	0.5631
Female	0.6953±0.0969	- 1.9161	2.8412	0.9110
Combined sexes	0.6450±0.1907	- 0.4458	1.8776	0.7043

Table 2: Chi squared test analysis on sex ratio of *C gariepinus* reared in water recirculation system

Sex	Observed (O)	Expected (E)	O-E	$(O-E)^2$	$(O-E^2)/E$
Male	73	76	-3	9	0.1184
Female	79	76	3	9	0.1184
Total					0.2368

Since TS < q(.05) i.e 0.2368 < 3.84, than we accept Ho. In other words, the ratio 1:1 sex ratio is supported by the observed data.

DISCUSSION

The "b" value was higher in the females than in the males. This supported studies by Srisuwantach *et al.* (1980) who observed that length-weight relationship and mean condition factor in *C. batrarchus* were higher in females than in males. The value of b was 2.8412 for females and 1.2713 for males. The combined sex was 1.8776. The value got for females was in agreement with findings of Cinco (1982) and King (1996a), who reported a general "b" value of fish to be closer to 3. Abdallah (2002) obtained a "b" value between 2.5 and 3.44 for fishes from different marine water bodies. Pauly and Gayanilo (1997) reported that "b" value may range from 2.5 to 3.5. *C. gariepinus* in this study exhibited negative allometric growth with the regression equation for the combined sexes being Log W = - 0.4458 +1.8776 Log L (r = 0.7043). In contrast, the regression equation for cultured *C. batrachus* obtained by Srisuwantach *et al.* (1980) was Log W = - 2.1692 +3.0857 Log L, indicating positive allometric growth.

The condition factors were 0.6948±0.2494, 0.6953±0.0969 and 0.6540±0.1907 for males, females and combined sexes respectively. Fafioye and Oluajo (2005) reported that the condition factor for *C. gariepinus* in Epe Lagoon was 0.79±0.15 while the b value was 2.790. This value was similar to the "b" value for the females (2.8412) obtained in this study. The difference in the values obtained for the males and females could be as a result of egg development in the females and hence increase in body weight. Frota *et al.* (2004) also made similar observation.

The difference in weight as recorded in this study may be due to the individual condition factors (K) as it relates to the well-being and degree of fatness (Pauly, 1983). The condition factors obtained in this study were lower than the values (2.9-4.8) documented by Bagenal and Tesch (1978) for mature fresh water fish. There was no significant difference in the mean condition factor of males, females and combined sexes. Generally the K factors obtained in this study were low (0.65- 0.69). This may be due to low feeding rate of 3% as against 5%. The cause of the poor condition will be the subject of a future study.

The sex ratio of 1: 1.08 (male: female) observed was not significantly different from the expected 1:1 ratio. The sex ratio obtained is highly desirable for broodstock development and hatchery operations for *C gariepinus*. In Nigeria the current practice is to kill the males to obtain the milt from the testis during induced breeding operations. The 1: 1.08 ratio will enhance adequate production of male and female broodstock for successful fingerling production of mud-catfish.

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